1890.

NEW ZEALAND.

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

(REPORT ON).

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

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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. T. FERGUS, Minister of Mines.

SIR,— Mines Department, Wellington, 1st June, 1890.

I have the honour to submit my annual report for the year ending the 31st of 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 which are 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 heads of "Subsidised Roads and Tracks;" "Grants for the Construction of Roads;" "Schools of Mines;" "Quartz-mining;" "Alluvial Mining, including Dredging;" "Antimony-mining;" "Tin-mining;" "Explorations, Southern Westland;" "McQueen's Patent Amalgamating-machine;" "The Progress of Metallurgical Science;" "Macarthur-Forrest Process;" "Milling Gold-ores in California;" and statistical tables showing the expenditure on works, and a list of the Mine Managers in the colony who have certificates, &c.

SUBSIDISED ROADS AND TRACKS (NORTH ISLAND).

COROMANDEL COUNTY.

Road, Matarangi.—This includes the road from the sea-beach to Kuaotuna, and gives facility to get goods and machinery, which are landed in fine weather on the ocean-beach at the mouth of the Kuaotuna Creek, to be conveyed to the reefs at Kuaotuna. It is constructed as a dray-road for about two miles, and afterwards as a horse-track. The estimated cost of completion is £600. Of this amount a subsidy has been authorised to the extent of £300, of which £100 has been paid.

Harbour View Extension.—This is the continuation of a narrow dray-road that leads from the Coromandel-Tokatea Road round the range to give facility to the claimholders and tributers who are working on this side of the range to get their quartz conveyed. Formerly they had to carry it in small bags over the range to the road that is constructed from the Tokatea Saddle to the Royal Oak Mine. The cost of this extension has been £222. Of this amount a subsidy of £111 was authorised, of which £105 has been paid.

Coromandel to Cabbage Bay.—A horse-track has been constructed from Cabbage Bay, on the east coast, to Paul's Creek, a distance of nine miles, and it only requires about five miles to complete this track to Coromandel. The estimated cost of completion, together with an extension which has recently been made, is £700. Of this amount £350 has been authorised, and payments have been made to the extent of £150.

Mercury Bay Road.—This is a horse-track leading from the Coromandel-Thames Road at Tiki Bridge to Mercury Bay. It has been in course of construction for several years, and different subsidies have been authorised from time to time; but the track is now nearly completed, the distance being about twenty miles. The total cost of the work has been £2,780. Of this amount subsidies have been authorised to the extent of £1,656 13s. 4d., of which payments have been made to the extent of £1,426 13s. 4d. The Mercury Bay end of this road was known as "Makarau to Waiau," and appears in the list of constructed works.

Mercury Bay to Kuaotuna.—As Mercury Bay is the place where all supplies will have to come from to the Kuaotuna field, unless in very fine weather, when goods can be landed from small steamers in boats on the ocean-beach at the mouth of Kuaotuna Creek, it is necessary to construct a horse-track to afford facility to get the supplies delivered. The length of road to construct is about five miles, which is estimated to cost £360. Of this amount a subsidy has been authorised to the extent of £180.

Wainaru to Kuaotuna.—This is a horse-track from the end of the track coming from Coromandel to Opitonui. The total distance from Coromandel to Kuaotuna is about twenty-two miles, and there is a horse-track constructed for a distance of twelve miles, leaving ten miles to construct. The estimated cost of the work is £450, and of this amount a subsidy has been authorised to the extent of £225.

Thames to Coromandel.—The road between Coromandel and the Thames is now almost completed, with the exception of one piece near Manaia, and another piece between Manaia and Tiki. These portions are estimated to cost £300, and of this amount a subsidy has been authorised to the extent of £150.

Road to Tarawera Claim.—A syndicate has been prospecting for some time in the range above the Coromandel Hospital, and they have found sufficient inducements to get machinery. This road is for the purpose of allowing it to be brought on to the ground. It is estimated to cost £100, of which amount a subsidy has been authorised to the extent of £50.

THAMES COUNTY.

Karaka Creek to Lucky Hit.—This is for widening and improving the road up Karaka Creek, to give better facilities to get the quartz from the mines conveyed to the crushing-batteries. The estimated cost of the work is £600, of which a subsidy to the extent of £300 is authorised, and out of this amount £170 has been paid.

Waiomo to Tapu.—This is for widening the horse-track between these two places into a dray-road. This work is nearly completed, and has cost £1,500, of which amount a subsidy was authorised to the extent of £750, and out of this subsidy £659 1s. 10d. has been paid.

Puriri to New Discovery.—Several quartz claims have been taken up near Puriri, some of which are proving payable for working. There is a road for some distance up the flat by which machinery can be conveyed, but there is no road to connect the claim with the machine-site. What was formerly known as the Ngawhakapoupou Claim has been acquired by another party, which is erecting a crushing-battery at the foot of the range. To improve the road in the flat and construct a dray-road to this claim is estimated to cost £200. Of this amount a subsidy to the extent of £100 has been authorised.

Hikutaia towards Maratoto.—This is a dray-road up the flat from the Thames–Te Aroha Road to the crossing of the Hikutaia River. A portion of this flat is very swampy, and there is another portion where a road has to be constructed round the point of a small terrace. This work is estimated to cost £400, and out of this a subsidy has been authorised to the extent of £200, of which £73 17s. 7d. has been paid.

Alabama Creek.—This is a horse-track from the road leading up Hape Creek to some claims on Alabama Creek where payable stone was reported to be found. The estimated cost of the track is £100, and of this amount a subsidy has been authorised to the extent of £50.

Rocky Point.—This is a portion of the main Thames–Coromandel Road within the Thames Borough boundary. It has been widened and nearly completed. The estimated cost of the work was £350, and of this amount a subsidy was authorised to the extent of £175.

Sylvia Claim to Tararu.—This is partly for constructing and improving the dray-road on the upper portion, up Tararu Creek, and connecting it with the Sylvia Mine, where some rich refractory ore has been discovered. There are two crushing-plants and two aerial tramways being constructed up this creek, and this work is necessary to enable machinery to be brought on the ground. Its estimated cost is £250, of which amount £125 has been authorised as a subsidy.

Te Papa Gully.—This is for widening and metalling a dray-road from the mines in Te Papa Gully, to enable the quartz to be conveyed to the crushing-batteries on the flat. The estimated cost of the work is £100, and of this amount a subsidy has been authorised to the extent of £50.

Paeroa to Hikutaia.—This is for widening and metalling a portion of the main Thames Valley Road through a swamp. The cost of the work was £400, and out of this a subsidy of £200 has been paid.

Maratoto Track.—This is to construct a track through the ranges from Waitekauri to Maratoto. It was estimated by the County Council to cost £100, and of this amount a subsidy was authorised to the extent of £50.

Repairs to Flood Damages.—A heavy flood occurred last year, and destroyed several portions of the roads in the county. The County Council represented that these damages would cost £200 to repair, and a subsidy was authorised to the extent of £100; but only £17 6s. 10d. of this has been paid.

Crushing-battery to Waihi Mines.—This was for constructing a road from the crushing-battery erected at the Ohinemuri River to the mine at Waihi. It was estimated to cost £300, and of this amount a subsidy was authorised to the extent of £150; but, as there is a new crushing-plant erected at the Waihi Gold and Silver Company's mine, this road is not now required.

PIAKO COUNTY.

Premier Mine to Katikati.—This is for a horse-track over the range from the end of the bridle-track at the Premier Mine, now belonging to Ferguson's syndicate, to Katikati. It is thought this track will tend to open up more mines, besides being a short road over to the east coast. The estimated cost of the work is £500, and of this amount a subsidy has been authorised to the extent of £250.

MIDDLE ISLAND.

MARLBOROUGH COUNTY.

Sounds Road to Cullensville.—This is a dray-road to connect Cullensville with the Queen Charlotte and Mahakipawa Sounds. The estimated cost of the work is £217 4s., and out of this a subsidy has been authorised to the extent of £108 12s.

Mahakipawa Creek.—This is a horse-track constructed from Cullensville up the side of the Mahakipawa Creek for a distance of two miles. The cost of the work was £450, and out of this amount a subsidy of £225 has been paid.

Waimea County.

Baton to Karamea.—This is for repairs to the track between the Baton River and Karamea, which are estimated to cost £100. Of this amount a subsidy has been authorised to the extent of £50.

Punt over Motueka River.—This punt was constructed last year, at a cost of £100, out of which a subsidy of £50 was paid.

Baton to Table-land.—This is for repairing a track from the Baton to the Table-land Diggings. The cost of the work was £40, out of which a subsidy was paid of £20.

Buller County.

Waimangaroa to Sea-beach.—This is a road leading from the Township of Waimangaroa to the sea-beach to open up a means of communication, and afford the miners who are working on the ocean-beach access to the township to get their supplies. The estimated cost of the work is £240, and out of this a subsidy has been authorised to the extent of £120.

Addison's to Wilson's Lead—This is for the construction of a dray-road from the Westport–Charleston Road to Wilson's Lead, where there are several claims being worked, and it is to afford a means of getting sawn timber and other materials brought to those claims. The estimated cost of the work is £400, and out of this amount a subsidy has been authorised to the extent of £200.

Cedar Creek to Coalbrookdale.—This is a track from the coal-workings at Coalbrookdale to join the track coming from Denniston to Cedar Creek. The estimated cost of the work is £100, and of this amount a subsidy has been authorised to the extent of £50.

Addison's Flat to Caroline Terrace.—Some time ago ground was taken up at Caroline Terrace, and a crushing-plant was proposed to be erected to crush the cement that is found here. The estimated cost of the proposed road is £200. Of this amount a subsidy to the extent of £100 was authorised.

Oparara to Fenian Creek.—This is for extending the horse-track that was constructed to Oparara some years ago to give better access to the diggings at Fenian Creek. The cost of the work was £100. Of this amount £50 was paid as subsidy.

Conn's Creek to Beaconsfield Mine.—This is for constructing a narrow road from the end of the railway at Conn's Creek to the Beaconsfield Company's mine, in order to enable this company to get machinery on the ground. The cost of the work was £80; of this amount a subsidy of £40 was paid.

Inangahua County.

Globe Hill to Merrijigs.—This is a horse-track along the line of reefs from the range in which the Globe Company's mine is situated to join the Reefton–Big River Road at Merrijigs. This track is one of the most useful in the district, as it opens up miles of country where auriferous lodes exist, some of which are now being worked. The estimated cost when completed is £1,560, and of this amount a subsidy of £780 was authorised, of which £464 has been paid.

Mangles Valley to McGregor's.—This is a road up the valley of the Mangles River, and gives access to the diggings in this locality, and it will give access to the Matakitaki when once the road is completed on the other side of the range. The estimated cost of the work is £1,200, and a subsidy has been authorised to the extent of half this amount.

Horse Terrace to Hunter's Station.—A dray-road has been constructed for about five miles up the valley of the Matakitaki River, and above this there is a horse-track for about eleven miles to Horse Terrace, and it is proposed to extend this track up the valley to join the one coming up the Mangles River, and thus open up a large extent of auriferous country. The estimated cost of the work is £1,280, and a subsidy has been authorised to the extent of half this amount.

Larry's Creek to Lyell.—This is the continuation of the horse-track from Capleston to Larry's, and it is now extended as far as Coal Creek. It is proposed to extend it further, so that a connection can be made to the main Westport–Reefton Road near the punt on the Inangahua River. The estimated cost of the work was £1,080: of this amount a subsidy of £430 10s. has been paid, and a further subsidy of £116 10s. authorised.

Devil's Creek to Globe Hill.—This is a dray-road from the Reefton–Big River Road at Devil's Creek to the Globe Mine, for the purpose of enabling machinery to be conveyed to the mine. The cost of the work has been £917 6s. 2d., out of which a subsidy of £458 13s. 1d. has been paid.

Westland County.

Hokitika to New Rush.—Some time ago gold was discovered on the south side of the Hokitika River, and this road is being constructed to give access to the mines working in this locality. The estimated cost of the work is £100, of which amount a subsidy was authorised to the extent of £50, and £18 19s. 3d. has been paid of this subsidy.

Tucker's Flat to New Rush.—This is the extension of the road up Commissioner's Flat, Kanieri, to a place where gold has recently been discovered. The estimated cost of the work is £500: of this amount a subsidy was authorised to the extent of £250, of which £85 9s. 9d. has been paid.

Christchurch Road to Bald Hill Range.—This is a road to connect the Hokitika–Christchurch Road with the quartz reefs on the Bald Hill Range. The cost of the work has been £500, and a subsidy of half this amount has been paid.

Grey County.

Deep Creek to Bell Hill.—This is the continuation of the horse-track from Notown which was constructed some years ago to Deep Creek. This is now being extended to Bell Hill. The estimated cost of the work is £1,400, and of this amount a subsidy was authorised to the extent of £700, of which £401 has been paid.

Black Ball Diggings.—This is a horse-track from the one leading up from Brunnerton, on the north side of the Grey River, to the Black Ball Diggings, where there is a considerable mining population. The estimated cost of the work is £800, and of this amount a subsidy was authorised to the extent of £400, of which £240 has been paid.

Baird's Terrace to Irishman's.—A horse-track from Dunganville, *viâ* Baird's Terrace, to Lake Brunner, and also one from Irishman's to Lake Brunner, were constructed some years ago, and a track is now being constructed to join Baird's Terrace track with the one coming from Irishman's, for the purpose of opening up the country. The estimated cost of the work is £250, and of this amount a subsidy of £125 was authorised, of which £76 has been paid.

COLLINGWOOD COUNTY.

Anatoki Diggings.—A horse-track was constructed some time ago from the Takaka Valley towards Anatoki Diggings, and it is now proposed to extend this track. The estimated cost of the work is £160, and of this amount a subsidy of £80 has been authorised.

TAIERI COUNTY.

Nenthorne Diggings.—This is a dray-road to connect the mines at Nenthorne with the main road coming from Palmerston. The estimated cost of the work is £600, and of this amount a subsidy has been authorised to the extent of £300.

LAKE COUNTY.

Morven Ferry Road.—This is for widening and constructing the road on the south side of the Kawarau River, from the suspension bridge above Gibbstown to the old Morven Ferry, for the purpose of getting coal conveyed to the dredges that are being constructed to work the bed and banks of the Kawarau River at this point. The cost of the work has been £289, of which a subsidy of £144 10s. has been paid.

ROADS WHOLLY CONSTRUCTED BY MINES DEPARTMENT.

Thames–Coromandel Road.—The sections of this road where the money has been expended are from Tapu to Waikawau in the Thames County, and from Waikawau to Mainaia in the Coromandel County. There is a dray-road now constructed from the Thames to Waikawau, and from this point to Coromandel there is a good bridle-track constructed (with the exception of two small portions), about 6ft. in width, laid out with good dray-road grades. The total expenditure on this road up to the end of March last from direct grants amounted to £1,025 2s. 6d., and the liabilities on works in progress amount to £744 17s. 6d.

Karangahake through Gorge.—This is a deviation of a portion of the main road from Paeroa to Tauranga. At present the road goes over a high hill, and is very costly to maintain during the winter months, as the ground is of a soft clayey nature and there is no metal in the vicinity; besides, the road is constructed with very steep grades, and becomes almost impassable in winter. A road is now being constructed through the gorge of the Ohinemuri River, which, when completed, will be almost level. The expenditure on this work up to the end of March last was £503 3s. 1d., and the liabilities on the works in progress amount to £494 16s. 11d.

Aorere Valley to Mokihinui.—This is portion of a main road running along the west coast of the Middle Island from Collingwood to Jackson's Bay. This road is completed from Collingwood to the Gouland Downs on the north end, and from Mokihinui to Haast River on the south end. There is also about twenty-five miles constructed between Mokihinui and the Gouland Downs. Very little of this portion can be utilised until the bridge now in course of construction across the Mokihinui River is completed. Contracts for ten miles of this road, leading from the Gouland Downs towards Karamea, have recently been let for the sum of £1,492 4s.; and when these are completed there will still remain about thirty-four miles to be constructed to complete the whole of the road along the coast-line. The total expenditure on this work between Mokihinui and Aorere Valley has been £20,048 19s. 8d., and the liabilities on works in progress amount to £4,905 4s.

Grey Valley to Teremakau.—This is the continuation of the road leading from Nelson Creek to Bell Hill. The road on the Teremakau end has been constructed for several years to the Crooked River; but a portion in the centre still remained to be constructed (which has recently been completed) before through-communication could be established. There is also a suspension bridge for foot-traffic being constructed across the Crooked River. The cost of making the connection between these two roads was estimated at £900, out of which £633 6s. has been paid.

Jackson's Bay to Cascade River.—There is a bridle-track constructed from the Cascade River to the Duncan River, and there is also a road from Jackson's Bay to the Jackson River; but there is about ten miles of road to be constructed to connect the Cascade River with the road up the valley of the Jackson River. A survey of this road was undertaken last year under Mr. Mueller, the Chief Surveyor of the district, who was authorised to have the timber felled along the line, and £138 16s. 6d. has been expended on this work.

Arthur's Point to Skipper's.—This is for the completion of the portion of the road from the saddle between the Shotover and Arrow Flat to the bluff near Stapleton's Beach, on the Shotover River. This completes the dray-road from Queenstown to opposite Londonderry Terrace, near Skipper's Point. The portion of the road lately completed is along a steep, rocky sidling for about two miles, on a gradient of 1 in 10; but some of the bends on this portion of the road are still too sharp for wheel-traffic. The expenditure on this road up to the end of March last amounted to £11,167 4s. 1d., and the liabilities on that date were £380 10s.

IMPROVING ROADS AND TRACKS, COLLINGWOOD, TAKAKA TO MOTUEKA.

This includes a number of roads and tracks which were completed in former years. The only work done last year was clearing the slips from the dray-road between Upper Takaka and Riwaka,

This has now been completed, and the road taken over by the Waimea and Collingwood Counties, about nine miles and a half being within the Waimea County, and seven miles within the Collingwood County. It is a road that is laid off with good grades and is well constructed, and, with the exception of a small portion on the Takaka side of the range, it will not be liable to any large slips taking place. When inspecting this road in April last I found the portion within the Waimea County in very good order, but on the portion within the Collingwood County there were a number of small slips, boulders, and logs lying on the road. The total expenditure under this head up to the end of March last was £10,905 18s. 11d., and the liabilities at that date amounted to £191 6s. 6d.

Garston to Nevis.—There is a dray-road up the valley from the railway-station towards the Nevis for about two miles and a half, and from the end of this road to the end of the gorge on the Nevis side of the range, where the flat valley commences, is about ten miles: the road-line has been laid off over the range (which is about 2,300ft. above the level of the end of the road coming from Garston) on a gradient of 1 in 10, and instructions have been given to have plans and specifications for this ten miles prepared to let by contract in the event of the work being authorised. The high elevation at which this road will have to be constructed will render it impassable for some time during the winter months, and, although it is a much shorter route than by the Clutha Valley, it can only be a summer road for wheel-traffic. The distance from the end of the gorge, where the survey ends, is about ten miles to the Upper Nevis township: this portion is down a flat valley, which requires very little money expended to make it a passable dray-road from the upper township to the lower township, a distance of about six miles; the present road goes over some high bluffs with very steep gradients, neither suitable for dray-traffic, nor even for a passable bridle-track.

Stewart Island.

Pegasus to the Remarkables.—A road-line has been laid off from Pegasus to the foot of the Remarkables, which, if constructed, would admit of supplies being taken into the country; but when returning from a visit to Stewart Island a deputation waited on me in Invercargill, and wished me to represent to the Government that a bridle-track would be of little service to them, and that a syndicate was formed to construct a tramway if the Government would give a subsidy of £300 towards its construction. The department communicated with one of the gentlemen comprising the deputation, requesting him to make an application in writing; but this never came to hand. The plans of the line of road were handed to the syndicate who proposed to construct this tramway, but no further action has been taken in reference to the construction of a horse-track or tramway.

WATERWORKS.

Laying new Mains, Thames.—The mains that have been used since the construction of the water-supply were constructed of wrought-iron and were only 20in. diameter. This size was found to be too small to deliver the quantity of water required to supply motive-power for the crushing-batteries and other machinery on the flat, and a new cast-iron main was laid down having pipes of 30in. diameter. The County Council procured all the pipes in England, and, after they were landed on the ground, made application for a subsidy of £1 for £1 towards laying them in position, giving the estimated cost of the work to be £1,500. A subsidy up to the extent of £750 was authorised, of which £285 has been paid.

WHARVES.

Coromandel Wharf.—This wharf has been constructed for a number of years, and some of the timber was getting greatly decayed; and, as the County Council represented that this wharf was greatly required to land coal for the mining companies, a contribution of £150 was paid, on the County Council paying a similar amount, towards putting the wharf in good repair.

Anikiwa Jetty.—This is for the construction of a jetty at the head of Queen Charlotte Sound, to enable small steamers to land passengers and goods for the Mahakipawa Diggings. The jetty has been constructed and approaches made to it, and it is found to be of great convenience to the people in this district; but, as there are no houses near this jetty, it requires a small shed to be constructed, so that goods can be landed from the steamers and put under cover until they can be taken away. The inhabitants complain greatly that at present they sometimes get perishable goods destroyed. The estimated cost of the works, including the erection of a shed, is £289 19s. 5d. Of this amount £96 6s. has been paid.

SCHOOLS OF MINES.

The establishment of schools of mines is beginning to have a good effect on mining, and a very large number of miners are now able to distinguish the different ores met with, and to ascertain the percentage of metals they contain. An important discovery was made last year by one of the advanced students of the School of Mines at Thames, Mr. R. Aitken, who has recently been appointed Instructor to the School of Mines at Reefton. He made an analysis of the water flowing out of what is known as the Moanataiari or Kuranui Tunnel. This tunnel or adit-level goes back into the hill for 3,000ft., and cuts a number of auriferous lodes, from which large quantities of gold have been got. Mr. Aitken first analysed a small quantity of the water, and was astonished at getting a very small button of gold. He then got a gallon of water by merely allowing the water to flow into the vessel: he did not lift it out of the drain so as to disturb any sediment, but only took the clear water, along with whatever sediment it contained. The result of the analysis of this gallon of water showed that about thirty pounds' worth of bullion was flowing away daily. On my visit to the Thames in October last I inspected this adit-level with the view of ascertaining the quantity of water flowing out of it, and estimated it at about forty-two gallons per minute, or, say, 60,000 gallons per day; but Mr. Aitken recently informed me that he based his calculations on 100,000 gallons per day. This quantity may have been flowing out of the tunnel at the time he made his experiments, but there was not that quantity flowing at the time of my visit. Allowing there is 60,000 gallons per day, this would make the value of the bullion flowing away daily

to be £18; and, assuming that 80 per cent. of it could be collected by a cheap process, it would mean that the proprietors of this tunnel are allowing bullion to the value of £14 8s. to go into the sea daily, or £5,256 per annum. There is no doubt there is a large percentage of iron in solution, but it must be in the form of the higher salts, or else it would precipitate the gold. Further experiments should be made not only with this water, but also with the water from the Big Pump shaft and from other mines, so as to clearly ascertain whether those made by Mr. Aitken are reliable. The following shows the way Mr. Aitken arrived at the value of bullion the water contained:—

Sediment contained—Bullion = 0·0016 grammes, or 0·0246gr., per gallon—namely, gold, 0·0006 grammes, or 0·0092gr., per gallon; silver, 0·0010 grammes, or 0·0154gr., per gallon.

Solution contained—Bullion = 0·0025 grammes, or 0·0386gr., per gallon—namely, gold, 0·0010 grammes, or 0·0154gr., per gallon; silver, 0·0015 grammes, or 0·0232gr., per gallon.

The value of the bullion was £2 5s. per oz.; and, taking 100,000 gallons as the quantity of water flowing in twenty-four hours, then the value was as follows:—

	£	s.	d.	
Bullion in sediment	11	10	7½	per day.
Bullion in solution	18	1	10½	"
Total	30	11	6	"

If this quantity or value of bullion is found in solution amongst the water, it is possible that 80 per cent. of it could be collected by filtering the water either through granulated zinc or zinc-turnings, on the same principle as that adopted by the Cassels Company; or the gold could be collected by filtering the water through charcoal. Neither of these would be an expensive method, and, if successful, it would open up a new source of revenue from many of the mines.

The Thames School of Mines is largely patronised, and is now turning out young men who are able to assay all descriptions of ores, with a good theoretical knowledge of mining, the chemistry of metals and gases, underground surveying, and geology; and it is also a great boon to mine-managers and those who wish to obtain mine-managers' certificates, as classes are held at night to afford instruction to those wishing to qualify themselves to pass their examinations. It will be seen by referring to Mr. Park's report that twenty men at the present time are attending the mining class with this object.

The following is the report of Mr. James Park, F.G.S., Lecturer and Instructor in the Thames School of Mines, for the year ending 31st March, 1890:—

"I have the honour to report that during the past year the usefulness and general efficiency of the school have been well maintained. The institution now affords a sound training in practical, scientific, and mining subjects, the advantages of which are becoming more fully appreciated, as shown by the good results at last annual examination and the steady increase of students.

"At the end of August Mr. A. Montgomery, M.A., left for an appointment in Tasmania, and at the same time I was transferred from the Geological Survey Department to take his place. The classes have been conducted since that date with but little change, except in the case of the mixed class of geology and mineralogy, which was divided into two distinct classes, and in that of the surveying and mining classes, in which the course of study was remodelled with a view to adapting it more to the requirements of the mine-manager's examination for certificates of competency under the regulations of 'The Mining Act, 1886.'

"The course of study at the school includes the following subjects: (1) Practical assaying, (2) practical chemistry, (3) mineralogy, (4) geology, (5) mining, (6) surveying, (7) mathematics, (8) mechanical drawing, (9) Saturday science lectures.

"1. *Practical Assaying.*—In this class the students are instructed in the use and properties of the different fluxes and reagents used in assaying ores of all kinds, both by the wet and dry methods. Beginning with the assay of gold- and silver-bearing ores, the valuing and refining of bullion, the student passes on to the assay of ores of lead, zinc, iron, copper, antimony, bismuth, manganese, &c. Many of the attendants at this class are competent assayers, and capable of performing reliable work. The advantages of a knowledge of assaying are becoming more apparent every day, and already several valuable finds have resulted from instruction obtained at the school. The students in this class comprise, at present, school-teachers, bank clerks, bank assayers, clerks, engineers, jewellers, miners, battery-men and artisans.

"2. *Practical Chemistry.*—The instruction in this class is of great value to those attending the assaying class, as it explains many chemical reactions which could not be understood without an elementary knowledge of chemistry. It embraces the study of the reactions of the metals and acids, and the principles of qualitative and quantitative analysis, particularly of the ores of the metals. From the determination of simple substances the student passes on to the separation and analysis of mixed substances, including coals, limestones, rocks, soils, waters, and complex ores. Some of the more advanced students have undertaken and successfully completed analyses of extremely difficult substances.

"3. *Mineralogy.*—In this class the students are instructed first in the elements of crystallography, the physical characters and blowpipe tests of the different ores, and then in descriptive mineralogy, including the classification, occurrence, composition, and determination of mineral substances. The text-books used are 'Dana' and 'Collins.'

"4. *Geology.*—In this class the attention of the students is devoted principally to the study of stratigraphical, physical, and dynamical geology, more especially as relates to New Zealand mining; also to the occurrence and disposition of mineral deposits of all kinds, and the phenomena of slides, faults, contortion, &c. This class is taken to the field once every week so as to enable the students to acquire a practical knowledge of the principles of geological surveying and making original observations for themselves. In this way most of the leading mines and the greater portion of the

adjacent country have been visited and examined with very beneficial results. The text-books used are Geikie's 'Manual' and Davis's 'Geology.'

"5. *Mining.*—The instruction in this class embraces the construction and timbering of shafts, drives, chambers, &c., in ordinary country and quicksand, the use of explosives, pumping and pit-work, ventilation, strengths of materials, &c. This is one of the most popular and best-attended classes at the school, and the progress made by the students during the two terms of its existence has been highly satisfactory—a result which is mainly attributable to our admirable and excellent text-book, Gordon's 'Miner's Guide,' which puts in a clear and graphic form most of the information required from those qualifying for certificates of competency as mine-managers. The attendants at present include four mine-managers, seven miners, two clerks, five regular students, an artisan, and a mining surveyor. Most of these are studying with the object of qualifying themselves for examination for certificates of competency as mine-managers.

"6. *Surveying.*—The field-work of this class includes instruction in the use of the dial, theodolite, level, and chain. The surface surveys with the theodolite are conducted on true meridian, and during the last two quarters ten distinct surveys of large areas have been completed with very good results. The broken country adjacent to Grahamstown has proved a most convenient training-ground during the summer months, as it affords every description of physical feature, from level ridges to steep declivities. Few underground surveys have so far been attempted, chiefly because the working mines are generally engaged trucking during the day, while the old abandoned mines fall so rapidly into disuse as to be dangerous to work in. The office-work embraces instruction in the adjustments of the theodolite and level, use of logarithms, solution of triangles, the calculation of areas and co-ordinates of traverses of field-surveys, plotting of surveys to scale, and connecting surface with underground surveys. The surveys are conducted, recorded, and plotted as far as practicable in accordance with the regulations of the General Survey Department. The rapid progress made in this class gives promise of good results in the future. This class is attended by most of the students of the mining class.

"7. *Mathematics.*—At the end of August the attendance in this class had fallen to two, in consequence of which this study was discontinued during the next quarter. At the beginning of the February quarter it was again revived under the able direction of Mr. R. D. Duxfield, M.A., with twelve names on the register. The instruction includes the study of higher arithmetic, algebra, Euclid, and trigonometry, in which very satisfactory progress has been made; but the average attendance has not been so large as the importance of the subject would warrant.

"8. *Mechanical Drawing.*—This class is conducted by Mr. A. J. Adams, a draughtsman of well-known ability. It was started in February with an attendance of eight pupils. The instruction is invaluable to those engaged in mechanical or mining pursuits, embracing lettering and drawing to scale of the different parts of machinery and mining appliances. This class supplies an important want at our school.

"9. *Saturday Science Lectures.*—During the first two quarters of 1889 Mr. Montgomery gave lectures on chemistry, illustrated by numerous experiments. Since that date I have conducted a series of lectures on the physical geography and geology of New Zealand, aided by sketches and specimens. Great interest is taken in this class, as may be judged from the fact that no less than ten separate first prizes had to be given for best attendance at the end of the year. The attendants are principally high-school boys, and the Fifth and Sixth Standard pupils from the State schools. The teachers and masters are also well represented.

"The following table shows the number of students attending the different classes in the four quarters during the year ending 31st March:—

Class.	First Quarter, 1889.	Second Quarter, 1889.	Third Quarter, 1889.	First Quarter, 1890.
Practical assaying	31	33	30	20
Practical chemistry	17	16	17	13
Chemistry	5	5	...	...
Mineralogy	10	12	11	6
Geology			11	6
Mining	...	...	20	20
Surveying	14	17	20	20
Drawing (mechanical)	...	...	...	8
Mathematics	5	5	...	12
Saturday lectures	41	56	58	46
Totals	123	144	167	151
Exclusive of Saturday lectures	82	88	109	105
Total number of individuals	31	32	33	35

"*School.*—During the past season the school and plant buildings were painted, and the grounds enclosed by a substantial fence, thereby adding greatly to the external appearance of the institution. The internal fittings have been overhauled recently, and cupboards and drawers, with locks, provided for each of the students attending the assaying and practical chemistry classes. On the arrival of the consignment of chemicals and apparatus daily expected from England, the laboratory will be fairly well equipped for conducting analysis and assay-work of all kinds. The Government

grant of £100 has relieved the committee of all existing liabilities, while the improvements referred to above, and the chemicals to arrive from England, will place the school in a better position than it has occupied for some time.

"*Experimental Plant.*—Since March, 1889, only two samples of ore have been treated at our plant—one by Mr. Montgomery, in July, 1889, and one by myself in January of this year. This is very disappointing, and is no doubt attributable to the general falling-off of the mines in the up-country goldfields, and the competition of the large reducing-works recently erected at Waiorongomai, Waihi, and Karangahake. Six samples of tailings from previous tests were put through the berdan by the students with a view of recovering a portion of the large amount of quicksilver lost during the original experiments in 1888, and in this respect their efforts were very successful.

"*No. 1. Particulars of Working-tests of Ore from Werahiko Mine.*—This parcel of ore weighed 3,123lb., and contained 7·8 per cent. of moisture, thus leaving 2,879lb. of dry ore. It was treated by first crushing it wet, using quicksilver in the stamper-box, and then collecting all the tailings and grinding them in the Railley pan. The ore milled very freely, and yielded a good proportion of its gold to the battery-plates and ripples. The tailings passed through three large settling-pits, and only a very small proportion escaped. After the tailings had settled the water was drawn off, and the tailings conveyed to the Railley pan, in which they were ground and amalgamated. The first pan-charge was worked cold, and without chemicals, for six hours. A test from this pan showed that it still contained 17dwt. 15gr. of gold and 1oz. 7dwt. 18gr. of silver to the ton. To try and improve this the next charge was worked hot for six hours, with the addition of copper-sulphate and salt. The use of copper-sulphate was found to be a mistake, as the copper reduced in the pan coated all the iron ground off the false bottom and muller, which then amalgamated with the quicksilver, forming a sludgy mass of so-called 'iron-amalgam.' The tailings from this test contained 1oz. 0dwt. 4gr. of gold, and 1oz. 7dwt. 17gr. of silver to the ton, showing a larger loss than by the cold amalgamation without chemicals. The next two charges were amalgamated hot, but without the addition of copper-sulphate. The tailings from these were found to contain respectively 17dwt. 15gr. of gold and 2oz. 0dwt. 8gr. of silver, and 1oz. 0dwt. 4gr. of gold and 2oz. 10dwt. 10gr. of silver, to the ton. The tailings from the fifth charge contained 1oz. 2dwt. 16gr. of gold and 1oz. 7dwt. 17gr. of silver to the ton. The mean of all the assays of the tailings after pan-treatment showed an average loss of 18dwt. 15gr. of gold and 1oz. 17dwt. 7gr. of silver to the ton. This is a very unsatisfactory result, but it showed that cold amalgamation, without chemicals, gave a slightly better result than hot amalgamation, with or without chemicals. By bulk-assay the ore contained 3oz. 6dwt. 9gr. of gold and 4oz. 10dwt. 8gr. of silver to the ton. The total bullion saved from plates, pans, tailings ground in berdan, and iron-amalgam amounted to 2oz. 5dwt. 1gr. of gold and 2oz. 19dwt. 14gr. of silver to the ton, which is equal to a saving of 68 per cent. of the gold and 66 per cent. of the silver. The gold is so finely divided that probably some wet process, such as chlorination, will be found indispensable to save it.

"*No. 2. Ore from Prospectors' Claim, Puhipuhi, January, 1890.*—This sample of ore weighed 225lb. It was composed of very hard amorphous quartz, generally white, greyish-white, or milky in colour. It was often chalcedonic in character, and sometimes possessed a banded, wavy structure, due to the alternations of white, sterile, and mineralised quartz-laminæ. Fine pseudomorphs of quartz, apparently after rhombohedral crystals of calcite, were common, occurring generally in drusy cavities in the ore. Short interlacing crystals of stibnite were also present, but not so plentifully as in the samples forwarded for assay in October and November. Small dark-red crystals of ruby silver (pyrargyrite) were sometimes, but rarely, seen associated with the argentite, which yields most of the silver, and imparted to the portions of the stone where it occurred a bluish-grey colour. The ore contained less than 0·25 per cent. of sulphides, and did not concentrate to advantage. The pulverised ore, after being dried, showed an assay-value of £11 17s. 4d. per ton—gold, 11dwt. 8gr.; silver, 63oz. 19dwt. 9gr. Argentite being a free-milling ore, 110lb. of pulp was treated by the ordinary pan-process—that is, four hours' hot amalgamation with 20lb. salt, 10lb. copper-sulphate, 10lb. iron-sulphate, and 5lb. alum per 2,000lb. of ore. The return from this charge was 2oz. 1dwt. of bullion, which was 14·1 fine in gold and 958 fine in silver. This represents a return of 64·7 per cent. of the bullion per ton, and 70·3 per cent. of the assay-value, showing that the proportion of gold saved was larger than that of the silver. The best results were obtained by subjecting the ore to a chloridizing roasting, and then amalgamating in an iron pan. Ninety pounds of the dry pulp was roasted with 6 per cent. of salt, 5lb. copper-sulphate, 5lb. iron-sulphate, and 5lb. alum per 2,000lb. As the ore was deficient in the quantity of sulphides needed to create the sulphuric acid necessary to assist the chloridizing of the silver, it was roasted with the addition of 3 per cent. of iron-sulphate. The result from this test was 2oz. 4·5dwt. of bullion, 013·2 fine in gold and 986 fine in silver, representing 85·5 per cent. of the bullion and 93 per cent. of the assay-value. The proper method by which to treat ores of this class is to crush dry, chloridize, roast, and then pan-amalgamate hot with the addition of chemicals. The bullion extracted by these tests was refined, granulated, and forwarded to the secretary of the company in two sealed bottles.

"*Laboratory.*—The number of samples of ores, bullion, minerals, tailings, &c., sent by the public for assay or analysis during the past year was 180, made up as follows: Gold and silver, 146; bullion, 4; lead, 3; zinc, 1; antimony, 2; copper, 6; manganese, 6; nickel, 1; coal, 2: limestone, 1; rocks, 1; waters, 2; miscellaneous, 5: total, 180. Of these no less than 155 have come to hand during the last six months, leaving only 25 for the previous half-year. Samples are now received from all parts of the North Island for assay and determination, showing that the Thames School of Mines has established itself as a place where reliable results may be obtained. These necessarily involve a large amount of work in addition to my ordinary duties, which occupy my time to the fullest extent. I have, however, to acknowledge the valuable assistance of my laboratory assistant, Mr. Edwin Banks, in the assay of a large number of samples.

"*Annual Examination.*—This was held at the end of November last, and showed in the most conclusive manner the steady progress made by the students during the past year. The examinations were conducted under strict supervision, and in accordance with the regulations of the Royal School of Mines and Science and Art Department, London. The questions set in the different subjects were all of a thoroughly practical character, being intended to bring out whatever knowledge the candidates actually possessed. The number of candidates who presented themselves for examination was forty-seven, and of these twenty-nine secured first-class, thirteen second-class, and four third-class certificates. Mr. R. M. Aitken was placed as first prizeman in practical assaying, geology, and mineralogy, and became the winner of the silver medal offered by the Geological Society of Australasia, with the high aggregate in geology and mineralogy of 97·5 per cent. of the total number of marks. He has recently received the appointment of lecturer to the Reefton School of Mines, which is gratifying to our school, and at the same time a recognition of his industry and ability. Mr. William Harris headed the mining and surveying classes, and secured the only first-class certificate granted under this head. He presented himself for examination in January for a certificate of competency as a mine-manager under 'The Mining Act, 1886,' and was successful in gaining his certificate. Among the students who have received appointments from the school is Mr. E. Banks, who has recently been appointed assayer to the large reducing-works at Waihi.

"*Coromandel.*—In December I visited this place, and held classes in practical assaying, mining, and surveying. Lectures were delivered in mining and assaying, and in surveying instruction was given in the field in the use of the theodolite and dial, and in the laboratory in the use of logarithms, calculation of co-ordinates of traverses, and plotting surveys to scale. The average attendance in these classes was about twelve. Most of the students evinced the deepest interest in their studies, and the great progress which they made was an ample reward for their diligence. At the end of the year twelve candidates presented themselves for examination, of whom four secured second-class and three third-class certificates. Mr. J. D. Colebrook, who attended the mining and surveying classes, succeeded in gaining a certificate of competency as a mine-manager at the examination held in January."

It will be seen from the foregoing report that a mechanical-drawing class has been again formed, under Mr. J. A. Adams, and a class for mathematics, which was discontinued for some time after Mr. A. Montgomery's resignation, has again commenced, under Mr. R. D. Duxfield, M.A. Previous to the end of August last this school was conducted by Mr. A. Montgomery, M.A., and the able and efficient manner in which he discharged his duties and organized this institution is highly commendable. He left at his own request, having accepted the appointment of Geological Surveyor to the Government of Tasmania, and Mr. James Park, F.G.S., formerly of the Geological Department, was transferred to the Mines Department as his successor. The success attending the Thames school is due in a great measure to the regularity with which the classes are held. With the exception of one month during which Mr. Park was at Coromandel, giving instruction at the School of Mines there, the classes at the Thames have been regularly held during last year; and it is only in schools where the classes are regularly held that a good attendance, and also students well grounded in the theoretical principles of mining in all its branches, can be looked for. A few weeks' instruction now and again by travelling instructors has no real value beyond directing the attention of the miners and others to the importance of becoming acquainted with the different ores met with and of ascertaining the percentage of metals the ores contain. They have done good in this respect; but it would be ultimately of more value to the colony if the instructors' services were confined entirely to the two schools in the principal quartz-reefing districts—namely, Thames and Reefton. The School of Mines in connection with the University of Otago provides for full instruction on all subjects in connection with mining for those who reside in the southern portion of the colony.

In reference to the Reefton School of Mines a grant of £200 was given last year for additions and improvements, and also for the purchase of chemicals and testing apparatus; but Mr. Fenton, the lecturer and instructor, complains of the apathy shown, inasmuch as he states the students do not come as regularly as he would wish. This is, no doubt, in a measure accounted for, as during the months of June, August, September, and February he was away from Reefton holding classes elsewhere, and the interest that students take in the subjects taught dies away if instruction is not regularly imparted. Both Reefton and Thames are large quartz-reefing centres, and students have an opportunity at each of these places to visit the mines and see the practical working of them, as well as all the machinery and appliances connected with mining. This shows them the practical effect of the theoretical teaching they receive, and leaves a far greater impression on their minds as to the value of the instruction imparted at the school.

The following is an extract of Mr. Fenton's report on the School of Mines, Reefton, for the year ending 31st March, 1890:—

"I have the honour to submit a report of the work carried on in the schools of mines on the West Coast under my charge for the last year.

"The grant of £200 for extension of Reefton school and purchase of chemicals and testing apparatus (balance given by the Hon. Mr. Richardson) was applied in following manner: £150 to erection of much-needed furnace- and melting-room and chimney to class-room, and the remaining £50, with £20 extra, was spent in importing from England a balance and chemical appliances requisite for instruction of students. These things we expect to arrive this week. They were a long-standing want, as up to the present, if I wanted to do even an assay, it was impossible for me to do it only for the kindness of Messrs. Pickett and Lewis, of the New Zealand and National Banks, who allowed me the use of their balances. . . . It would be most desirable also if we could procure a small roasting-furnace and grinding-pan for test purposes, as in this district nearly all the pyrites are worth from 3oz. gold per ton upwards; and I am sure if we had only one trial to roast them, and afterwards amalgamate, which treatment, I think, would be successful and save perhaps

90per cent. of the gold, it would save the place thousands of pounds. At present, in most instances, the tailings are allowed to run away into the rivers.

"Classes have been held during the year in the following subjects and at the following times, at Reefton:—Mining and mathematics (for mine-managers' certificate): Tuesday and Thursday, at 10 a.m.; Monday and Friday, at 8 p.m. Assaying: Monday, at 10 a.m.; Thursday, at 8 p.m. Laboratory and practical chemistry: Friday, at 10 a.m.; Thursday, at 8 p.m. General chemistry (for advanced pupils from schools): Saturday, at 10 a.m.; Wednesday, 8 p.m. (Boatman's). During the month of June, under your instruction, I held classes at Kumara, and part of August, September, and February at Denniston.

"In the mine-managers' class the surveying work taught up to the present has not been thoroughly practical. It is impossible to do this without a theodolite, as the use and adjustment of surveying-instruments and their application to mine-surveying cannot be shown. Mr. Caples kindly lent us his theodolite for some time, but, requiring it himself, it had to be returned. The Minister of Mines kindly promised to give a theodolite when in Reefton some months ago, but we have not received it yet. The subjects taught in this and the mathematical, mining, assaying, and chemical classes include arithmetic, logarithms, trigonometry, calculation of areas and co-ordinates of traverse, plotting the survey, mining geology, practical mining; how to timber, and sizes of timber for shafts, drives, stopes, &c., and proper manner to place it in position; strength of ropes, material and hydraulics; how to assay and test gold, silver, copper, lead, zinc, tin, antimony, &c.

"The number of students attending the different classes is about ten each; but I am sorry to say they do not come as regularly as I would wish. This is accounted for by their having to work on different shifts, and they cannot get away. In July six members of the school went up for the examination prescribed in the regulations attached to the Mining Act for certificates of underground manager, and five of them were successful. I have several attending the classes now who intend to go up next examination.

"My classes at Kumara were attended by about fifteen on an average. It seems a pity classes in a place like this cannot be carried on while the Instructor is away at other schools. During my visit they built an assaying-furnace; they have a nice little laboratory, and nearly all the appliances necessary for assaying and testing ores. At Denniston the School of Mines has a nice building, furnace, fair laboratory, &c. There are several students who are anxious to pass the examination necessary to qualify them for coal-mine managers, and I am certain if they had a little more instruction some of them would be successful.

"At Boatman's school there are also several members who would like to receive the instruction necessary to pass for mine-managers. I held classes here for about twenty days in early part of year. . . . I have also made a considerable number of assays and analyses during the year. The school is made use of to a large extent in this way, and it is always convenient for miners to get samples of from 1lb. to 200lb. treated for them, and to learn the result, by amalgamation, the same as a battery-test. In assays the result is always so much larger, which often leads people astray.

"In conclusion, as I leave the Government service at the end of the month, and know the wants of the Reefton School, . . . I would beg to recommend to the favourable consideration of the Hon. the Minister of Mines the question of helping it by subsidy, or supplying it with apparatus and appliances we are at present without, but which are necessary for the future carrying-on of classes. . . ."

Mr. Fenton draws attention to the want of a roasting-furnace and pans to treat pyrites in the Reefton district, some of which are rich in gold. Attention has been drawn in several of my previous annual reports to the loss of gold by not using concentrators and appliances to treat pyrites; but it is to be hoped the day is not far distant when this question will attract more attention, and when mill-proprietors and battery-managers will see the necessity of using every means of extracting the gold the pyrites contain, and will also look on the by-products as having a commercial value. But a small plant, such as Mr. Fenton recommends in connection with the School of Mines, would be of very little service to the district. The method of treating pyrites being so well known, and so largely used in the Victorian goldfields, many companies should in their own interest combine together to have pyrites works erected in the district. The test plant erected in connection with the Thames School of Mines has been utilised but very little by mining companies, only two parcels having been tested during last year; and it is questionable if one at Reefton school would meet with larger support. Such a plant would, however, be the means of instructing young students in the practical treatment of pyrites.

Mr. Park gives the results of treatment of ore tested at the School of Mines plant, Thames, by different processes of amalgamation, in which both hot and cold water was used, and also with and without chemicals; and draws attention to the use of copper-sulphate, which he states to be a mistake. The chemical action produced by the use of copper-sulphate in amalgamation is a question upon which neither chemists nor metallurgists are agreed; and yet many of them show that its use is an advantage. This subject is referred to in my remarks on mining in the Karangahake district, showing the different opinions of chemists and metallurgists as to the effects produced by the use of sulphate of copper and salt in amalgamation. The Thames School of Mines has developed into a valuable institution, eliciting a recognition of the value of such institutions by the people of the locality. That schools of mines are apprecioted in the adjacent colonies is evidenced by the encouragement to prosecute their studies given to the students attending them. Last year a silver medal was given by the Geological Society of Victoria to the student who had the highest marks in geology and mineralogy. This was awarded to Mr. R. M. Aitken, the newly-appointed Instructor in the Reefton School of Mines, who got 97·5 per cent. of the aggregate number; and for the present year Dr. Scheidel has offered a medal for the best student in chemistry and assaying. This gives the students an incentive to work hard during the year.

The following statement will show the expenditure by the department on the Schools of Mines since their inauguration:—

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
Total	696 4 3	888 2 9	7,509 16 6	9,094 3 6

The total expenditure on these schools for the five years they have been in existence has been £9,094 3s. 6d., exclusive of an annual contribution of £500 which has been paid towards the School of Mines in connection with the University of Otago, and last year an additional £200 was given towards providing a Metallurgical Instructor at the same University; so that the total amount paid to the University of Otago is £2,700. Adding this amount to the expenditure on other schools, it shows the total cost of this class of technical education has been £11,794 3s. 6d. In concluding my remarks on the schools of mines, it may be well to reiterate that if the services of the Instructors were strictly confined to the two schools, Thames and Reefton, the progress would be much greater, especially in the latter district, where the Instructor has been travelling about from place to place, and when this is done the students can only learn the mere elementary rudiments of the science taught.

WATER-RACES.

Waimea Water-race.

The construction of this water-race was commenced in the early part of 1874, and portions of it have therefore been constructed for sixteen years. Some of the original timber now shows a state of decay, but all the long legs in the fluming have been replaced as well as many other portions of the timber structures, so that at the present time the race is in a good state of repair, and can be kept up so long as water is required to work the ground it commands in sufficient quantity to pay the cost of maintenance. There is still a great deal of ground in the wash-drift terraces in the vicinity of Stafford and Goldsborough, but there is no doubt the ground is becoming less remunerative for working, as far more drift-wash has to be removed to get the same amount of gold that was obtained some years ago. The dump for tailings is also getting less, and the sluices have to be constructed on a less gradient, which all tends to increase the cost of working the ground. Indeed, it is only by improved systems of hydraulic sluicing, which require a plentiful supply of water, that a great deal of the poor ground can be made to pay.

The following table will show the sales of water, cash received for sales of water, expenditure, outstanding moneys at end of each month, number of men employed, approximate amount of gold obtained, and value of gold for the year ending the 31st March, 1890:—

Month.	Sales of Water.	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.
1889.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		Oz.	£ s. d.
April	96 11 3	223 13 6	93 18 7	58 11 0	77	144	547 4 0
May	145 2 11	126 12 6	54 11 9	61 5 2	90	256	972 16 0
June	102 16 7	105 16 10	57 11 0	56 16 5	87	218	828 8 0
July	112 8 3	102 7 10	57 19 0	57 5 9	84	246	934 16 0
August	100 0 7	114 7 9	59 16 0	56 13 11	90	209	794 4 0
September	111 0 5	111 3 4	53 1 0	59 17 8	89	207	786 12 0
October..	131 4 4	141 5 4	53 9 0	57 7 1	95	253	961 8 0
November	113 3 4	103 0 8	57 4 0	60 0 10	93	233	885 8 0
December	85 9 7	45 18 0	80 0 9	62 2 1	97	218	828 8 0
1890.							
January	43 10 6	91 9 8	92 4 6	61 2 9	91	114	433 4 0
February	92 2 1	88 14 0	55 18 0	61 12 2	96	226	858 16 0
March	106 19 9	80 5 4	79 14 0	60 0 4	97	279	1,060 4 0
Totals	1,240 9 7	1,334 14 9	795 7 7	..	91	2,603	9,891 8 0

The value of the sales of water for last year amounted to £1,240 9s. 7d., as against £1,416 6s. 8d. for the previous year, which shows a falling-off in the revenue of £175 17s. 1d. The expenditure for the past year has been £795 7s. 7d., as against £860 2s. 5d. for the former year. Therefore, although the revenue has been falling off, the expenditure on maintenance has also decreased, leaving the actual profit on the working the race to be £445 2s., as against £556 4s. 3d. for the year previous.

The value of free water given to the miners from this race last year amounted to £96 10s. 4d., as against £183 10s. for the former year; and the average number of men employed in claims worked with water from this supply has been ninety-one. The approximate quantity of gold obtained from these claims is about 2,603oz., representing a value of £9,891 8s. This will make the average earnings of those employed, after deducting the value of the sales of water, to be £95 1s. 3d. a man per annum, or about £1 16s. 7d. per week, which is 9s. 6d. a week less than the average wages for the former year. The cost of constructing this work has been £118,762 11s. 8d., and, taking the profit on the working last year, it pays about $\frac{4}{10}$ per cent. on the capital invested.

Kumara Water-race.

This is the only one of the Government water-races that is worked that gives a fair profit for the outlay on its construction; but the sludge-channel in connection with it has been so costly to maintain that the profits have been curtailed to a large extent. The whole of the water-race is in good repair; the fluming, as it gets decayed, is being replaced with iron and steel piping, which is not only less costly to maintain, but by removing the fluming where it was originally constructed, and laying the piping on the worked-out ground, it allows a much larger area of the field to be worked. The manager estimates that the ground which the new deviations of the race has liberated will take from ten to twelve years to work out.

One of the large deviations is being constructed by Palmer, Pascoe, and party, who have taken a tunnel through the terrace from the Larrikins' side of the hill to the Dillman's side, where there is about 5 chains of ditching; the water is then taken in three lengths of steel pipes 30in. in diameter. This will do away with 20 chains of the original water-race, which was constructed on ground that was driven out in the early days of the field, and has been a continual source of trouble by the ground caving in from the surface. A subsidy of £900 in water is to be given these parties towards the cost of constructing the deviation—which will be equal to about one-third of the cost—on condition that the pipes are the property of the Government. The original race was constructed over the ground which these parties have taken up, and it was only by constructing this deviation that they could work the ground.

Another line of pipes 30in. in diameter is being laid down for about 15⅓ chains in length, to do away with a flume which would have to be removed on the lower water-race coming through Dillmanstown, and from the end of the pipe-line the water is conveyed in a ditch which has recently been widened to a carrying-capacity of thirty heads of water, so as to supply water to work the claims on the lower end of the field.

A new water-race has been constructed along the side of the Kapitea Hill, above Larrikins', to supply water to work the claims at the upper end of the flat. This race is capable of carrying about forty sluice-heads of water. The cost of this work, when fully completed, will be about £500. A by-wash is constructed from this race into Dawson Creek, which flows through the Long Tunnel Company's claim; but the manager obtained a permit from the chairman of directors of the Long Tunnel to use the creek as a by-wash. A by-wash has also been constructed near the tank in Dunedin Flat, which is capable of carrying twenty sluice-heads of water, and the one from the siphon of the high-level race has been repaired so as to carry thirty heads, and the by-wash at Blake's old saw-mill is being repaired to carry forty heads. The whole of the water that is used in the sludge-channel and water-race can now be turned off at a few minutes' notice if required.

The following table will show the value of the sales of water, the cash received, the expenditure on maintenance, the outstanding moneys at the end of each month, the number of men employed, and the approximate quantity of gold obtained from claims worked with water from the race, and the value of same for the year ending the 31st March last:—

Month.	Value of Water given towards the Construction of New Deviation of Channel.	Sales of Water.	Cash received for Sales of Water.	Outstanding Moneys at End of each Month.	Expenditure.	Number of Men employed.	Approximate Amount of Gold obtained.	Value of Gold.
1889.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		Oz.	£ s. d.
April	..	401 13 4	621 19 6	37 1 11	82 5 11	180	766	2,910 16 0
May	..	495 16 4	310 18 9	63 13 8	87 12 10	182	746	2,834 16 0
June	..	256 16 8	301 0 6	60 13 6	131 3 10	182	383	1,455 8 0
July	..	377 16 3	354 4 9	42 17 9	94 9 6	182	550	2,090 0 0
August ..	..	353 4 2	524 1 7	63 17 9	93 10 6	189	864	3,283 4 0
September ..	..	237 7 11	230 7 6	54 18 7	93 2 11	176	804	3,055 4 0
October ..	..	518 10 10	261 7 6	76 3 7	72 0 6	179	879	3,340 4 0
November ..	..	293 8 4	306 19 0	73 18 3	130 12 6	178	883	3,355 8 0
December ..	..	159 18 9	247 0 0	55 6 7	130 12 8	178	383	1,455 8 0
1890.								
January ..	..	219 15 10	147 12 6	80 8 9	246 12 2	156	292	1,109 12 0
February ..	..	248 19 7	277 10 0	72 6 8	108 5 2	162	742	2,819 12 0
March ..	..	186 16 8	122 2 6	81 10 4	154 4 9	156	251	953 16 0
Totals ..	1,492 2 10	3,550 4 8	3,705 4 1	..	1,424 13 3	175*	7,543	28,663 8 0

* Average.

It will be seen from the foregoing statement that the value of the sales of water amounts to £3,550 4s. 8d., and the value of water given towards the construction of the channel-deviation £1,492 2s. 10d., making a total of £5,042 7s. 6d., as against £6,716 6s. 10d. for the year previous; but it has to be borne in mind that the breakage in the sludge-channel last year diminished the

total sales considerably, while the expenditure has been increased owing to the large amount of repairs and construction of by-washes. The cost of maintenance last year was £1,424 13s. 3d., as against £1,024 1s. 9d. for the former year. There are, however, other items to be taken into account —namely, the value of water given towards the cost of constructing deviations, which amounts to £465, and for constructing tail-races £238 5s. When these amounts are added to the sales of water, as they represent cash-payments, the value of the sales would amount to £5,745 12s. 6d., and the profit on the working for the year would then be £4,320 19s. 3d. The total cost of this work up to the end of March last was £37,706. The profit on the working of the race last year would be equal to about 11$\frac{2}{5}$ per cent.

The value of free water given to open out claims, &c., last year was £157 17s. 6d., and the average number of miners employed was 175, and the approximate value of gold obtained by them was £28,663 8s.; so that, after deducting the value of the water used, their average earnings would be equal to £130 19s. 2d. a man per annum, or £2 10s. 4d. per week, as against £3 6s. 4d. per week for the year previous.

Kumara Sludge-channel.

This channel has been a continual drag on the revenue from the water-race ever since it was constructed, as well as a source of constant worry to the Government. It was shown in my report last year that, up to the 31st March, the total receipts, including the value of gold-dust got from the channel, amounted to about £12,240, while the expenditure in maintenance was £33,286, thus showing a direct loss on the working of £21,045; and since then the loss has been considerably augmented, as will be shown in the table of receipts and expenditure for the last year. The tailings-site that this channel commands is completely filled, and the working of the channel depends on floods in the river washing a portion of the tailings away. This was foreseen some years ago, and became so apparent last year that the miners using the channel could see that it would not be the means of allowing them to work out their claims, and they made application to the Government to construct 34 chains of a new channel at less fall to join on to the upper end of the present channel; but after making this application some dispute arose between those having private tail-races and those using the channel: it was said that this length of new channel at the proposed gradient—namely, 4in. to 12ft., or 2ft. 10in. in 100ft.—would bring the mouth of the new channel about 22ft. higher than the mouth of the present one, and that this would interfere with the working of the private tail-races. The Hon. the Minister of Mines deputed me to go to Kumara in July, 1889, to see the miners with reference to this subject; and satisfactory arrangements were come to with all parties to construct a new deviation of channel for 30 chains on the gradient proposed, and the miners using the channel undertook to construct the new deviation on receiving from the Government water from the Kumara Water-race to the value of £3,200, and on its completion, or, at the furthest, on the 1st April, 1890, to take over the channel and maintain it at their own expense. This was agreed to by the Hon. the Minister of Mines, and an Act was passed last session to enable this to be done.

The miners at once appointed trustees from amongst themselves to carry out this agreement, and let a contract for the construction of the new deviation, binding down the contractors to have the work completed within a certain time. The contractors sublet two sections of the work, to be carried on by connections with the present channel, and the work proceeded in a very satisfactory manner up to the 18th December last, when one of the cap-pieces in the present channel broke down at about 19 chains from the mouth, bringing down with it two sets of laths, and filling up the channel with drift-gravel and large boulders from the roof. When this accident occurred there were several parties sluicing into the channel, and from the evidence lately taken before Dr. Giles there was from 50 to 60 sluice-heads of water in the channel. A connection had been made from the channel to the upper section which was being constructed by the sub-contractors, and this connection was a short distance above the place where the cap-piece broke, and the channel was filled with *débris* coming down from the roof. This blockage dammed up the water in the channel, and caused it to rise for some distance in the upper section of the new deviation, where five of the sub-contractors were at work, when another break took place a little above the connection of the upper section of the deviation with the channel. This break had the effect of damming back the water in the channel above the outlet from the upper section of the deviation, and no doubt was the means of saving the men's lives who were in there at the time. The drainage coming through the upper break got away through the lower one, so that the water did not rise any higher in the new deviation. The men were, however, imprisoned in this unpleasant position for about twenty-two hours, when an opening was made above the upper break into the new portion and the men rescued.

On this accident being communicated to the Hon. the Minister of Mines, he despatched me to Kumara to have the channel repaired with all possible speed, and the manager was instructed to employ as many men to repair the break as could be set to work, working continuously, Sundays included, until the repairs were effected; but, as there is always a certain drainage into the channel, the repairs could only be carried on from the lower end, and they were not completed so as to allow sluicing to be carried on in the channel until the first day of February last. A certain length of the channel being blocked, it did not at that time admit of me making an examination of the whole of the timber in the channel, but in the portion of the channel downwards there were only a few caps that were what could be considered "dozed," and where these were intermediate sets had been placed. Indeed, there were intermediate sets placed in between every second main set. The manager was also instructed to have uprights placed under all the cap-pieces at each side of the flume from the Dunedin shaft to its junction with the new deviation, as soon as the breaks were repaired, so as to make sure that a similar accident would not occur.

The following is the report of Dr. Giles, who was appointed by Royal Commission to inquire into the cause of the accident:—

"To His Excellency the Earl of Onslow.—May it please your Excellency,—In pursuance of your Excellency's Commission, dated the 28th of March ultimo, appointing me to inquire into the cause of the break in No. 1 Government Sludge-channel at Kumara on the 18th of December, 1889, I have now the honour to report the steps which I have taken in the matter, and the opinion which I have formed.

"I reached Kumara on the 2nd of April, and opened the inquiry on Thursday, the 3rd. On that day I sat until late in the evening, and during the day made a visit to the sludge-channel, in company with Mr. Gow and Mr. Seddon, as well as Mr. Rogers, the overseer of the channel, and Mr. Mansfield, one of those whose lives were in such imminent jeopardy by the accident. The inquiry was then, in consequence of the Easter holidays, adjourned to Tuesday, the 8th of April. The sittings were continued through that and the two following days, and were closed on the evening of Thursday the 10th of April. On the first day Mr. Gow, and afterwards Mr. Purkiss, solicitor, represented the management of the sludge-channel, and Mr. Moss, and afterwards Mr. Guinness, appeared as counsel, instructed by Mansfield and party. Mr. Seddon, M.H.R., also appeared, and took much the most prominent part in the proceedings. I am at a loss to say what interest Mr. Seddon may be considered to represent, and he did not seem able to give me any information on the subject, except that as one of those who had asked for an inquiry he represented himself. I, however, made no difficulty in permitting Mr. Seddon to appear and to put questions to the witnesses; for, although he could not have been so recognised had the proceeding been a Coroner's inquest, yet I thought that Mr. Seddon's minute and extensive knowledge of mining matters in the Kumara district might be of much assistance, and, further, that it might be as well that the member for the district should satisfy himself that the inquiry had been as complete as possible.

"I now proceed to give briefly an outline of the leading circumstances connected with the accident, which occurred on the 18th of December last. On that morning, probably between 7 and 8 o'clock, the tunnel became blocked by a fall of the roof at a point about 18½ chains from the mouth. At that time five men—viz., Mansfield, Morgan, Evans, Thomas, and Straight—were employed on the upper section of No. 3 channel, the upper end of which was destined to open into No. 1 about 30 chains above the mouth of the latter. To reach their work they had been constructing a cross-drive, through which they got rid of their *débris* by sending it into the main channel. At the time of the fall of earth a large quantity of water was coming down the channel, and this water was so suddenly backed up in the tunnel that it entered the cross-drive before the men could escape, and so shut them up in a *cul de sac* from which there was no egress. In that position they would all have been drowned in a very few minutes had the water continued to rise, but it ceased to do so before it was too late, and in the course of an hour or two it had drained off sufficiently to allow steps to be taken for the extrication of the men, which was effected after they had been confined in the drive about twenty-two hours. There is very little doubt that the cause of the check given to the rising of the water in the drive was the occurrence of a second break in the tunnel, which took place about 5 chains above the first, and must have followed it almost immediately. Mr. Seddon made some attempt to show that this upper break occurred first, but without any success whatever, and the men concerned have no doubt that it was this upper break, and this alone, that saved their lives when nothing else could have done so. The only motive that I can conceive for such a desire to show the facts otherwise than they really were is to be found in the circumstance that the upper break was probably due to the giving-way of some rotten laths, and that if this could be shown to have been the first thing that occurred, it would have afforded some foundation for a charge of neglect against those whose duty it was to inspect the channel.

"The question how this accident was caused admits of an answer perfectly clear and distinct. It was caused by the giving-way of a cap-piece at the spot where the lower break occurred. This cap-piece was observed by more than one witness to be broken and sagging in the middle within an hour before the fall took place. The same cap was afterwards dug out from the *débris*, and the fragments into which it was sawn or split in the process were produced in Court and examined by various witnesses, who have given their opinion on the subject. The central part of this cap, showing the precise seat of the fracture, was preserved, and no reasonable doubt can remain that this fracture was the immediate cause of the accident. The next question is how this fracture was caused—that is to say, how did this cap become at that particular time unable to bear the weight upon it? The answer to this question given by Mr. Gow and the channel-managers generally is that in all probability there was a cavity overhead, and that a fall of earth and large stones took place, by the impact of which the cap was broken. On the other hand it was contended by Mr. Guinness and Mr. Seddon that the cap had become by decay too brittle to support the accustomed weight, or that if there was any increased weight at this time, it arose not from any fall from the roof of a cavity, but merely from water getting in through a broken surface above, and causing a greater tendency to subsidence (I suppose through diminished lateral cohesion of the earth), and consequent increased pressure on the cap. They say that this state of things ought to have been expected in the ordinary course of events; that the cap was unsound, and that its unsoundness ought to have been discovered, and a remedy supplied by putting in props or an intermediate set.

"Either of these theories, so far as the state of the ground over the roof is concerned, might be accepted as reasonable, and in the case of a tunnel ten or eleven years old it must be to a great extent a matter of conjecture which is the true one, for if a cavity existed it could hardly be known, in consequence of the probability that there would be a layer of earth resting on the laths and forming the floor of the cavity, by which any examination would be rendered impossible. The balance of probability, therefore, must be determined by any indirect evidence there may be, and chiefly by the state of the cap-piece itself. Now, there is evidence that after the break some remnants of scrub and rushes were found among the *débris*, such as are commonly used in stuffing over the laths when cavities overhead occur in driving. This establishes a probability that some sort of cavity existed, although it gives no indication of its size; and this direct testimony cannot be

invalidated by conjectural opinions that this was not the kind of ground which required such stuffing, or that the stuffing would not be found after so many years. The state of the cap itself is, however, the principal feature to be considered. The cap-pieces are all described as of black-birch, a timber spoken of in high terms in Mr. O'Connor's report on the sludge-channel, dated 16th September, 1880. But many witnesses have alleged positively that this timber is not black-birch, and they say there is no black-birch in the Blackwater Forest, from which the caps were obtained. They mostly call it brown-birch. This is a question which I cannot determine. Perhaps the same thing may be called by different names, and perhaps different things may be called by the same name; but the attention of the Government department concerned may well be called to the statements made, and particularly to Mr. Seddon's assertion that this timber has more recently been condemned by the Minister and Under-Secretary for Public Works. The broken cap itself has knots in it, which are considered a defect, and it was probably taken from a higher part of the tree than it should have been. But it does not appear that the knots had anything to do with the fracture. Concerning the quality of the timber itself, it is remarkable what different statements are made by different witnesses, all having the same sample under their eyes. Some say it is good sound timber, capable of doing ordinary duty as a cap for three or four years longer; others say it is unsound, decayed, 'dozed,' perished, dead, affected with dry-rot, &c.

"My own opinion, after examining the pieces, is that the wood is not affected with any decay of a kind which makes timber soft. If any molecular change has taken place in its fibres, it is of a kind which produces brittleness and diminishes toughness. The wood is very hard indeed, but evidently of a very short grain and very little toughness. The surface of fracture shows this clearly, and the general character of the cap strongly supports the view that it was suddenly cracked through by a fall from above, and that it shortly afterwards fell quite down, either by a second fall of earth coming on it, or from the gradual pressure of what had already fallen. I certainly do not think this timber can be regarded as suitable for caps in a tunnel having a span of 10ft. between the props, and I think it leads to the inference that all such caps ought to have centre props—*i.e.*, at the sides of the channel—except where the ground is known to be safe and without cavities overhead. But I cannot find any reason for imputing blame or neglect to the channel-overseer, or any other person, for having failed to centre-prop this particular cap. I do not see how he was to have ascertained that it required under-propping. It would assuredly have resisted the thrust of a miner's candlestick, the usual instrument for this sort of testing. It would have rung hard and sound to a blow with the back of a tomahawk; and there is no evidence to show that the dust brought out by a borer would have indicated anything wrong. I believe therefore that, whilst other timbers, presenting marks of what is commonly called decay, were from time to time strengthened by centre props or intermediate sets, this particular one might have been tested a score of times without any reason for interference becoming apparent. And I doubt if there is a miner in Kumara who, after applying the usual tests, would have pointed out this as a faulty cap.

"My opinion, therefore, upon the question submitted to me by your Excellency's Commission is that the break in the sludge-channel which occurred on the 18th December, 1889, was caused by the snapping of a cap-piece by reason of a sudden subsidence or fall upon it of the earth and stones overhead; that no officer concerned in the channel-management is chargeable with neglect in the ordinary discharge of his duties, inasmuch as no examination such as it was his duty habitually to make would have led him to think any measures of protection necessary. But the evidence seems to show that the timber employed is not of a suitable sort for horizontal weight-bearing beams, and that in a tunnel having a span of 10ft. between the uprights, and after the lapse of several years, it is safer to underprop all such beams, or to insert intermediate sets, wherever there is any doubt about the ground.

"There are still one or two matters which require a brief notice before I conclude my report. I have already said that the upper break occurred after the lower one, and therefore could have had nothing to do with the cause of the accident. The fall at this spot probably occurred through some rotten laths giving way, and this was caused by the water, which was backed by the lower break, rising into the roof and disturbing the earth overhead. Undoubtedly, if this had been the original seat of the accident, and it had occurred without the aid of the water, it would have been said, and plausibly so, that the overseer was culpable in leaving the laths there. But this is a hypothetical case, for the break did not occur here first, nor at all until the water got into the roof. Attempts were made to show that the inspection and repairs of the channel had been generally neglected, and particularly latterly, in view of the expected abandonment of the channel to the care of trustees. Such charges might be relevant if the particular cause of the accident of the 18th December were in any way doubtful; but they are not so in the present case. They could only be substantiated by a precise enumeration of all the repairs done in a given time, and by proof of individual instances of repairs needed and neglected. The cause of the accident having been exactly ascertained, this part of the subject may be dismissed, the statements being irrelevant and insufficiently proved. A good deal of evidence has been given about the means in use for quickly turning off the water. This, of course, can have nothing to do with the cause of the accident; but if life had been lost the subject might have had immediate relevance and importance. As a matter of fact, if the water could have been stopped in time to prevent the second break—a matter of impossibility by any means—it would inevitably have resulted in the death of five men. Nevertheless, it is unquestionably important that there should be as perfect a system of signalling as possible, and means of stopping the water in the shortest possible time when the signal is given. In these respects some important deficiencies appear to me to have been proved; but, as they have no bearing on the immediate subject of my inquiry, they call for no further remark from me.

"In conclusion, I trust that your Excellency will be of opinion that the question submitted to me has been adequately investigated. I have appended to this report, in an appendix, a few notes

of the points that have come under my notice in respect of the strength of beams, and the weights that they have to bear. These are matters on which I am not competent to pronounce, and they relate, moreover, to the original design and construction of the tunnel, and not directly to my inquiry. But I have thought it might be useful, and perhaps interesting to the officers of the Government department concerned in such works, to throw together compendiously a few notes, showing some of the points that have arisen, and the discrepancies of scientific opinion which appear to exist in relation to the strength of the tunnel. I also forward my notes of the evidence taken.—I have, &c.,

"17th April, 1890." "JOSEPH GILES.

"*Appendix.*

"Mr. C. Y. O'Connor has been good enough to lend me his report on the Kumara Sludge-channel, dated 16th September, 1880 (P.W., Mid. Isl., No. 80, 1,492). In that report is a full criticism of Mr. Wylde's opinion as to the weight which a cap-piece would have to bear in the event of any subsidence happening. Mr. Wylde, in his evidence given ten years ago, on the occasion of a fatal accident occurring in the tunnel at the time of its construction, estimated the weight on each cap as the amount of earth vertically over it to the surface; but in a letter to the *Kumara Times* of the 30th July, 1880, Mr. Wylde explained that he only meant that the caps would have to bear that weight in the event of a subsidence. In answer to a question put by me at the late inquiry, Mr. Wylde further explained that he meant, in the event of a subsidence reaching to the surface. Mr. Wylde also said that he thought the theory set forth by Mr. O'Connor in his report, based upon the similarity of the conical cavities over tunnels of different sizes, sound enough, but that there was nothing to prevent such cavities in many cases from running to the surface. Mr. Wylde added that in the event of a subsidence to the surface it would in some cases be impossible for any timbers to bear the weight. Mr. Wylde says that the strength of the caps in the sludge-channel ought to be nine times that of the caps in an ordinary mining drive—that is, that the strength should be inversely as the square of the span, 12^2 being to 4^2 as 9 to 1. (But, the caps being 10ft., and not 12ft., in the span, the proportion would be 6·25 instead of 9 to 1.) Mr. Wylde says the caps are in fact only $2\frac{1}{4}$ times as strong. This seems to be founded on the supposition that the strength of the beams of equal length is as the area of surface of their transverse sections. I must presume that he means that this is the case when the breadth and depth preserve the same relative proportions, for otherwise it would be indifferent whether a board were set flat or edgewise. It would follow, therefore, from Mr. Wylde's datum that the caps ought be of such a size as to give an area on transverse section of $64 \times 9 = 576$in.—that is, that each dimension ought to be $\sqrt{576} = 24$in. !

"The formula used by the Government engineers for obtaining the strength of beams is founded on Balfour's experiments on timbers, which gives the coefficient S for various kinds. W = the ultimate strength of the beam; b and d the breadth and depth of cap in inches; l the length in feet between the uprights: then $W = \frac{8bd^2S}{l \times 2{,}240}$, the coefficient for birch being 202·5. This gives a strength of 125 tons as weight distributed over a beam of 10ft. span and 12in. thickness: $\frac{8 \times 12 \times 144 \times 202{\cdot}5}{22{,}400} = 124{\cdot}97$ tons. Applying this formula to a cap of 10ft. span and 8in. thick, the result would be about 37 tons, which is to 125 as about 1 to $3\frac{1}{3}$. In this formula it is clear that when $b = d$, $bd^2 = d^3$, and therefore d^3 is the varying factor, and not d^2 as Mr. Wylde seems to suppose. This seems to be rather a serious error, unless Mr. Wylde can show that the formula used is wrong.

"With regard to the general question of the strength of beams, I have referred to a little book called 'Trautwine's Civil Engineers' Pocket-book,' where I find the following formula (adopting the same letters as before): $W = \frac{bd^2S}{l}$, where W will be pounds instead of tons, and represents the centre-breaking weight; whereas the weight in the other case is distributed. Trautwine gives the coefficient for English beech, sycamore, and yellow-pine at 500, and teak at 750. Applying this formula to the sludge-channel caps, if they were made of teak, the centre-breaking load would be something under 58 tons, whereas the formula of the Government engineers gives 62·5 tons for birch. Mr. Balfour gives for teak a coefficient of 205·17, which is a little more than birch. The two formulæ are easily reconciled, so far as I am able to understand the matter from the explanations which have been given me. But the fact that birch is regarded as at all comparable to teak in weight-bearing power rather surprised me. If the estimates made are approximately correct it would seem to point to the conclusion that, whilst birch may have a high power to resist dead weight, it is yet likely to give way under a sudden impact.—J. G."

At the recent inquiry held by Dr. Giles as to the cause of the break in the sludge-channel the evidence given by Mr. James Wylde ought not to pass without some remarks, as he stated he was a civil engineer of forty-five years' experience, during twenty years of which he had been on the West Coast, and therefore his evidence might be taken as that of an expert capable of giving a reliable opinion as to the design of this work; whereas it can be clearly shown that the principle on which he based his calculations was a fallacy and the results arrived at erroneous. It is also due to those who had charge of the construction of this work and designed it, not to allow the assertions made by Mr. Wylde to pass unchallenged. It is stated in the *Kumara Times* of the 5th April that he gave the following evidence: "The tunnel is only one-fourth the strength of an ordinary miner's tunnel. I prove that in this way: It is an ascertained and well-known fact that the strength of a beam is inversely as the square of its length. An ordinary cap is 4ft. long, the square of which is 16. The channel caps are 12ft. long, the square of which is 144. As 16 will go 9 times into 144, the caps should be nine times the strength of ordinary 4ft. ones. Caps used by miners in permanent tunnels are usually 8in., the square of which is 64. The channel caps are 12in., the square of which is 144. Sixty-four will only go $2\frac{1}{4}$ times into 144; consequently, instead of being 9 times

they are only 2¼ times the strength of miners' caps." Mr. Wylde states that it is well known that the strength of beams should be inversely as the square of their length and the square of their depth. This applies in a measure to tunnel-timber; but it is also well known that if Mr. Wylde's theory were applied to beams the result arrived at would be perfectly erroneous, as will be shown hereafter.

In calculating the strength of beams the distance between the supports, or actual span, is taken. The span of the channel caps is 10ft., and not, as stated by Mr. Wylde, 12ft. Also, the caps usually in miners' tunnels are of round timber, and in very few instances are square caps met with in small tunnels, except it were an opening set, or some particular place where connections are made with branch tunnels or suchlike; and, moreover, in many instances the best description of timber is not used, but generally timber growing in the locality adjacent to the work. It is also laid down by all authorities, such as Rankin, Stoney, Barlow, Molesworth, Trautwine, and others, that round beams are not more than two-thirds the strength of square beams. Indeed, some of these authorities make them to be less than this; but, assuming them to be two-thirds the strength, then there is another element to be taken into account—namely, the sap-wood on small round timber, which decays in the course of a couple of years; and, at the least, the depth of sap-wood cannot be taken at less than ½in. It must also be remembered that the only authentic experiments on New Zealand timber at the time this work was designed were those made by Mr. Balfour in 1865, which were published in the jurors' report on the first exhibition held at Dunedin. The values of the constants there given had to be taken, as there was no other data to work on. The averages of all the experiments of the number of pounds it required to break an inch square on the different classes of timber such as are generally used on the West Coast were as follows: Black-birch, 202·5; black-pine, 190; red-pine (rimu), 140·2; totara, 133·6; white-pine (kahikatea), 106; kamai (which at that time was generally termed red-birch), 158·2; kawaku, 75. These are the general classes of timber growing on the West Coast, and in many places, such as at Ross, the general class of timber used for main drives and tunnels was red-pine and kamai (red-birch—or, at least, it was known by the name of red-birch).

The question of the weight that is likely to come on timber in tunnels depends entirely on the nature of the ground, and cannot be calculated to such a nicety as when the exact load is known. We find the strength of different materials by experiment, and by experiments made in timbering tunnels it has been found that timber of certain dimensions was sufficient to keep up the ground. The question of deciding on the dimensions of the timber to be used in the construction of the sludge-channel was not arrived at in a haphazard manner, as one might suppose from the evidence given by Mr. Wylde at the inquiry, but was gone fully into after the first accident in 1880, as will be seen from a table of the relative strength of different caps used in underground workings, taken from the office records as a means of arriving at the strength of caps for the sludge-channel:—

Tunnels referred to.	Width of Tunnel in Clear — Span of Cap.	Distance from Centre to Centre of Frame.	Relative Load on Bases of Square of Span only.	Relative Load taking into Account the Distances of Frames also.	Probable Maximum Actual Load, arrived at as Above.
	Ft. in.	Ft. in.			Tons.
New Zealand water-race tunnels where 6ft. wide	6 0	3 0	1·0000	1·0000	8·11 (assumed).
New Zealand water-race tunnels, ordinary	5 0	3 0	0·6944	0·6944	5·63 (calculated).
Mining-drives at Ross	7 8	4 0	1·6327	2·1769	17·65 "
Sludge-channel as proposed by Mr. Gow	9 0	4 0	2·2500	3·0000	24·33 "
Mining-chambers at Ross	10 0	2 0	2·7778	1·8518	15·02 "
Sludge-channel in course of construction	10 0	4 0	2·7778	3·7037	30·04 "
Sludge-channel where double-timbered...	10 0	2 0	2·7778	1·8518	15·02 "

Caps.—Factors of safety, arrived at by dividing the ultimate strength by the probable maximum actual loads deduced as above:—

Tunnels referred to.	Span of Caps.	Diameter of Caps.	Class of Timber.	Load.	Ultimate Strength.	Factors of Safety.
	Ft. in.	In.		Tons.	Tons.	
New Zealand water-race tunnels where 6ft. wide	6 0	9	Rimu ...	8·11	40·56	5·00
New Zealand water-race tunnels, ordinary...	5 0	8	" ...	5·63	34·18	6·07
Mining-drives at Ross	7 8	10	" ...	17·65	43·54	2·46
" "	7 8	10	Kahikatea	17·65	32·92	1·86
Sludge-channel as proposed by Mr. Gow ...	9 0	9	Rimu ...	24·33	27·04	1·11
Mining-chambers at Ross	10 0	15	" ...	15·02	112·65	7·50
" "	10 0	15	Kahikatea	15·02	85·18	5·67
Sludge-channel as in course of construction	10 0	12x12	Black-birch	30·04	124·97	4·16
" where double-timbered ...	10 0	12x12	" ...	15·02	124·97	8·32

The second part of the foregoing table gives a higher factor of safety for round sticks than should be taken, inasmuch as the whole diameter is included. The sap-wood becomes in a very short time valueless; besides, it is customary in making sets of round timber to flatten the upper side of the cap a little, for chocks or riders to be used so as to allow the next set of laths to be entered. Therefore, in using round green saplings, or young trees newly cut, the sap-wood should be deducted in calculating either their transverse or crushing strength. Assuming, as before, that the New Zealand water-race tunnels have a factor of safety of 5, then the relation of the different caps in the table shows that the channel caps have their relative strength in comparison to those used in other tunnels and drives. As regards the actual transverse strength and durability of the timber used, far more is now known respecting it than when this work was designed; but at that time the coefficients arrived at by Mr. Balfour as regards its transverse strength had to be taken, and these coefficients are used in calculating the ultimate strength of the different caps in the following table :—

Tunnels, same as previous Table.	Span of Caps.	Diameter of Caps.	Diameter of Caps with Sap-wood deducted.	Class of Timber.	Load.	Ultimate Strength.	Factor of Safety.
	Ft. in.	In.	In.		Tons.	Tons.	
New Zealand water-race tunnels where 6ft. wide	6 0	9	8	Rimu ...	5·70	28·49	5·00
New Zealand archway tunnels ...	5 0	8	7	" ...	3·96	22·90	5·78
Mining-drives at Ross	7 8	10	9	" ...	12·41	31·74	2·56
" "	7 8	10	9	Kahikatea	12·40	24·00	1·93
Sludge-channel as proposed by Mr. Gow	9 0	9	9	Rimu ...	17·1	17·00	0·99
Mining-chambers at Ross ...	10 0	15	14	" ...	10·55	91·60	8·68
" " ...	10 0	15	14	Kahikatea	10·55	69·25	6·56
Sludge-channel with sets 4ft. apart from centre to centre ...	10 0	12 x 12	12 x 12	Black-birch	21·11	124·97	5·92
Sludge-channel where double-timbered	10 0	12 x 12	12 x 12	"	10·56	124·97	11·84

It will be seen, therefore, that the strength of beams depends on the class of timber used, and not inversely as the square of its cross-section, as stated by Mr. Wylde, regardless of anything else. If the cross-section was taken as the element of arriving at strength, then a beam would be as strong laid on its side as one standing on edge. This would totally disregard all the known formulæ for arriving at the strength of beams to carry a given load—*i.e.*, beams supported at both ends—namely, $\frac{8bd^2s}{l}$, where b is the breadth of the beam in inches, d the depth in inches, s the coefficent of the transverse strength of the different classes of timber, and l the span in feet between the supports. Taking $\frac{bd^2}{l}$, and omitting the other elements, we find the relative proportions of strength. We will suppose a beam is 10ft. long between the supports, 12in. broad, and 6in. deep; then we have $\frac{12\times6\times6}{10} = 43{\cdot}2$; but if its depth were 12in. and its breadth 6in., then we should have $\frac{6\times12\times11}{10} = 86{\cdot}4$, which shows that it is twice as strong when set on edge as it would be if laid on its side, although its cross-section is the same in both cases. It will be seen, therefore, that estimating its strength by the number of square inches in its cross-section is erroneous.

There are a number of tunnels and adit-levels which are 6ft. wide in the clear, timbered with caps of red-pine (rimu) 9in. and 10in. in diameter, which have stood for more than ten years, and, if the strength of these be compared with the sludge-channel caps, the latter will bear a favourable comparison. Taking the relations of the squares of their respective lengths as their strength is to each other, they are as 36 is to 100, or, the sludge-channel caps would have to be 2·77 times the strength of the 6ft. caps; taking the channel caps to be of black-birch, and using the coefficients arrived at by the experiments of Mr. Balfour, their relative strengths are as follows :—

$$\text{Channel-caps} = \frac{8\times12\times12\times12\times202{\cdot}5}{10} = 279{,}936\text{lb.}$$

$$\text{6ft. caps of rimu 10in. in diameter, allowing 1in. for sap-wood} = \frac{8\times9\times9\times9\times140{\cdot}2}{6}\times\tfrac{2}{3} = 90{,}850\text{lb.}$$

The strengths of these, therefore, are as 90,850 is to 279,936, or, the channel caps are 3·08 times the strength of the 6ft. caps, whereas according to the squares of their respective lengths they only required to be 2·77 times. If the 6ft. caps were to be taken as being of the same description of timber as the channel caps, then the relative strength would be as 131,220 is to 279,936, or, the channel caps would be 2·13 times the strength of the other, in place of 2·77, but the caps in ordinary miners' tunnels might be of any other description of timber, such as kamai, totara, and even in some instances white-pine, and in that case the channel caps would have more than their proportionate strength.

To take such a case as that stated by Mr. Wylde, of ordinary miners' tunnels, having 4ft. caps 8in. in diameter, and compare the strength of these with that of the channel caps, the shorter caps would be stronger in proportion to their length than the other, but not to the extent which Mr. Wylde endeavoured to show. Thus, the squares of their respective lengths would be as 16 is to 100, or, the channel caps would have to be six and a quarter times the strength of the shorter caps. Taking the 8in. caps to be of red-pine, and allowing for sap-wood, then the relative strengths would be as 64,118 is to 279,936, or, the channel caps would be 4·36 times the strength of the others, in place of $6\frac{1}{4}$ times.

In evidence given by Mr. Wylde at an inquiry in July, 1880, and which was handed in by him at the recent inquiry, he states, "In the event of a subsidence taking place each set would have to bear a calculated weight of 334 tons. From the fact that some of the props have crushed into the caps, there has been a subsidence." Now, when this statement is analysed, it means that the weight on the roof of the tunnel is the entire weight of the material above the tunnel in a vertical line at each side to the surface. If such a weight had come on the caps by the subsidence he referred to that had taken place, the whole of the channel would have collapsed; but the mere fact of the timber sustaining the weight for ten years after the subsidence he stated had occurred is in itself sufficient to show the fallacies adduced by him.

The timber in the channel caps is in proportion to the strength of timber used in other tunnels constructed in alluvial drifts, and, although an accident happened, and one of the caps, after ten years' use, broke down, there is not a tittle of blame to be cast on any one connected with its construction or maintenance. The same thing might happen in any other tunnel where the timber had not been so long in use. The evidence of Mr. Wylde tends to cast reflections on those who had charge of the work; but, when analysed, it shows that, even with all his experience, he has not studied this subject sufficiently.

The following table shows the amount received from channel-fees and gold-dust obtained from the channel, the expenditure on its maintenance, the outstanding moneys due at the end of each month, and the number of miners employed in claims that are worked from this channel, for the year ending the 31st March last:—

Month.	Channel-fees paid towards the Construction of New Deviation.	Channel-fees.	Value of Gold-dust obtained from the Channel.	Cash received for Channel-fees.	Expenditure.	Outstanding Moneys due at End of each Month.	Number of Men using the Channel.
1889.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	
April	..	64 1 8	27 3 6	93 8 6	390 4 9	..	80
May	..	68 19 8	29 12 0	58 16 3	356 2 5	..	80
June	..	..	33 7 0	..	203 18 1	..	80
July	..	21 15 5	13 11 0	9 5 9	360 17 2	0 13 4	80
August ..	56 7 5	12 12 6	16 8 6	13 0 11	213 3 5	1 8 4	79
September ..	116 17 2	..	91 14 0	..	192 1 1	..	79
October ..	107 13 6	..	75 3 6	..	236 10 1	..	79
November ..	94 0 10	..	62 2 0	..	212 6 5	..	78
December ..	35 8 10	..	..	..	189 14 0	..	78
1890.							
January ..	2 0 0	..	..	..	302 12 7	..	78
February ..	75 17 0	..	47 2 0	..	342 17 0	..	78
March ..	31 8 8	..	145 12 0	..	213 8 11	..	76
	519 13 5	167 9 5	541 15 6	174 11 5	3,213 15 11	..	79

This shows that the channel-fees previous to the construction of the new deviation of channel amounted to £167 9s. 3d., and the value of channel-fees paid towards the construction of new deviation, £519 13s. 5d., thus making the total fees for the year £687 2s. 8d.; and the value of gold-dust obtained from the channel amounts to £541 15s. 6d., which added to the channel-fees amounts to £1,228 18s. 2d.; while the expenditure on maintenance and repairing the breakage amounted to £3,213 15s. 11d.: thus showing a direct loss on the working for the year of £1,984 17s. 9d., as against £2,619 8s. 2d., which was the loss for the previous year. But the reason of the loss being less this year is that a large number of blocks were on hand, and, as the channel will shortly be handed over to the miners, the material on hand has been used, and only such material as was actually required to continue the maintenance until handed over to the miners has been procured, so that the supplies on hand at that time will be reduced to a minimum.

In order to show the actual loss to the revenue by the Government maintaining the sludge-channel, it is necessary to take into account the quantity of water supplied to the different parties who are using it, which the following table will show;—

Month.	Sales of Water.	Channel-fees.	Gold-dust obtained from the Channel.	Number of Men using Channel.	Average Receipts from Sales of Water, &c., per Man.	Average Earnings per Man per Week.	Approximate Amount of Gold obtained.	Value of Gold.	Expenditure.
1889.	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.	Oz.	£ s. d.	£ s. d.
April	192 10 0	64 1 8	27 3 6	80	3 11 1	3 11 3	332	1,261 12 0	390 4 9
May	209 10 8	68 19 8	29 12 0	80	3 17 0	2 15 7	184	699 4 0	356 2 5
June	..	..	33 7 0	80	0 8 4	..	9	34 4 0	203 18 1
July	61 16 8	21 15 5	13 11 0	80	1 4 3	0 16 1	70	266 0 0	360 17 2
August ..	200 9 7	69 0 11	16 8 6	79	3 12 5	3 3 6	218	828 8 0	213 3 5
September ..	335 1 3	116 17 2	91 14 0	79	6 17 7	3 8 2	338	1,284 8 0	192 1 1
October ..	310 11 8	107 13 6	75 3 6	78	5 10 8	4 2 9	368	1,398 8 0	212 6 5
November ..	275 8 0	94 0 10	62 2 0	78	1 14 2	1 10 3	124	471 4 0	189 14 0
December ..	97 13 4	35 8 10	..						
1890.									
January ..	6 0 0	2 0 0	..	78	0 2 0	..	9	34 4 0	302 12 7
February ..	211 18 3	75 17 0	47 2 0	78	4 5 10	3 10 3	373	1,417 8 0	342 17 0
March	102 11 5	31 8 8	145 12 0	76	3 13 7	1 14 3	222	843 12 0	213 8 11
Total ..	2,003 10 10	687 3 8	541 15 6	79	41 1 11	2 0 11	2,639	10,028 4 0	3,213 15 11

It will be seen from this statement that the value of the sales of water to the different parties using the channel amounted to £2,003 10s. 10d., the channel-fees to £687 3s. 8d., and the value of gold-dust to £541 15s. 6d., making a total of £3,232 10s.; while the expenditure alone on the maintenance of the channel was £3,213 15s. 11d. This leaves only £18 14s. 1d. for the value of the water sold from the Kumara Water-race last year to those parties who are using the channel, while those who have private tail-races have had to pay the full value for the water; and it is only from those parties that any profits on the working of the water-race have accrued. This shows that it is unjust for the Government to continue the maintenance of the channel in order to assist seventy-nine men who are employed in claims worked from the channel, while ninety-six men have paid the full value for the water and maintained their own tail-races.

The following statement will show the results of working for the last seven years:—

Year ended 31st March.	Value of Channel-fees and Gold-dust obtained from the Channel.	Expenditure on Maintenance.	Loss on Working the Channel.
	£ s. d.	£ s. d.	£ s. d.
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
Total	13,469 12 1	36,500 4 1	23,030 12 0

It will be seen from the foregoing statement that the loss on working this channel has amounted in seven years to £23,030 12s., which is more than its original cost of construction: if the original cost of construction—namely, £17,200 12s. 6d., and also the amount allowed for construction of the new deviation—namely, £3,200—be added to the loss on working, it makes a total loss of £48,431 4s. 6d.; for not one penny of this will ever be recouped. The only collateral advantages that can possibly be gained arise from the duty on goods and gold-duty paid by those who are working claims by means of the channel; and, taking the average number of men em-employed in those claims last year, which was seventy-nine, and assuming that each of those supported four individuals, the population that this channel is the means of supporting is 395; and the Customs and other revenue derived from these individuals would never compensate the colony for the outlay of maintaining this work.

Waimea–Kumara Water-race and Sludge-channel.

Having now given each branch of this work in detail, it is necessary to take it as a whole, since it is only one work, and to show the results of working for the year.

The following table shows the value of the sales of water, the cash received, the value of gold-dust obtained from the channel, the expenditure on maintenance, the outstanding moneys at the end of each month, and the approximate quantity and value of gold obtained, for the year ending the 31st March, 1890:—

Month.	Value of Water given towards the Cost of Deviation and Construction of Tail-races.	Sales of Water, Channel-fees, and Value of Gold obtained from Channel.	Cash received for Sales of Water and Channel-fees.	Expenditure.	Outstanding Moneys at the End of each Month.	Number of Men employed.	Approximate Quantity of Gold obtained.	Value of Gold.
1889:	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		Oz.	£ s. d.
April ..	..	589 9 9	939 1 6	566 9 3	95 12 11	257	910	3,458 0 0
May	..	739 10 11	496 7 6	498 7 7	124 18 10	272	1,002	3,807 12 0
June	..	393 0 3	406 17 4	392 12 11	117 9 11	269	601	2,283 16 0
July	..	525 10 11	465 18 4	513 5 8	100 17 3	266	796	3,024 16 0
August ..	..	482 5 9	651 10 3	366 9 11	122 5 0	279	1,073	4,077 8 0
September ..	..	440 2 4	341 10 10	338 5 0	114 16 3	265	1,011	3,841 16 0
October ..	..	524 18 8	402 12 10	361 19 7	133 10 8	274	1,132	4,301 12 0
November ..	..	468 13 8	409 19 8	400 2 11	133 19 1	271	1,116	4,240 16 0
December ..	..	245 8 4	292 18 0	400 7 5	117 8 8	275	601	2,283 16 0
1890.								
January ..	..	263 6 4	239 2 2	641 9 3	141 11 6	247	406	1,542 16 0
February ..	..	388 3 8	366 4 0	507 0 2	133 18 10	258	968	3,678 8 0
March ..	..	439 8 5	202 7 10	447 7 8	141 10 8	253	530	2,014 0 0
Totals ..	2,715 1 3	5,499 19 0	5,214 10 3	5,433 17 4	..	266*	10,146	38,554 16 0

* Average.

This shows that the value of the sales of water and gold-dust was £5,499 19s., and the value of water given towards the construction of deviations and tail-races, £2,715 1s. 3d.; making the total value £8,215 0s. 3d., as against £9,798 11s. 6d., which shows a falling-off last year to the extent of £1,583 11s. 3d. The cost of maintenance for the year was £5,433 17s. 4d., as against £6,169 10s. 4d. for the former year; thus showing a decrease in the expenditure last year of £735 13s. The profits of last year would amount to £2,781 2s. 11d. if the value of the water given towards the construction of deviations and tail-races were taken into account, but if this value were deducted, there is only left a profit of £66 1s. 8d.; but, seeing that the value given away represents a certain amount of money, the larger amount has to be taken to give a clear idea of the value of the work.

The outstanding moneys at the end of the previous year amounted to £128 15s. 4d., and at the end of last year they amounted to £141 10s. 8d. The average number of men employed in claims which are worked with water from this supply last year was 266, or one man less than for the year previous. The approximate quantity of gold obtained from the claims worked with water from these races was 10,146oz., representing a value of £38,554 16s. If the value of the water used be deducted from this amount the total earnings of the miners employed are shown to be £30,339 15s. 9d., which is equal to about £113 18s. 11d. a man per annum, or about £2 4s. per week, as against £2 15s. 4d. for the former year. Taking the total cost of the construction of the works, which was £173, and the profit on the working last year, it is equal to about 1⅔ per cent.

In concluding my remarks on the different water-races and sludge-channels which are in connection with this work, it is only fair to the manager to state that he has displayed considerable ability and energy in effecting the repairs and in combating with the different obstacles he had to encounter in connection with the sludge-channel, and in carrying on the work in the different deviations.

Nelson Creek Water-race.

The maintenance of this water-race is becoming so expensive in keeping up the bridges and flumes that it is now impossible to do this from the revenue arising from sales of water. The principal bridges are now in such a decayed condition that some of them may collapse any day. To renew these bridges would entail an expenditure of about £25,000, and the present prospects of the future sales of water do not warrant any such outlay. Most of the known auriferous drift-terraces are washed away, and, unless water were required to work the flat, beds of the gullies, and also the bed of Nelson Creek on the hydraulic elevating principle, there is no prospect of being able to sell sufficient water to cover the cost of maintenance.

The length of bridges and flumes on the main race is 1 mile 17 chains, and a large number of the bridges have long spans, varying from 40ft. to 150ft. These bridges have been erected for over fourteen years, and, although some of them are strengthened and repaired, and may be expected to be good for another two years, they are so much decayed that they may collapse any day, and if such an accident were to take place it would be much cheaper to substitute iron piping as siphons across the gorges and gullies. There are likewise seven flumes and bridges on the branch race, of an aggregate length of 9 chains 10 links. One of these bridges has been down for two years, so that no water can be supplied from the branch race. If there were sufficient ground proved payable for working near the lower end of the race—such as the valley and bed of Nelson Creek—to justify the race being put in good repair, the whole of the water should be brought down the branch race, and conveyed across the valley of Gow's Creek by a wrought-iron siphon to join the main race at 10 miles 6 chains. This would cut off that portion of the main race from the 6-mile peg to 10 mile 6 chains, and shorten the distance 1 mile 68 chains; it would also cut off 32 chains of the worst bridges and flumes on the race. The cost of substituting siphons for all the remaining bridges, including the branch race and siphon across the valley of Gow's Creek, would be about £13,000.

This work up to the present time has cost in round numbers £90,723, and during the twelve years that water has been sold to the miners the sales of water have amounted to £16,766 15s. 7d., and the expenditure on maintenance for the same period to £14,183 0s. 7d., thus leaving a balance of profit on the workings of £2,583 15s. The approximate quantity and value of gold extracted by means of this water-race is 31,733oz., of a value of £121,143. The amount of revenue in the shape of gold duty that the water has been the means of getting is £3,173 6s.; adding this to the net profits on working, it amounts to £5,757 1s.; while the approximate total value of the gold obtained is

only £30,656 more than the cost of the construction of the work. It is possible that the bridges may be kept up another year, or even two, by incurring a heavy expenditure on maintenance, but it is evident that before long either the wooden structures will have to be renewed or siphons substituted in lieu thereof, or else the whole must be allowed to collapse. It is therefore a question which requires mature consideration, and also minute examination of the locality as to whether there is sufficient auriferous ground left that is likely to prove payable for working to justify the large outlay. The dam and headworks are permanent structures, and the reservoir, which is Lake Hochstetter, is capable of supplying a hundred sluice-heads of water continually for at least four months without any supply coming into the reservoir.

The following table shows the results of the working of the water-race during last year:—

Month.	Sales of Water.	Expenditure.	Number of Men employed.	Approximate Amount of Gold obtained.	Value of Gold.
1889.	£ s. d.	£ s. d.		Oz.	£ s. d.
April	39 12 6	71 12 0	29	75	286 17 6
May	44 5 0	77 19 0	30	84	321 6 0
June	73 11 8	71 18 0	31	98	374 17 0
July	70 17 6	77 18 0	31	92	351 18 0
August	24 0 0	77 17 0	27	49	187 8 6
September	15 5 0	73 15 0	19	13	49 14 6
October	63 10 0	77 14 0	25	66	252 9 0
November	34 3 4	79 2 3	20	51	195 1 6
December	24 3 4	75 8 0	23	57	218 0 6
1890.					
January	31 8 4	90 10 1	26	70	267 15 0
February	60 18 4	68 17 0	32	97	371 0 6
March	48 3 4	75 0 0	31	94	359 11 0
Totals	529 18 4	917 10 4	324*	846	3,235 19 0

* The average number of men employed being 27.

This table shows the receipts from sales of water to be £529 18s. 4d., whereas the receipts for the previous year were £427 11s. 8d.; this shows an increase of £102 6s. 8d., but in reality there is no increase, the difference in the receipts of the two years being due to a break in the water-race during the first year, which necessitated a new deviation being constructed, so that the year's receipts were only for ten months' sales of water. The expenditure on maintenance last year was £917 10s. 4d., as against £994 15s. 3d. for the year previous. This is very satisfactory, inasmuch as the wooden structures on the race are gradually becoming more decayed every year, and necessitate more repairs; nevertheless, there is a decrease in the expenditure last year of £77 4s. 11d., but it still leaves a loss on working for the year of £387 12s.

The value of free water given to open out claims last year was £128 15s., as against £172 19s. 2d. for the previous year. The average number of men at work in claims supplied with water from this race is twenty-seven, and the approximate amount of gold obtained by them was 840oz., representing a value of £3,235 19s. After deducting the value of water sold from the total value of the gold, the average earnings of the miners would be about £1 18s. 6d. a man per week, as against £2 0s. 5d. for the previous year, thus showing the ground is every year getting less remunerative for working.

Argyle Water-race.

The revenue derived from sales of water from this water-race last year was not sufficient to cover the cost of maintenance, owing to the very dry season, which caused a scarcity in the supply of water. There are no permanent streams coming into the reservoir—the supply has to entirely depend on catch-water; therefore in a dry season such as was experienced last summer the supply soon becomes exhausted. There are only two sources from which a permanent supply could be obtained—namely, from the Nile River and from the Four-mile Creek.

A survey was made some twelve or fourteen years ago by the Public Works Department of a water-race from the Four-mile Creek, which is about 6 miles 26 chains in length, and at that time the estimated cost of construction and of raising the Argyle Dam was £13,400; but since then the dam has been raised, so that the cost of the water-race might be set down at from £8,000 to £9,000. The sales of water are, however, so low that there is no encouragement to make further expenditure on this work at the present time. The ground the race commands in the vicinity of Candlelight Flat is getting worked out, and, indeed, so is most of the ground along the race until it crosses Ballarat Creek. There is a considerable area yet to be worked about Sardine Terrace and the Back Lead, and also on the flat between this and Charleston; but it is questionable if the whole of this could be made payable for working even by the most improved methods. There is no doubt but that the beds of some of the gullies and creeks will pay for working on the hydraulic elevating system. One party, Weir Brothers, have been working a claim in the bed of Ballarat Creek by elevating the material, and this is said to be paying very well. A great deal of the auriferous ground in this locality is of hard cemented sand, which cannot with the head of water available be broken up sufficiently to liberate the particles of gold it contains. Solutions containing iron have cemented the sand to such an extent that it comes out in large blocks of ferruginous brown soft sandstone. Three parties of miners have erected crushing-batteries of four heads of stamps each to work this cement, and it is said that their ventures are likely to be remunerative.

The main water-race is in good order, but the siphon across Ballarat Creek continues to give a good deal of trouble by bursting occasionally. The construction of this portion was done under the superintendence of the County Council, and the result is that the pipes comprising the siphon, although of the thickness specified, were very badly constructed, and the material was not of the

best description. There is a good deal of fluming and boxing on the supply-races which has recently been partially renewed, so that they are now in a very fair state of repair.

The following table will show the value of the sales of water, the expenditure on maintenance, the number of men employed in claims worked with water from this supply, and the approximate quantity and value of gold obtained, for the year ending the 31st March, 1890:—

Month.	Sales of Water.	Expenditure.	Number of Men employed.	Approximate Amount of Gold obtained.	Value of Gold.
1889.	£ s. d.	£ s. d.		Oz.	£ s. d.
April	35 8 8	29 18 0	15	35	134 5 0
May	29 3 1	32 8 0	17	30	115 10 0
June	30 19 8	32 2 6	16	32	123 4 0
July	24 0 10	67 6 7	20	31	119 7 0
August	15 12 3	31 1 0	11	16	61 12 0
September	42 14 11	28 15 0	23	100	385 0 0
October	73 3 3	34 0 11	22	80	308 0 0
November	20 17 0	38 11 1	15	35	134 0 0
December	Nil	34 8 0	Nil	Nil	Nil
1890.					
January	46 15 8	31 1 0	22	50	192 10 0
February	7 15 6	32 12 0	20	12	46 4 0
March	Nil	31 4 0	Nil	Nil	Nil
Totals	326 10 10	423 8 1	181	421	1,619 12 0

It will be seen from the foregoing statement that the value of the sales of water for last year was £326 10s. 10d., as against £497 5s. 2d. for the former year, which shows a falling-off in the sales of £170 14s. 4d.: this is no doubt attributable in a great measure to the very dry season and the scarcity of water. The expenditure on maintenance for the past year has been £423 8s. 1d., as against £396 19s. 10d. for the year previous; thus showing an increase in the expenditure last year of £26 8s. 3d., while the direct loss on the working amounts to £160 14s. 4d. The average number of men employed in claims worked with water from this race for the ten months that water was available was eighteen, and the approximate quantity of gold obtained by them was 421oz., representing a value of £1,619 12s. Deducting from this amount the value of the sales of water, the average earnings of the men employed will be about £71 16s. 9d. each man for the ten months they were at work, or about £1 13s. 4d. per week, which is 3s. 3d. per week less than the previous year.

Mikonui Water-race.

The constructed portion of the Mikonui Water-race is still leased to the Mont d'Or Company at an annual rental of £50 per annum. The cost of construction up to the present time is £25,644 9s. 6d., and to complete this supply would require an additional £60,000; but at present the prospect of sales of water in this district does not warrant any further expenditure being made.

Mount Ida Water-race.

The extraordinarily dry season last year has added considerably to the loss in working this water-race. There is always a certain period in midwinter when the miners cannot work for frost; and when the summer is dry and there is not sufficient water to work the claims on the field it does not give the miners an opportunity of making wages. The Trust which manages this water-race state explicitly that it is impossible to make it pay unless there is a larger supply of water, and they are urging on the Government the necessity of constructing the Eweburn Reservoir, as this work was always included as portion of the construction. The known auriferous ground that the race commands in the immediate vicinity of Naseby is getting well worked out. The ground that the Trust looks forward to being worked is in the vicinity of Spec Gully, and between this gully and the Kyeburn Diggings; but even this does not hold out much prospect that the construction of the reservoir would be a remunerative work.

The following is a statement showing the results of working this water-race for the year ending the 31st December last:—

Months.	Sales of Water.	Cash received for Sales of Water.	Expenditure.	Amount of Outstanding Money at End of each Month.	Number of Men employed.	Approximate Amount of Gold obtained, in Ounces.	Value of Gold.
	£ s. d.	£ s. d.	£ s. d.			Oz.	£ s. d.
January, 1889 ..	37 10 5	116 1 1	85 13 2	No monthly record kept. The outstanding accounts on the 31st December, 1888, amounted to £1,330 12s. 10d., and on the 31st December, 1889, to £1,346 4s. 1d. £1,000 of this amount is reckoned bad, having accumulated during the last thirteen 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, „ ..	29 7 9	70 10 3	123 3 8			180	675 0 0
March, „ ..	47 3 8	87 19 8	114 5 8			110	412 10 0
April, „ ..	96 10 2	110 13 0	75 1 8			170	637 10 0
May, „ ..	91 8 6	37 5 0	88 10 8			200	750 0 0
June, „ ..	16 10 6	42 10 0	75 8 2			100	375 0 0
July, „ ..	..	..	40 13 6			..	..
August, „ ..	12 1 10	13 1 6	56 8 4			20	75 0 0
September, „ ..	47 16 4	42 7 1	187 14 8			300	1,125 0 0
October, „ ..	170 5 9	6 11 8	76 17 8			300	1,125 0 0
November, „ ..	160 4 3	127 18 1	87 4 9			250	937 10 0
December, „ ..	92 1 10	130 12 5	78 6 9			370	1,387 10 0
Totals	801 1 0	785 9 9	1,089 2 8			2,250	8,437 10 0

This shows that the sales of water last year amounted to £801 1s., while those for the preceding year were £1,099 18s. 3d.; thus showing a decrease in the sales last year to the extent of £298 17s. 3d. The expenditure last year was £1,089 2s. 8d., while for the previous year it amounted to £1,687 15s. 6d. The actual loss on the working of this water-race last year amounted to £288 1s. 8d.

There is always a large sum of money in outstanding accounts at the end of each year, and there does not seem to be an effort made to reduce them. The outstanding accounts at the end of last year amounted to £1,346 4s. 1d., while at the end of the previous year the amount was £1,315 15s. 11d. The average number of men to whom this water-supply is the means of giving employment when water is available is 130, and the approximate quantity of gold obtained by them last year was 2,250oz., representing a value of £8,437 10s. After deducting the value of the sales of water from the value of the gold obtained the average annual earnings of the miners will be about £58 14s. 10d. a man, or about 7s. 8d. per week less than last year. The total cost of the work is £65,766 3s. 8d.

Summary of Water-races.

In considering the collateral advantages in working these water-races, the duty paid on gold has to be added to the direct profits of working, as these water-races have been the means of this revenue accruing. In dealing, therefore, with the direct profits, the value of the duty paid on gold is included, and the results of working are shown on this basis in the following table:—

Statement showing the Profits and Losses on the Working of the Water-races for Twelve 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 Profits or Losses, with Value of Gold Duty added.	Total Cost of Construction.
	£ s. d.	£ s. d.	£ s. d.		Oz.	£ s. d.	£ s.	£ s. d.	£ s. d.
Waimea-Kumara Water-race and Sludge-channel.									
Eleven years ending the 31st March, 1889	93,536 5 7	63,457 9 7	30,078 16 0	405	184,127	685,774 19 3	..	..	..
Year ending 31st March, 1890	8,215 0 3	5,433 17 4	2,781 2 11	266	10,146	38,554 16 0	..	..	..
Total	101,751 5 10	68,991 6 11	32,859 18 11	393	194,273	724,329 15 3	19,427 6	52,287 4 11	173,647 7 1
Nelson Creek.									
Eleven years ending the 31st March, 1889	16,263 17 3	13,265 10 7	2,998 6 8	56	30,887	118,142 15 6	..	..	..
Year ending 31st March, 1890	529 18 4	917 10 4	*387 12 0	27	846	3,235 19 0	..	..	..
Total	16,793 15 7	14,183 0 11	2,610 14 8	53	31,733	121,378 14 6	3,173 6	5,784 0 8	90,722 10 8
Argyle.									
Eleven years ending the 31st March, 1889	4,962 5 2	4,396 1 0	566 4 2	17	7,356	28,029 9 0	..	..	..
Year ending 31st March, 1890	326 10 10	423 8 1	*96 17 3	18	421	1,619 12 0	..	..	..
Total	5,288 16 0	4,819 9 1	469 6 11	17	7,757	29,649 1 0	775 14	1,245 0 11	14,701 15 3
Mount Ida.									
Eleven years ending the 31st March, 1889	15,915 7 2	19,112 9 0	*3,197 1 10	99	27,011	102,368 0 0	..	..	..
Year ending 31st March, 1890	801 1 0	1,089 2 8	*288 1 3	130	2,250	8,437 10 0	..	..	..
Total	16,716 8 2	20,201 11 8	3,485 3 1	101	29,261	110,805 10 0	2,926 2	*559 1 1	65,766 3 8
Grand Totals ..	140,550 5 7	108,195 8 7	39,425 3 7	564	263,024	986,163 0 9	26,302 8	58,757 5 5	344,837 16 8

* Shows a loss on the working.

The foregoing statement shows that the total cost of constructing these works was £344,837 16s. 8d., and also that during the twelve years they have been in operation the total profits on the working amounts to £58,757 5s. 5d. Taking the profits last year on the working, there is only one of these works which has paid for the expenditure of keeping it in repair—namely, the Waimea-Kumara, and that work paid about 2⅛ per cent. on the cost of construction.

QUARTZ-MINING.

Puhipuhi District.

This field is situate about twenty-two miles from Whangarei, and sixteen miles from Kawakawa, and is about ten miles eastward from the main Whangarei–Kawakawa Road at Hikerenui. The present track to the field leaves the main road near Mr. Rasmussen's store, going past Mr. Garsted's homestead, and following the valley of the Waiotu Creek to Mr. Parsons's homestead; thence through the Puhipuhi State Forest to near the head of the Tangiapakura Creek, where the prospectors' claim is situated.

A discovery of auriferous and argentiferous quartz lodes was made in this locality in October, 1888, by two brothers, William and Charles Wilson, and J. D. Collins, who were engaged at that time gum-digging. This party got Mr. John Connyngham, a storekeeper at Whangarei, to take out a prospecting-license, when John Fraser, C. E. Smith, and George Walker joined them to prospect the lodes which they had found. Up to October last very little was done to test the lodes beyond scratching the caps of the reefs and forwarding samples for assay. The first lodes discovered are situated alongside a small branch of the Tangiapakura Creek, about 12 chains above its junction with the main creek. The cap of one of these lodes is exposed in the bed of the small stream—it shows about 8ft. in width, and is running in a north-west and south-east direction. The quartz is of a bluish-white appearance, with small streaks resembling silver-glance. A small parcel of 210lb. of stone from the cap of this lode was forwarded to Messrs. Fraser and Sons, of Auckland, and tested in the ordinary way in their pans, and gave bullion—principally silver—at the rate of 18s. 6d. per ton of ore. Another sample of 460lb. of stone was taken from what is termed the Black Reef, which runs parallel with the other and about 3 chains further to the northward. This lode is from 2ft. to 3ft. in thickness, and contains a good deal of the oxides of iron and manganese mixed amongst the quartz, and presents the appearance of a lode where iron-pyrites has become decomposed. This sample was also tested by Messrs. Fraser and Sons, and gave bullion—principally gold—at the rate of £1 6s. per ton.

Since the discovery of the two first lodes six other reefs have been discovered in the prospectors' ground, and in two of them—the Silver Reef and Wilson's Reef—there were fair samples of pyrargyrite and proustite (ruby silver). Mr. Whitaker, of the Bank of New Zealand, Auckland, got as high assays from Wilson's Reef as 8oz. of gold and 254oz. of silver to the ton, and Mr. Burns, of the same bank, made assays from stone found outside the prospectors' claim, which gave the following results:—

No. 1 sample—19dwt. 14gr. gold and 8oz. 3dwt. silver per ton.

No. 2 sample—16dwt. 8gr. gold and 23oz. 16dwt. silver per ton.

No. 3 sample—4oz. gold and 53oz. silver per ton.

At the time of my last visit to this field the prospectors had sunk a winze on the Silver Reef to the depth of 8ft. The lode at this depth was about 2ft. 9in. in width, and showed a little ruby silver disseminated through the stone for the whole width of the lode. An adit was commenced at the creek-level, and at the time of my visit in January was constructed for 60ft., but about 200ft. further had to be driven before they expected to cut the lode. When this adit is completed it will give 100ft. of backs. The construction of this adit was at that time the only legitimate prospecting work that had been done as regards testing the value of the lodes at a reasonable depth below the surface. Wilson's Reef is situate alongside the main branch of the Tangiapakura Creek. It is about 18in. in thickness, but there has been no work done on it to test its value beyond breaking out a little of the lode-stuff near the outcrop. Mr. G. Wilson, Inspector of Mines, Thames, inspected this field in December, and took what he considered average samples from the different reefs then discovered, and had these samples assayed by Mr. C. Rodes, of the Bank of New Zealand, Paeroa, with the following results:—

No. of Sample.	Description of Reefs, &c.					Value per Ton of 2,240lb.		
	Name of Reef.	Thickness.	Course.	Underlie.	Remarks.	Gold.	Silver.	Value.
		Ft. in.				Oz. d. g.	Oz. d. g.	£ s. d.
1	Black Reef ..	1 9	N.–S.	1½ to 1 E.	Brown oxidized quartz	Trace	Trace	Nil
2	Wilson's Reef ..	1 6	N.–S.	Slightly to W.	Reef hanging on wall of precipice ..	0 1 15	7 8 5	1 8 10
18	" ..	..	..	..	Quartz, very hard, from two places ..	Trace	4 11 11	0 13 10
..	Silver Reef ..	2 0	N.–S.	1 in 3 E.	Hard whitish ore, with bluish streaks of sulphide, and probably antimonide of silver	..	..	..
3	" ..	2 0	..	..	Sample from northern workings, rubble	Trace	1 12 6	0 5 0
3	" ..	..	..	..	Sample from solid stone	0 2 0	21 9 4	3 12 6
6	" ..	2 6	..	..	Sample from middle workings, face ..	0 3 6	32 10 2	5 10 8
14	" ..	..	..	..	Sample taken from paddock ..	Trace	5 11 1	0 16 10
15	" ..	2 0	..	..	Sample from southern end of paddock	0 1 15	21 9 13	3 11 0
16	" ..	..	..	..	Selected ore, picked by prospectors ..	0 1 15	97 18 9	15 0 6
13	Mary Reef ..	2 6	N.–S.	1 in 2 E.	Hard whitish quartz, rubbly ..	0 1 15	8 14 18	1 12 10
5	Fraser's Reef ..	1 4	N.W.	1 in 3 E.	.. ..	0 1 15	8 18 1	1 13 6
12	Ditto, No. 2 ..	1 0	N.W.	1 in 3 E.	.. ..	Trace	2 12 6	0 8 0
4	Nickel Reef ..	1 0	N.–S.	Slightly to W.	Very hard agatised laminated quartz	Trace	0 16 8	0 2 8
7	Snowdrift Reef ..	2 6	N.N.W.	1 in 3 W.	White mullocky soft quartz	Trace	0 16 8	0 2 8
10	Blue Reef ..	6 0	N.W.	1 in 1 N.E.	Quartz brown and flinty, also white mixed with blue streaks	Nil	Nil	Nil
11	Barton Reef ..	1 0	N.N.W.	1 in 3 W.	.. ..	Trace	4 18 0	0 7 0
9	Connyngham Reef	1 0	N.–S.	1 in 3 E.	South-west corner of ground, hard white quartz	Trace	1 15 22	0 5 6
9A	Easterbrook Reef	5 0	N.N.W.	Slightly to E.	Brown oxidized quartz	Trace	0 9 19	0 1 6
8	Christie Reef ..	1 0	E.–W.	Vertical	Has hard bluish slate walls	Nil	Nil	Nil
8A	Ditto, No. 2 ..	3 0	N.W.	1 in 3 E.	.. ..	Trace	0 6 12	0 1 0

A sample from Mr. Connyngham, from lode in most northern portion of Puhipuhi State Forest, contained neither gold nor silver.

These sample assays, with the exception of one which was made from stone selected by the prospectors, do not appear to show that the lodes are payable for working, but they prove that auriferous and argentiferous lodes exist, and, moreover, hold out inducement for further prospecting. On my recent visit to this field in January last the prospects of the place had considerably improved. A number of new lodes had been discovered, some of these showing ruby silver, which was not found on my former visit. The whole of the assays, however, show that there is very little gold in the lodes, and that silver will be the main product to be looked for. The following assays were made at the Colonial Laboratory from samples of ore selected by me promiscuously out of different reefs—namely:—

No. 1 sample, Kaimanaku Creek—Stibnite found, but no silver.
No. 2 sample, Mary's Reef—Traces of bullion.
No. 3 sample, Blue Reef—Bullion, 5oz. 0dwt. 20gr.
No. 4 sample, Wilson's Reef—Bullion, 107oz. 18dwt.
No. 5 sample, Silver Reef—Bullion, 102oz. 19dwt. 7gr.

Samples of the same stone were handed by me to Mr. Park, of the School of Mines, Thames, who assayed them and got somewhat similar results. According to some of the assays made from stone forwarded by the prospectors and others from the field, very high results have been obtained; but it is well known that it is very seldom that a stone is selected from new discoveries for assay unless it has the appearance of containing metallic substance, and the piece operated on is so small that unless great care is taken in selecting average samples for assay it gives very little criterion as to the value of the lode. Where assays have to be made to ascertain the value of the ore, a hundred or more samples are taken and all mixed up together. They are then divided and redivided until the quantity left is only sufficient for assay purposes. But, even when an average assay has been made, although it will give the assay-value per ton, the question of getting a fair percentage of the value of such assay when the ore is treated in bulk is a matter which remains yet to be decided.

These auriferous and argentiferous lodes have been discovered within the boundary of a State forest where it is estimated that there is 129,000,000ft. of valuable kauri timber standing, and where regulations have been made for gum-digging being carried on within its boundaries which prohibit any person being in the forest during the six summer months, so as to guard against the forest being set on fire. These regulations caused heartburnings amongst those who were prospecting for gold and silver, as it prohibited them from working during the best season of the year. After repeated applications for mining leases, and urgent protestations of the people of the district against the closing of the forest during the summer months, the Government proclaimed the district a goldfield on the 6th March last.

It is yet premature to say whether the field will become a payable one for working or not. There are a large number of quartz lodes in the Puhipuhi Forest, and between it and Cape Brett, but there is not sufficient work done to prove whether any of these lodes will be payable for working. The distance of the field from any place where reduction-plants are erected retards its rapid development, and will lead to reduction-works being erected near the vicinity of the mining operations. When once this is done the question of the permanency of the field will soon be decided.

One of the most important questions in connection with this field is the erection of a suitable plant for the proper treatment of the ore. If the ore were in the form of chloride it would be easily dealt with, but when the silver occurs in sulphides a chloridizing process will have to be adopted. A somewhat similar character of ore is found in the Owhyhee District, Idaho, on the Pacific Slope. The process adopted there for the treatment of the ore is what is known as the Washoe process; but if the ore contains a very large percentage of sulphides it would have to be crushed dry and roasted with a little salt, to chloridize the metal, before putting it in the pans, as it is almost impossible to get the sulphide of silver to settle in tanks such as are used in the Washoe process, the sulphur being so light a metal and having so great an affinity for other metals that it is carried away by the water. It may, however, be of some benefit to the proprietors of mines in the Puhipuhi district to briefly describe the Washoe process.

Washoe Process.

This process is somewhat similar to that which was used by Mr. Railey at Karangahake. The ore as it comes from the mine is first put through rock-breakers with the jaws set very close, so as to break up the ore as fine as possible. From the rock-breaker the ore is fed into a stamp-battery having screens from thirty- to forty-mesh, according to the character of the ore. No more water is used in the stamp-mortar than is actually necessary to keep the screens clear. As the pulverised ore comes from the mortar it falls into a launder, which conveys it to a series of settling-tanks, with the water flowing through them, and on the first one becoming full of crushed pulp it is shut off and emptied. These tanks or vats are placed in front of the stamp-battery, and are so arranged that the waste water has to pass through the whole series before getting away. Each tank, as it is filled, becomes the final one of the series, and as soon as emptied receives all the muddy and partly-clarified water after passing through the other vats.

From these vats the pulp is removed, and taken to the grinding and amalgamating pans. These pans are of different designs, according to the ideas of the millmen who use them, but the principal pans used are the Wheeler, the Wheeler and Randall's, the Varney, Hepburn and Peterson's, McCon's, Horn's, and Fountain's combination pan. The quantity of ore with which the pans are charged depends on their size, and varies from 600lb. to 5,000lb., but the ordinary charge in the pans most generally in use is from 1,500lb. to 2,500lb. In charging the pans the muller is raised a little from the bottom, so as to revolve freely at first. Water is supplied by a hose-pipe, and at the same

time sand is thrown into the pan with a shovel. Steam is either admitted into the steam-chamber below the pans or directly into the pulp; some pans are covered to assist in retaining the heat. When properly managed the temperature may be kept up to 200° Fahrenheit. The exhaust steam from an engine should never be admitted directly into the pulp, on account of it being charged to some extent with oil, which is highly injurious to amalgamation. The muller is gradually lowered after the commencement of the grinding operation, and is allowed to make from sixty to seventy revolutions per minute, and the grinding operation is continued for about two hours, after which the muller is raised and quicksilver is added. The quantity of quicksilver used for a charge of 1,500lb. of ore varies, according to the ideas of different millmen, from 200lb. to 250lb. When the quicksilver has been added the muller is again set in motion, and kept revolving for about two hours. It may be well to add that in about half an hour after charging the pans a quantity of salt and sulphate of copper is added—about 10lb. of the former and 2lb. of the latter, but this varies according to the character of the ore.

The muller is kept revolving for two hours after the quicksilver is added, after which the pulp is drawn off into a settler, and plenty of clean water is used to rinse out the pans previous to adding another charge. Generally two of these pans are discharged into one settler. When the charge is drawn off it should not fill the settler, but there should be plenty of room to allow a spray of clean water to fall into the settler like a shower of rain. The arms of the settler are kept revolving slowly for about four hours, and the water is gradually drained off the settler from the upper discharge, until at last the quicksilver and amalgam are drained off, and the residue in the settler is drained into an agitator having a constant stream of water flowing into it.

The diluted pulp from the agitators is sometimes siphoned off into concentrators, and after the pulp and slimes leave the concentrator the tailings are run over a great length of blanket-sluices from 200ft. to 300ft. long. These blanket-sluices are washed about once a week, but only very little is saved on them.

There are, however, silver-ores found in Puhipuhi that are too rebellious to work by the Washoe: these will require to be roasted to drive away the sulphur, antimony, arsenic, and other volatile products. The dry process was first practised in Washoe on rich ores, when they were crushed dry and roasted with a little salt in reverberatory furnaces, and afterwards treated by the Freiberg barrel-amalgamation.

In roasting these ores they are at first subjected to a very dull heat, when the sulphur takes fire, and goes off in sulphurous acid or oxidized sulphur during the first stage of roasting. Some of the oxidized sulphur will combine with other metals, which, under the influence of heat and air, have been converted into oxides, to form metal sulphates. The silver is also converted into a sulphate. Antimony and arsenic are oxidized, and pass into the flue or up the chimney; but certain proportions may combine with other metallic oxides and form antimoniates and arsenates. In the first stage of roasting, the oxygen in the air plays an important part. Dead roasting is scarcely necessary with silver-ores. In the next stage the ore is mixed with a certain proportion of salt and subjected to a greater heat, when the remaining sulphur in the sulphates combines with the salt, and chlorine is liberated, and the silver-sulphates will be converted into silver-chlorides, and will be in the best condition for amalgamation.

Coromandel District.

The yield of gold from this district last year is not so large as for the former one; nevertheless mining ventures on the whole present a more healthy aspect than they have presented for some years. This is in a great measure due to the introduction of English capital, which has been expended on mines with the view of working them on a commercial basis. This is a district which is remarkable for rich auriferous veins, leaders, and lodes; at the same time it may be termed very patchy. A rich block of stone may be found, and very rich specimens obtained, but it is very seldom that the run of gold continues for any great distance. A block of good stone, and rich veins and leaders, may be found almost in any place; but there is nothing regular—it may cut out any day. Still, it is many times found again as suddenly as it cut out. It is a field that is likely to afford profitable employment to individual miners in the high ranges for many years to come—at least, for the present generation.

Tokatea Range.—This range has been worked on since 1862, and exceedingly rich patches of gold-bearing stone have from time to time been found. Claims have been repeatedly given up as worked out, and other parties have again taken them up and done remarkably well. The same thing takes place yet. Men may work for a few months and get nothing, and leave the ground, and another party take it up and get well paid for their labour. The whole of this range is a network of stringers and leaders running in every direction, and, although the range is completely burrowed with adits and drives, it still continues to give good results for working. The miners are now quite accustomed to this system of following the small thread-like veins of quartz, which occasionally widen out to two and three inches thick, and generally where this takes place rich stone is found. There is no other place in the colony where quartz-mining can be carried on with more success by individual miners than on the Tokatea Range. They have not a large output, and do not require expensive crushing-plant. If they get three or four tons of quartz during the year, it pays them for their labour. If the quartz does not yield 10oz. of gold per ton it is considered poor stone. It is a question well worth considering whether this range would not pay for quarrying it in a face and transmitting the material by tramways to the flat, and putting it through a crushing-plant erected on the most approved principle. At present there is not a plant on the field that extracts anything like a fair percentage of the gold. Indeed, except in the case of very rich specimen-stone, it is questionable if 60 per cent. of the gold is obtained.

The following statement will show the quantity of quartz crushed from some of the claims on the range during the past year, and the yield of gold therefrom:—

Name of Claim.	Quartz crushed.		Yield of Gold.	Average Number of Men employed in Claim.
	Lb.	Tons.	Oz.	
Tokatea	...	233½	433	16
Queen of the North	...	20	132	6
Royal Oak	300*	7	1,029	12
Bachelor's	...	2½	52	2
Rob Roy	...	3	25	2
Bismarck	...	2½	160	6
West Tokatea	...	4	45	2
Total	300	272½	1,876	46

* Specimens.

This shows the average yield of gold out of the quartz crushed from those claims to be equal to a little over 7oz. 17dwt. per ton, or nearly 40oz. 16dwt. of gold per man for the number employed. There are several other claims on this range from which no returns have been obtained, and probably these did not turn out much gold; but the above statement is sufficient to show that the range is still worth working.

West Tokatea Company.—This company holds one of the claims mentioned in the foregoing statement. It is formed with English capital, and before going to any expense in erecting machinery it is their intention to construct several adit-levels and test the ground, especially the main Tokatea Reef, which runs through their claim. This reef is known to be auriferous, but the quartz that has hitherto been tested has proved to be of very low grade; still, there is a great thickness of stone, and probably the lode will yet be proved payable for working with a large and efficient crushing-plant on the ground. It is only by carrying on mining in this manner, and prospecting the ground thoroughly before going to any expense in erecting expensive machinery, that mining ventures are likely to prove remunerative investments.

Kapanga Company.—This company holds a claim comprising 60 acres. It is formed entirely with English capital, and the mine is worked on purely a commercial basis. No expense has been spared in putting the mine and plant in thorough working-order, while rigid economy is observed in carrying on their operations. If the venture does not recoup the shareholders for the capital invested, they will at least have the satisfaction of knowing that their money has not been unnecessarily expended. At the time of my visit, in December last, 3,000 tons of quartz had been crushed since this company commenced operations, which yielded 7,223oz. of gold, representing a value of £21,239; and for the twelve months ending the 24th of November last 2,291 tons of quartz had been crushed, which yielded 5,422oz. of gold, representing a value of £15,959. This shows that only 1,801oz. of gold was obtained by the company prior to the 24th November, 1888. In addition to the yield of gold mentioned, 40lb. of specimen-stone was obtained from Scotty's Lode, which was valued by the assayer of the Bank of New Zealand at Auckland at £400. These specimens were sent to the Melbourne Exhibition, and afterwards exhibited at Paris. Taking the last general annual balance-sheet of the company, their receipts from gold obtained amounted to £12,286, and their expenditure on mine and plant to £10,630; thus leaving a profit on the workings of £1,656. For the twelve months ending the 31st March last they crushed 1,334 tons of quartz, which yielded 3,153oz. of gold, representing a value of £9,065. This would show that the return has of late been falling off.

The principal workings are on Scotty's Lode, which is about 2ft. in thickness. These have been carried on from the 225ft., 300ft., 340ft., 420ft., and 500ft. levels respectively. The run or shot of gold on this lode is from 75ft. to 80ft. in length. The main shaft at the time of my visit was down to a depth of 540ft., and up to the end of March last it was down to a depth of 565ft., and they intend to carry on sinking until a depth of 600ft. is reached. There has been an average number of seventy men employed in the mine and about the works.

There is not a great deal of water in this mine. The plungers, which are 12in. in diameter in the upper lifts and 9in. in diameter at the bottom, are sufficient to keep the water down, working with a 6ft. stroke, and making 3¾ strokes per minute. The crushing-plant is one of the very old type, and does not do the same duty that a more modern plant would, nor is it one that is likely to save a large percentage of the gold. However, this is a subject on which there is still a great deal to earn. The loss of gold through defective crushing-plants is something almost incredible; but more attention is now being directed to remedy this evil.

Coromandel Company.—This company is formed principally with English capital, and is under the same management as the Kapanga Company. It holds the same ground that was formerly held by the Union Beach Company, comprising an area of about thirty-nine acres. At the time this company purchased the property, about two years ago, there was a shaft down to a depth of 180ft., and three lodes stoped out in places from this level to near the surface. A winze was also sunk on one of the lodes for 60ft. below the 180ft. level, and some stoping done; but the water was too much for the pump then used to lift.

This company have sunk a new shaft on the face of the terrace, about 300ft. distant from the old shaft, and it is down 100ft. below the 180ft. level. The old shaft was sunk on the ocean-beach, alongside the edge of the water, and the distance to drive levels from this shaft at a greater depth was so great that it was less expensive to sink a new shaft; besides, the old one was too small for pumping and winding. They have also erected a direct-acting Cornish beam steam-engine, with a

40in. cylinder and 9ft. stroke, to do the pumping. The old pump formerly used, which was 9in. in diameter, was taken out and replaced with a 12in. plunger-pump, and the 9in. lift placed in the new shaft to lift the water from the bottom up to the 180ft. level. These pumps, working three strokes per minute, are now sufficient to drain the mine. Since the new pumping-engine has been erected the saving in fuel amounts to about 50 tons of coal per month, which means a saving of £600 per annum.

The two shafts are connected at the 180ft. level, and the water from the new shaft is led along this level in boxes to the old shaft. A commencement has been made to construct a level at 280ft. in the new shaft. It is expected to cut the Green Harp lode at about 25ft. in an eastward direction from the shaft, and the Black Reef at about 80ft. north, and after driving on this reef for 230ft. westward, the level will intersect the Cross Reef, which is a parallel one to the Green Harp. Taking the underlie of the lodes, this level will give about 120ft. of backs. Until these lodes are cut nothing can be said in regard to the future prospects of this mine. The average number of men employed has been about thirty.

The company had expended on the mine and plant at the time of my visit, including the machinery on the ground, about £19,000, the machinery costing about £10,000.

The management of the Kapanga and Coromandel Companies has been under Mr. Francis Hodge, who was sent out from England to take charge of these companies' works; and it may be said that he is the only one who has come out direct from the Home-country who has carried on quartz-workings in a systematic and successful manner. He has now resigned his charge and is returning to England, Mr. Argal having been appointed to fill his place.

South Kapanga Company.—A shaft was sunk down to a depth of about 100ft., and a level put in from the shaft for a considerable distance, some three years ago; but at that time the company was not successful in finding payable stone. Operations were suspended for a long time, but working has again been resumed. They are driving for Scotty's Lode, which is supposed to come through their ground, and occasionally get small blocks of auriferous stone; but so far the workings have not proved to be remunerative. There are ten men employed in the mine.

North Kapanga Company.—This company has a claim of 60 acres. They have six men employed prospecting for the same lode on which the Kapanga Company is getting gold; but so far have not been successful in finding any stone of a payable character for working.

In the Tiki, Matawai, and Manaia districts there has been very little work done. The most of those formerly employed here have left for the Kuaotuna field. Mr. Vizard, at Castle Rock, is still working his claim, and last year he got 100lb. of specimen-stone, which yielded 150oz. of gold.

Lanigan's Claim, Whangapoua.—A new discovery of an auriferous quartz was made last year on the Kauri Syndicate Company's property, near one of the branches of the Opitonui River, about four miles up from Whangapoua Harbour. The discovery was made in September last. The prospectors, Messrs. Lanigan and McIsaac, found quartz cropping out on the surface, and saw a little gold in the stone. They commenced and opened out a cut or trench on the lode, which is about 3ft. in thickness, and blotches of gold were seen in different parts of the lode. Thirty tons of quartz was taken out and forwarded to the Thames for treatment, which gave a return of 61oz. 3dwt. of gold. Since then an adit-level has been constructed, which cut the lode at 60ft. below the surface, where it is from 6ft. to 8ft. in thickness, and gold is seen in the lode. This is likely to prove a valuable discovery. The whole of the country between Matawai and Kuaotuna is less or more auriferous, and this claim lies at the back of Castle Rock and on the line or belt of country leading towards Kuaotuna. There is a good site for a crushing-battery on the side of the Opitonui River, where water can be got at a sufficient elevation to drive the machinery.

Kuaotuna.

This is an entirely new field, and one which promises to yield a large quantity of gold. There are numerous quartz lodes cropping out here and there, and prospecting has been carried on for a number of years within one mile of where the present workings are situate. On my visit to the Waitaia district about four years ago there were two men prospecting at the head of the Waitaia Creek, looking for a reef. The creek-bed had been worked in places and rich specimens had been found, evidently come from a reef. On ascertaining from these men the place where the gold was traced to the head of the gully, my impression then was that an auriferous lode would be found in the range on the opposite side of the creek to that on which they were working, as the gold seemed to have come from that direction; and apparently a payable auriferous lode has now been found within about a mile of where these prospectors were at work. Some of the claims promises to contain very rich stone, but the gold is of a fine character. In some of the lodes it appears in blotches here and there in the quartz, and in other lodes it is difficult to see a trace of gold without crushing the stone in a mortar and panning off the crushed material. A large number of claims have been taken up; but, as there is no crushing-plant erected on the field, very little of the stone has been tested. The land where the auriferous lodes have been discovered is partially Crown land, partially Native land — Kuaotuna Blocks Nos. 1B, 2, and 3—and partially freehold land, belonging to Mr. McPherson, of Mercury Bay.

Try Fluke Claim.—This is one of the richest claims yet discovered. The lode was first discovered cropping out on the surface. An adit-level has been constructed from the side of the range facing the Kuaotuna Creek, and has cut the lode, which is about 5ft. in width, and contains a large percentage of the oxides of manganese and iron. The quartz is very porous, containing numerous small disc-like cavities, with thin wafer-like silica walls between each cavity, presenting the appearance of sinter. There is very little gold to be seen in the stone; yet, when it is crushed in a mortar and panned off in a tin dish, a large prospect of gold is obtained. On my visit to this mine a piece of stone in which no gold was visible was pounded up in a mortar, and the pounded material panned off into a tin dish full of water, when a splendid prospect of very fine floury gold was obtained. The muddy water, but none of the crushed material, was then emptied into another

tin dish and mixed with clean water, and allowed to settle for a short time, and the sediment panned off a second time into a dishful of water, and nearly as much gold was obtained from the muddy water as that got in the first panning. The same operation was gone through four times, and still there was a fair prospect of gold left. The panning operation was carefully performed, and showed conclusively that the gold from this lode cannot be saved by the ordinary wet-crushing process. The gold is disseminated through the stone in the finest dust-like particles, and the muddy water will carry away more than half the gold the stone contains. It resembles the character of the gold found at Mount Morgan. The same obstacle was found there when crushing the quartz. According to the assay-value of the Mount Morgan stone, it contained over 10oz. of gold per ton; but not more than 2oz. of gold could be got by the ordinary battery process.

The manager of the Try Fluke claim informed me that a sample of the lode-stuff was tested by the Cassel Company, at Karangahake, and was shown to contain gold at the rate of 40oz. to the ton; but a trial of one small sample is no criterion of the average value of the lode. Thirty tons of lode-stuff was sent to the Thames for treatment, which yielded 351oz. of gold, being an average of 11oz. 14dwt. per ton; and there is little doubt that had the slimes and tailings been saved they contained far more gold than that obtained from the battery-tables. There is on every field a considerable loss of gold by its being carried away in muddy water, and not lodging amongst the tailings, and the loss of gold on this field will be very considerable if the ordinary process of wet crushing is resorted to. It is a field where the chlorination process could be successfully carried on, or, if the Cassel process can extract as large a percentage of the gold as it did in the ton samples tested at Karangahake, it would be the most economical method of saving the gold.

The proprietors of this claim have purchased a crushing-battery of ten heads of stamps, which formerly was erected at the Tiki, and are now erecting it on the side of the Kuaotuna Creek. It will be driven by steam-power. As soon as this plant is completed the other claims on the field will be able to get their stone tested, although it is questionable if such a plant will give a very high result. Still, if the quartz be rich in gold, the claimholders may be satisfied with the returns without taking the means of ascertaining the amount of gold lost.

Carbine Claim.—This claim adjoins the Try Fluke, and the adit-level, which has cut the lode, is close to the place where rich stone is being got in the latter claim. About 50ft. has been driven along the lode, which is about 4ft. in thickness, and 20 tons of stone have been crushed, which yielded nearly 22oz. of gold. This shows that, although they have got the same lode as the Try Fluke, they have not got the same shot of gold; and possibly the gold in the Try Fluke claim may not be carried to any great depth. However, nothing can be said in reference to this until more work is done.

The Mariposa, John Bull, Red Mercury, and Great Mercury claims are supposed to be on the Try Fluke line of reef; but some of these have more than one lode in which fair prospects of gold are got. The Great Mercury is known as the prospectors' claim: here a considerable amount of work has been done, and twelve different lodes and leaders have been found, varying from 6in. to 10ft. in thickness. Five hundredweight of quartz has been crushed from this claim, which yielded 11dwt. 9gr. of gold, which is equal to 2oz. 5dwt. 12gr. of gold to the ton.

Otama Claim.—This claim is on Native land, and lies to the westward of the Great Mercury. There are two quartz leaders in this claim—one 6in. and the other 15in. in width—from which 31 tons of quartz was forwarded to the Thames for treatment; and the result was 181oz. of gold, or nearly 6oz. of gold to the ton. A considerable amount of work has been done in this claim, where nine men are employed, and where there is a considerable stack of quartz at the mouth of the adit lying ready for treatment.

Waitaia Claim.—This is a claim on Mr. McPherson's land, near the place where prospecting was carried on for several years at the head of the Waitaia Creek, but this is on the opposite side of the range. There is a quartz lode cropping out here and there in the face of the range, from which some very fair specimen-stone has been got; but at the time of my visit they were prospecting on a narrow ridge, in a lode about 18in. in width, the quartz being to a certain extent mixed with mullock, but on breaking up the stone several large blotches of gold could be seen. There was not sufficient work done on this claim to prove whether the lode would be payable for working or not. Some of the owners accompanied me, and stated that they had found a lode 4ft. wide further along the range; but as it was nearly nightfall we had not time to visit these outcrops.

There are a number of other claims on this field which are referred to in Mr. Wilson's—the Inspector of Mines—report, and detail of workings given. Suffice it to say that there are numerous quartz reefs in this district which contain gold; but, as there is no crushing-plant on the field, very few of the claims are sufficiently tested. At the same time, the present indications lead one to suppose that rich patches of auriferous stone will be found, although possibly many of the present claims may be after a time abandoned. This is only what might be expected on any new field where claims are pegged off on supposed lines of reefs without any knowledge whether the lode continues through the ground or that it contains sufficient gold to pay for working.

A small township is being formed on Native land not far above the mouth of Kuaotuna Creek. There is a small bay here in which steamers can come and lie in good weather, and where the goods are landed on the ocean-beach. It is also from this place that the quartz is shipped to the Thames for treatment.

Mahakirau.

Auriferous-quartz leaders have been found on the range on the west side of the left branch of the Mahakirau River, going up the stream. The place where this discovery was made is twelve miles from Mercury Bay and five miles up the river, where the track leaves the main Coromandel–Mercury Bay Road. There were at the time of my visit three men employed in prospecting a leader which was in places not more than 3in. in thickness, but widens out in other places to nearly

2ft. When the leader was first found about 9cwt. of stone was sent to Coromandel for treatment, and yielded 89oz. of gold. Since then quartz has been taken out and stacked, and prospecting carried on. Several people have been prospecting in this range, but have so far failed to make any further discoveries. The country here is thickly timbered and very broken, and it is therefore difficult to carry on prospecting; but, now that it is known that auriferous quartz has been found, there is little doubt but that further discoveries of auriferous lodes will be made in this district.

Thames District.

The yield of gold from this district for the past year shows a slight decrease on the previous year's return. Although the mines on the whole look more promising, a great deal of dead-work has been done, and better appliances are being got, which will curtail the expenditure, or, at least, will be the means of the ore being brought to the crushing-plants at a cheaper rate. Two companies are erecting aerial tramways, and when once these are in use other companies will likely follow in their neighbours' footsteps. About two years ago great hopes were entertained with reference to the discovery of auriferous lodes at Mata Creek, but so far the golden anticipations have not been realised. The lodes are small and very patchy, and the value of work done in this portion of the district for the past year has not been recouped from the returns from the claims. There is still a small population at Tapu, but the yield of gold is very small. The reefs here are very patchy, and those patches containing rich auriferous stone are very small. There is, however, plenty of virgin ground on the Hauraki Peninsula that never has been prospected, and where possibly rich auriferous lodes are likely to be discovered. The whole of the peninsula is less or more auriferous, and the time will come when very low-grade material will be made to pay for working with improved appliances.

The following returns will show the quantity of mullock and quartz crushed from the principal claims in the Thames district, with the average number of men employed on wages, and also working the claims referred to on tribute:—

Name of Claim or Company.	Quantity of Mullock crushed, including Specimens.	Quantity of Quartz crushed.	Yield of Gold.	Average Yield of Gold per Ton.	Number of Wages-men employed.	Number of Tributers employed.
	Tons.	Tons.	Oz.	Oz. dwt. gr.		
McMahon's, Tapu ...	...	395	51	0 2 13		
Centennial, Tapu	...	26	16	0 12 7		
Draffin's, Tapu	...	2	6	3 0 0	20*	...
Hawke's, Tapu	...	72	7	0 1 22⅔		
McCormack's, Tapu ...	...	10	3	0 6 0		
Manuel and Hendricks's, Tapu	...	19	3	0 3 3		
Sheridan's, Tapu	...	Specimens	36	...	3	...
Broken Hill, Tapu ...	...	24	5	0 4 4	3	...
Nevis, Tapu	...	12	6	0 10 0	2	...
Paroquet, Waiomo ...	...	226	38	0 3 6	2	...
Golden Gem, Waiomo ...	...	62	17	0 5 11	10	...
Nymph and Mermaid ...	...	2½	4	1 12 0	2	...
Hansen's, Kuranui No. 3 ...	15,755	...	1,014	0 1 6	17	...
" " ...	...	60	57	0 19 0	...	3
Comer's, Kuranui No. 2 ...	10,550	...	617	0 1 4	20	...
" " ...	...	873	934	1 1 9	...	35
Turtle's, Kuranui No. 1 ...	...	292	116	0 7 22	...	6
Moanataiari	3,065	495	615	0 3 10	56	...
"	...	1,238	2,346	1 17 21	...	59
Caliban	...	76	24	0 6 7	3	...
Orlando	225	...	115	0 10 5	...	6
"	...	35	99	2 11 10	3	...
Whau	...	120	105	0 17 12	4	...
"	...	210	196	0 18 16	...	8
Alburnia	...	210	418	1 19 19	18	...
"	...	100	60	0 12 0	...	6
Dixon's No. 1	...	120	121	1 0 4	5	...
" "	...	295	235	0 15 22	...	4
New Prince Imperial ...	...	64	55	0 17 4	5	...
" ...	...	450	905	2 0 5	...	10
Saxon	...	14,550	8,171	0 11 5	115	...
Caledonian	...	4,128	395	0 1 21	17	...
"	...	619	238	0 7 16	...	8
Waiotahi	...	2,431	3,218	1 6 11	40	...
New Manukau	...	209	287	1 7 11	6	...
"	...	132	144	1 1 19	...	2
Cambria	...	532	1,018	1 18 6	30	...
Trenton	...	75	41	0 10 22	27	...

* Estimated average number of men.

Name of Claim or Company.	Quantity of Mullock crushed, including Specimens.	Quantity of Quartz crushed.	Yield of Gold.	Average Yield of Gold per Ton.	Number of Wages-men employed.	Number of Tributers employed.
	Tons.	Tons.	Oz.	Oz. dwt. gr.		
Fame and Fortune ...	...	1,146	1,809	1 11 13	53	...
Calliope	...	10	7	0 14 0	1	...
"	...	84	61	0 14 12	...	6
Craford's Special Claim ...	...	221	254	1 2 23	20	...
Adelaide	...	249	780	3 2 15	6	...
"	...	70	61	0 17 10	...	2
Lone Hand	...	551	1,090	1 19 13	16	...
"	...	20	68	3 8 0	...	5
E. and M. Claim	...	10	30	3 0 0	2	...
Claremont	...	Specimens	78	...	2	...
Hokianga	...	18	124	6 17 18	2	...
Lucky Hit	...	115	290	2 10 10	...	13
Dives	...	142	275	1 18 17	11	...
Occidental	...	16	471	29 8 18	8	...
Little Edwin	...	29	50	1 14 11	3	...
"	...	18	20	1 2 5	...	2
North Star	...	115	296	2 11 11	...	9
Consols	...	30	22	0 14 16	2	...
"	...	124	91	0 14 16	...	9
Old Prospectors', Puriri ...	...	20	27	1 7 0	6	...
Bedford's, Puriri	...	351	230	0 13 2	6	...
Decido, Tairua	...	188	89	0 9 11	6	...
Totals	29,595	31,691½	28,059	...	552	193
From other claims ...	...	...	5,758			
			33,817			

This statement is compiled from the detail returns given by Mr. G. Wilson, Inspector of Mines: these returns do not coincide entirely with the returns given by the battery-managers, but they may be taken as approximately correct for the claims included in the statement. In addition to the number of men shown in this statement, there have been about 126 men employed on wages, and eleven tributers, in claims not included in this return.

Tapu.

There are about twenty-six men employed in claims in this portion of the district; and, as far as can be ascertained, about 568 tons of quartz has been crushed, which yielded about 147oz. of gold; but 21oz. of this was obtained as free gold by sluicing, which has been discontinued on account of the ground being too poor to work by this means. If the whole of the gold be taken as the result of twenty-six men's labour, it only gives them about 5oz. 13dwt. per man for the year's work. It has, however, to be borne in mind that many of the men who have claims here have also homesteads and pieces of land, which they employ portions of their time in cultivating. A good deal of gold was obtained here in the early days of the field, but it was always known to be very patchy. A very old resident, Mr. D. Sheridan, at the time of my visit struck a small lode, from which some good specimen-stone was obtained. From 35lb. of stone he got 35oz. of gold, and he is stacking the rest of the quartz, waiting for a road to be constructed, so as to get it taken to the crushing-battery. A new claim was taken up last year by C. Bull, who formerly worked the Bullion Mine. He erected a small crushing-battery of four stamps; but so far he has not met with much reward for his expenditure and labour. Mr. Kelly has discovered payable stone in an old mine, which had been worked in the early days of the field, and is now in one of the homestead sections.

Waiomo.

The large auriferous lode discovered here some years ago by Lawry Brothers, and which gave good returns of gold near the cap, is now abandoned. The Paroquet Company purchased this mine from Lawry Brothers, and erected a crushing-battery of twenty stamps, and an aerial tramway to convey the quartz from the mine to the battery; but this company have suspended operations, and sold their battery and tramway, which are now removed. The only company at work here now is the Golden Gem, who are working on a different lode from that worked by the Paroquet Company; but the returns from their mine have not been very encouraging. They suspended operations for a time, but have resumed work again, and it is said that they have discovered a valuable lode, on which several other claims have been taken up.

Tararu Creek.

Sylvia Company.—A new discovery of ore, containing gold, silver, galena, zinc-blende, and copper, was made by the Sylvia Company in the early part of last year. It is said that about thirteen years ago 5 tons of stone from the cap of the reef yielded 15oz. of gold; but the run of

gold could not be traced far into the hill. However, prospecting has been done on the lode from time to time without anything being found that was deemed payable for working. A syndicate of Auckland and Melbourne gentlemen took up the mine, and constructed a low-level adit for a distance of 1,027ft. When the lode was cut they drove 100ft. on it, and found that about 85ft. of it contained rich stone according to assay, but of a very complex and refractory character. Very high assays have been obtained, of both silver and gold, from the ore. The lode varies from 4ft. to 7ft. in thickness, and at my visit they were constructing an uprise which showed the lode to continue up for 107ft., that being the distance constructed. This uprise will connect with the upper level that was partly constructed by the present company and partly by the original holders of the claim, the distance between the levels being 126ft.

The low-level adit was ventilated by means of a Pelton wheel 8in. in diameter, driving a small fan, and the air was conveyed into the face by galvanised-iron pipes. These had not been long in use, but the action of the mineral water coming out of the ground showed that thin-iron pipes are of very little service, the water being highly charged with sulphurous acid. This Pelton wheel and fan, with supply-pipes, erected at the mine, only cost £25, and it produces a large current of air for its size, and also gives a much greater useful effect for the head and quantity of water used than the common method of forcing a current of air into a mine by water falling down a pipe.

The company have about 400 tons of ore stacked ready for treatment as soon as their crushing-plant is erected on the machine-site, which is near the junction of the Ohio and Tararu Creeks, about 35 chains distant from the mine. An aerial tramway is in course of construction; but, as the fall from the mine to the machine-site is only about 175ft., or an average gradient of 1 in 12, it will not be self-acting, but will require to be worked by motive-power. It is intended to erect a Pelton hurdy-gurdy water-wheel to work this tramway, and also the reduction plant. The latter is to consist of a stamp-battery of the American type, with concentrators and other appliances for the treatment of this peculiar class of ore. A water-race 37 chains in length has been constructed from the Tararu Creek, to supply water for the Pelton wheel and battery. Since the syndicate acquired this mine they are said to have spent about £2,500, and they have £2,000 in hand for the erection of the plant. There is some very rich ore in the mine, and if they erect a plant capable of treating the ore successfully their property is likely to prove a valuable one.

Norfolk Mine.—This mine is situate on the same side of the range as the Sylvia, but considerably nearer the mouth of the creek. During last year rich stone was said to have been discovered in this mine, but on my visit here in October last the lode did not look promising. The manager, however, assured me that the stone contained a good deal of gold, although it was not visible. On representations being made that the mine contained plenty of good stone, the company purchased a crushing-battery belonging to Messrs. Brown and Campbell, of Auckland, which was erected near the mouth of Tararu Creek. They then put the plant and water-race in repair, and crushed about 70 tons of the stone, which only gave a return of something like 2oz. of gold. The manager of this mine called my attention to the hardship it was for him not to be able to obtain a manager's certificate, and spoke of his past experiences in connection with the management of mines; and no doubt at that time his employers would have entertained the same views of his abilities as a manager as he did himself: but such glaring cases as these point to the necessity of having really competent men in charge of mines, so that the shareholders may have some chance of getting their money returned. A manager ought to have some knowledge of the real value of the ore in a lode before recommending a large expenditure, as failure means not only a loss to those directly interested, but also a loss to the colony, as it deters people from investing money in mining properties, and retards the development of the mining industry. They have been prospecting the mine recently, and have discovered what appears to be a payable lode, and it is to be hoped they will yet be rewarded for their outlay.

Several parties are prospecting in the Tararu district, and it is said some of them obtain fair prospects from the reefs and leaders they have discovered. If lodes that prove payable for working are found higher up than the Sylvia Company's mine, the road will have to be continued higher up the creek, so as to afford facility to get the quartz brought to a crushing-plant.

Darrow and Company.—This company are erecting a crushing-battery of twenty heads of stamps near the junction of Tinker's Gully and Tararu Creek. They have acquired the right from the owners of Dixon's Mine to work all the ground between the surface and their low level, a depth of about 200ft.; and they propose erecting a self-acting aerial tramway, 60 chains in length, from near the head of Tinker's Gully, and transmitting to the battery a large quantity of material that is on and near the surface, as well as any quartz they find, and putting it through in a wholesale manner, on the same principle as Messrs. Hansen and Comer are working on in the Kuranui Nos. 2 and 3.

Thames.

Kuranui No. 2.—The mine is the property of Mr. R. Comer, who erected a crushing-battery of twenty heads of stamps, and is carrying on his mining operations principally by quarrying the hill in a face. Last year he crushed 10,550 tons of material from this cutting for a return of 617oz. of gold, or an average yield of 1dwt. 4gr. of gold per ton. Portion of his mine is let on tribute, and from the quartz obtained by the tributers 873 tons was crushed, which yielded nearly 955oz. of gold.

Kuranui No. 3.—This mine is chiefly worked in an open face, and the material all put through the crushing-battery. A few men are working on tribute on the reefs and leaders, but these are not getting a great return for their labour. Last year 15,755 tons of material went through the crushing-battery, which yielded 1,014oz. of gold, being an average yield of about 1dwt. 6gr. of gold per ton. About 60 tons of quartz was also crushed for a yield of 56oz. of gold. The yield of gold from this quantity of mullock appears to be very small, but if the value of the gold be taken at £2 15s. per ounce it would amount to £2,788 10s. The average number of men employed in

obtaining this gold was sixteen, and, taking the average wages at 9s. per day, and allowing four weeks in the year for holidays and repairs to machinery, the wages would then amount to £2,073 12s., thus leaving £714 18s. to pay for wear-and-tear of plant.

The New Moanataiari Company.—This company was formed some two years ago to take over the property of the Moanataiari Company, and since then they have acquired the Don Pedro, Moonlight, and Reuben Parr holdings; these, together with ground held by the Moanataiari Company, comprises an area of 93 acres. The present company is formed with 50,000 shares, of 10s. each, of which 49,906 have been issued, and the balance is held by the company. During the year ending the 31st of October last they expended £3,622 on opening out and working the mine, and £1,481 on the battery and incidentals, thus making the total expenditure £5,103; while the value of gold obtained from the mine, and moneys received for crushing, amounted to £2,175 9s.; thus showing a loss for the year of £2,928: but this loss is easily accounted for by the large amount of dead-work in prospecting and opening out the mine, and also in repairs to the main adits, travelling-roads, crushing-plant, &c. This company holds, as it were, the key to the back country, inasmuch that the main low adit-level—what is known as the Kuranui Tunnel—is constructed some 20ft. above sea-level, and extends straight back into the range for a distance of over 3,000ft., having a double line of rails for the greater part of the distance, and high enough to admit of horses being used to haul out the trucks. Everything is now in good working-order, and great hopes are entertained that it will prove a successful venture. For the year ending the 31st of March last they crushed 3,065 tons of mullock and 1,733 tons of quartz, which yielded 2,961oz. of gold. They have a crushing-battery of thirty heads of stamps, with ordinary quicksilver- and blanket-tables, and twenty-one berdans, which are driven by two Pelton water-wheels. There is also an air-compressor for working rock-drills.

Saxon Company.—For the past year this has been the most successful company on the Thames field. During the last year they crushed 14,550 tons of quartz, which yielded 8,171oz. of gold. The capital of this company is £25,000, in 50,000 shares of 10s. each. Of the capital, 2s. 6d. per share was paid up on 6,000 shares at the time of formation of the company, and since then 1s. 10d. has been paid up on 44,000 shares, amounting to £4,033 6s. 8d., as working capital. During last year the value of gold obtained from the mine amounted to £23,851 6s. 6d., and the expenditure on the working of the mine, crushing-plant, and general management was £16,463 12s. 2d.; leaving the actual profit on the working for the year £7,387 14s. 4d. Since this company commenced operations they have paid £12,916 13s. 4d. in dividends to the shareholders.

The principal workings in the mine during the last year were carried on from the fourth and fifth levels, but they are constructing another level at a depth of about 460ft. below the surface. The lodes in this mine are large, but are subjected to numerous breaks. In some of the levels they take a jump to one side for a distance of 40ft., but the whole of the stone is of a payable character for working. The gold still continues to go down, but to what depth it has not been yet ascertained. The workings in the mine are carried on in a systematic manner, and every care taken so as to provide for the safety of those employed therein.

The winding is done by a steam-engine, but the air-compressor is worked by a Pelton water-wheel, and is capable of supplying compressed air for two rock-drills. The drills are the Little Giant and the Slugger–Rand's Nos. 2 and 3. The compressor is also one manufactured by the Rand Drill Company. The compressor and rock-drills give great satisfaction, especially the drill known as the "Slugger." The building where the crushing-battery is erected (consisting of thirty-three heads of stamps and sixteen berdans), as well as the surface workings, are lighted with electricity supplied from a dynamo which is driven by a small Pelton wheel.

Waiotahi Mine.—This is one of the best-worked mines in the Thames district. Every part of the workings clearly shows that care and order have been observed. The network of string-like veins of quartz intersecting the tufaceous sandstone is all prospected, and the veins followed wherever they show gold, and it is from these veins that the most of the gold is obtained. It is indeed a pleasure to visit this mine, to observe the orderly system on which the workings are carried on. It is a company in which the shares scarcely ever change hands, and the directors have the fullest confidence in the ability of their manager, and they never interfere with him in any way as regards the working of the mine. The result is that this mining venture is conducted on a purely commercial basis. There are a certain number of men employed in prospecting and on dead-work, while others are working on the leaders and lodes which contain gold. At the time of my visit the workings were carried on from the third and fourth levels, 310ft. and 380ft. respectively below the surface; but the surface of the ground where their shaft is sunk is much higher than the flat, consequently the Big Pump, which drains the ground to a depth of 500ft. below the surface, keeps the workings in this mine always completely dry. There are six main lodes in the ground held by the company, some of which run at about right-angles to others, and all are less or more auriferous; but it is in what is termed the No. 5 lode,—about from 1ft. to 1ft. 6in. in thickness,—that the most of the thread-like veins of quartz and leaders exist, all containing sufficient gold to make them payable for working.

The returns from this mine for the year are not so large as those from some of the other mines, but they are more uniform, the manager stating that the average quantity of gold obtained monthly for a period of seven years was about 250oz. This company purchased ground six years ago which had been previously worked by three different companies, who considered it valueless, but since this company has been working it it has been paying dividends. None of the ground in this mine is worked on tribute, only wages-men being employed, as the greatest care has to be observed in carrying on prospecting operations in the numerous veins and stringers met with. The quantity of gold obtained during the past year was 3,218oz., from 2,431 tons of quartz.

Cambria Mine.—Some years ago this was considered the most valuable mining property on the field. Only £1,181 have been paid in calls, while dividends to the extent of £79,357 has been paid to the shareholders. During the past year the returns have not been great. From 532 tons of quartz

crushed, and 181lb. of specimen stone, 1,018oz. of gold was obtained. According to the balance-sheet in December last the receipts from gold obtained and money received for crushing, haulage, and sale of tailings amounted to £5,008 3s. 10d., and the expenditure on working the mine, crushing-plant, and incidental charges, £5,047 4s. 1d.; but, as they had a cash balance from the year previous of £200 13s., they had still a small balance left on the year's transactions. This mine is situated in such a position on the field that there is no telling the day when another rich block of auriferous stone may be discovered, and there are also numerous small quartz veins, similar to those found in the Waiotahi Mine, carrying gold.

Trenton Mine.—This mine adjoins the Cambria and Saxon Mines, and, judging from its position on the field, it can hardly fail from getting gold. The company who own this mine have expended over £6,000 in prospecting the ground, and until recently have failed to get anything likely to become payable for working. They have sunk a shaft to a depth of 557ft. through very hard close-grained rock, having the strata dipping into the hill, and adjoining this hard belt of country the soft tufaceous sandstone lies against it at the high levels; therefore this hard rock overlies the soft sandstone where the lodes are found in the Saxon Company's ground payable for working. In the latter company's mine the lodes on the higher levels became broken and branched off in leaders before coming against this hard country, and when this took place the gold ran out. The Trenton have now constructed a level from near the bottom of their shaft towards the Saxon boundary for a distance of 440ft. At 400ft. they struck the hanging-wall of one of the branches from the Saxon lode, which is being worked in the Saxon Mine from the No. 5 level, and at 440ft. they struck the foot-wall of the other branch. The first branch of the lode met with is about 2ft. in thickness, but broken up into several small veins; but the other branch is more solid, and from 1ft. to 1ft. 6in. in thickness. At the time of my visit they were driving towards the Saxon boundary, which was only about 50ft. distant, and gold was visible in some of the stone.

On examining the strata of the hard rock met with in the Trenton shaft, and for some distance in the low level, there is a hard band of close-grained indurated tufaceous sandstone at about 120ft. from the shaft, running in a north-west and south-east direction, and dipping into the range, which has a very marked discoloration, and to the east of this the country rock becomes altered in a slight degree, getting softer, until the soft brown tufaceous sandstone is met with. Judging from the angle at which this rock is dipping, the shaft will have to go through from 300ft. to 400ft. of hard country until it strikes the soft sandstones where the payable lodes in this district are usually found; but in sinking through this hard rock they will have the advantage of not being liable to a large quantity of water unless open seams are met with, which is not at all likely; and this may compensate in a measure for the extra expense in sinking through hard rock. They are not likely to have a great extent of a payable lode on the present levels; but if the gold continues to go down they are likely to find it on the deeper levels. The same run of soft country goes into the Old Queen of Beauty ground, where gold was got below the level of the bottom of the Big Pump shaft, which is 640ft. below the level of the flat; whereas the Trenton Company's shaft is sunk on the face of the range, the surface of which is considerably above the level of the flat where the Big Pump shaft is put down. During last year they crushed 75 tons of quartz from the branches of the Saxon lode, which yielded 41oz. of gold. The shareholders in this mine deserve to be well rewarded for their perseverance and energy in prospecting the ground.

Fame and Fortune Mine.—This comprises ground that had been previously worked and abandoned as valueless. A special claim was granted to Mr. E. Kersey Cooper, of 55 acres, in November, 1887, and soon after obtaining the grant he formed a syndicate to take the claim up and work it. Operations were commenced in August, 1888, and since then 1,146 tons of quartz has been crushed, which yielded 1,809oz. of gold. The whole of the ground is full of string-like veins and leaders of auriferous quartz, similar to those found in the Waiotahi Mine, and Mr. Cooper has been working on a number of these. There is a large lode from 6ft. to 7ft. in thickness going through this claim, and from a trial-crushing of 25 loads of quartz from this lode 13oz. 5dwt. of gold was obtained, being an average yield of 10dwt. 14gr. to the load, the value of the gold being about £2 15s. per ounce. This would be equal to £1 8s. 11d. per ton, which ought to pay for working a lode of this dimension. A large amount of work has recently been done in this mine in repairing old adit-levels and extending them, and a low level is in course of construction to open up the mine at 150ft. below the present workings. The syndicate are so thoroughly satisfied with the value of their property that they have purchased from the Caledonian Company a crushing-battery of twenty head of stamps, and propose to construct an aerial tramway of 60 chains in length, to connect the mine with the crushing-plant.

Lone Hand Company.—This company's mine is in the vicinity of Karaka Creek. From the annual balance-sheet the following results of the working are taken: namely, 576 loads of quartz crushed for a yield of 1,141oz. 4dwt. of gold, representing a value of £2,990 7s. 9d., and tailings sold £1 11s. 8d., this making the total receipts £2,991 19s. 5d.; while their expenditure was £2,691 19s. 5d., including the cost of a low-level adit; thus leaving a clear profit for the year of £300. If the cost of constructing the low level were deducted—namely, £547 10s. 3d.—it would leave the profits on the working of the mine for the year £847 10s. 3d.; but all dead-work should be included in the cost of working the mine. The construction of a low adit has occupied some considerable time. It is constructed for a distance of about 960ft.: of this distance only about 60ft. is in the ground the company have been working. They propose extending it for a further distance of 65ft. on the lode, which is about 12in. in thickness, and then making a cross-cut to the Adelaide reef. This level will give about 90ft. of backs on the Adelaide and other reefs, and allow them to work about 900ft. in length on the lodes if they continue to prove payable through the ground for the whole distance. According to the returns from this mine for the year ending the 31st March last, there was 571 tons of quartz crushed, which yielded 1,158oz. 1dwt. of gold.

Other Claims on the Field.—It is needless to enumerate the whole of the claims on this field, as they are all fully described in the report of Mr. Wilson, the Inspector of Mines. Suffice it to state

that generally the mining ventures present a more favourable aspect than they did last year, and, moreover, more improved appliances are beginning to come into use, which will cheapen the cost of working to some extent, and therefore enable ground to be worked that has been formerly abandoned as valueless. The proprietors of mining ventures are beginning to realise the fact that the days are fast passing away when they may make money by simply trafficking in shares, and the sooner this is done away with the sooner will the mining industry be placed on a more solid foundation, and be worked on such a basis as to induce capital to develop the hidden wealth that lies beneath the surface. The discoveries made by Mr. Cooper in ground which was for years considered to be worked out cannot fail to attract attention and cause mining to be carried on with more energy, and in a more systematic manner. The large area of auriferous lands in the Hauraki Peninsula where scarcely any prospecting has been done will some day be worked, and many auriferous lodes found that will give returns for the capital invested. Mining ventures have in the past been looked on by many as simply gambling transactions, and many unprincipled people have been connected with mining who had no consideration for the consequences so long as they made a few pounds, their great object being to make money, even if it was acquired by fraudulent representations. And no doubt this particular industry affords a large field for unscrupulous adventurers. Nevertheless, it is an industry that, if carried on in a systematic manner and on purely commercial principles, will gain supporters, and capital will be forthcoming to develop it.

Ohinemuri District.

Marototo.

This field has not turned out according to expectations. There are only three claims being worked, and the prospects of these becoming payable investments are not very encouraging at the present time. There is, however, now a small grinding-plant on the field, where any ore can be taken to be tested, and this may be the means of prospecting being more energetically carried on. There is rich ore in this district, but so far it has been in thin veins, and it takes a long time to get a quantity of it. Some ore forwarded me by Mr. Moore, the manager for the Dunedin Exhibition, assayed as high as 4,350oz. of bullion to the ton—about 50oz. of gold, and the remainder silver. When such rich ore as this is found it gives encouragement to carry on prospecting, and it is likely that some rich finds will yet be discovered in this part of the district.

Marototo Mine.—A large amount of work has been done in this mine, and some very rich ores have been obtained. In former years the rich ore was picked out of the lode-stuff, and sold by assay at the mine. During last year the proprietors of this mine erected two McKay or Fraser pans and one settler, and these have recently been started to crush the ore from the mine. They are driven by a Pelton water-wheel 3ft. 6in. in diameter, supplied with water from a head-race from McBrinn's Creek. This race is only 5½ chains in length, and it gives a head of water at the machine-site of 110ft. The head-race is constructed of boxing, and the water is brought from the end of this race to the wheel with 210ft. of wrought-iron pipes. At the time of my visit in February last they had a considerable quantity of ore on hand. This ore at the mine is estimated at about 150 tons, and it is graded in three classes. There is about 4 tons of first-class ore, similar to that tested at the School of Mines at the Thames in 1888, which gave bullion to the value of about £600 per ton; about 100 tons gives an assay-value of about £20 per ton; and the balance about £10 per ton. This mine is carefully and economically worked; indeed, the company has been fortunate in securing a first-class man for their manager. Although the lode is from 4ft. to 5ft. in thickness, there is not more than about 15 per cent. of this saved. The stuff has to be carefully selected; it is only the fine material that is worth saving. As the ore is taken out it is screened, and what does not pass through a ½in. mesh is packed away in the stopes. The lode is richer as it gets near the surface; but the gold and silver does not seem to be found in payable quantities at any great depth. However, now, when they have a plant near the mine, they will be in a better position to test the value of any lode-stuff they find.

Silver Queen Mine.—This mine has lately been acquired by a Sydney company, who are driving on the course of the reef, and are said to be obtaining fair prospects. Some rich stone has been found in this mine, containing principally sulphide of silver.

Arizona Mine.—This mine has recently been taken up again, and two men are engaged in sinking a winze on the lode; but very little is yet known respecting the quality of the ore. A good deal of prospecting will have to be done in this and the other claims before any of them may be considered valuable properties.

Karangahake.

This is a field where there are large bodies of quartz containing both gold and silver; but so far these lodes have not proved highly remunerative. Some rich auriferous quartz was obtained from the Adeline Mine; but the lode did not carry the gold down for any great distance, and very little prospecting has been done to try and pick up the shot of gold-bearing stone again. A good deal of work has been done in prospecting the Woodstock and Kenilworth Mines, and also the Crown Mine, and occasionally ore is found that pays for working; but, to take this field on the whole, it has been very disappointing to all those who have embarked capital for its development. When the second rush set in to this field, seven years ago, great expectations were formed as to its richness—the only thing necessary to make the claims payable was said to be a good crushing-plant. When Mr. La Monte visited this field at the time he erected the smelting-furnace at the Thames, he caused quite a reaction in mining by drawing attention to argentiferous ore which gave high assays being thrown over the waste-tip as mullock. Indeed, the enthusiam of the people connected with mining properties on this field induced parties to erect a La Monte furnace at Karangahake even before the one at the Thames was tried; but this furnace completely failed to

treat the ore economically, on account of the large percentage of silica there was in the ore. The expense of fluxes was so great that the richest of the ores could not be made to pay by this method of treatment.

After the failure of the La Monte furnace, Mr. Railey erected a crushing-battery on the side of the Waitawheta Creek, consisting of ordinary stamps and the wet-crushing process, the crushed or pulverised ore being run into a series of tailings-tanks, twelve in number, eleven of which were used as settling-pits, the tank which had been emptied forming always the end of the series, and as one got filled up with tailings the stuff from the full tank was removed and reground-up in pans, such as Mr. Railey had been accustomed to use years previously in Mexico. Sulphate of copper and salt were used in the pans, along with mercury and hot water; but this system of treatment also proved a failure: a fair percentage of the bullion could not be saved, and the cost of treatment——£1 10s. per ton—was considered too high for the results obtained. Railey's company then stopped their operations and sold their plant.

It may be premised that where sulphide-of-silver ores exist, such as are found in many of the mines at Karangahake, any system where wet crushing is resorted to will prove a failure to extract all the silver, as a large percentage of the sulphides will not settle, but will float away on the surface of the water. The chemical action of sulphate of copper and salt in amalgamation, although these are used largely in America, and are said to produce good results, has not been satisfactorily determined: it is supposed to effect the decomposition of the sulphides and facilitate amalgamation, but the real chemical action is but imperfectly understood. Sonnenschmidt, a German chemist, and Bowering, an English metallurgist, have different theories as to its chemical action. Sonnenschmidt claims that the salt and sulphate of copper react upon each other, and produce sulphate of soda—which is neutral in its action—and chloride of copper. The latter salt acts upon the argentiferous sulphide, and yields chloride of silver, subchloride of copper, and free sulphur. The subchloride reduces a second portion of the sulphide of silver, and causes the formation of an additional amount of silver-chloride, and subsulphide of copper. The silver salt is then attacked by the mercury, and calomel, or subchloride of mercury, is produced, while metallic silver is set free, which combines with the second portion of the mercury as amalgam.

On the other hand, Bowering denies that any of the sulphide of silver is chloridized, and asserts that before amalgamation takes place metallic silver is first produced. He claims that chloride of copper in contact with mercury forms the subchloride of both metals. The subchloride of copper in contact with the oxygen of the air is converted into an oxychloride, which in turn acts on the sulphide of silver, and liberates the metal in a free state by oxidizing the combined sulphur.

Again, M. Eissler, in his "Metallurgy of Silver," states that, although oxychloride of copper may possibly be found at times, there does not appear to be any decided evidence that such is the case in practical operations, or that it decomposes the sulphide of silver, while other experiments show conclusively that both the chlorides of copper, under favourable circumstances, do chloridize the argentiferous sulphurets. The experiments, however, seem to indicate that the action of the chloride of copper was much more intense than that of the subchloride. The action exerted by these two reagents in the pan would appear clearly to indicate that the benefits derived from their use are partly to aid in converting the sulphide into chloride of silver, and partly to decompose such minerals as are slightly attacked by mercury. The large quantity of iron produced by grinding in a pan tends greatly to produce subchloride of copper almost as soon as the chemical agents are thrown into the pulp.

The quantity of salt used by millmen in America varies from ¼lb. to 7lb. or 8lb. per ton of ore, scarcely any two establishments having the same rule. The quantity of sulphate of copper also varies, according to the ideas of the millman, from ¼lb. to 3lb. per ton of ore. The addition of sulphate without salt has also become a common practice. The opinion of those who work their ore in this way is that it gives a better yield than when mercury alone is employed, particularly when the ore indicates the presence of galena, in which case it is said to quicken the mercury and render it more energetic.

Continued experience appears to determine that in working ores containing only a small percentage of lead the quicksilver very soon becomes dull and inactive, or, as it is technically termed, it sickens, and the yield from the pan is consequently low. Sulphate of copper possesses to a certain extent the property of expelling lead from mercury, but not the power of completely driving out the lead, copper being amalgamated, and sulphate of lead formed at the expense of the sulphuric acid of the copper salt. If a concentrated solution of copper-sulphate be allowed to stand on lead-amalgam the action takes place quite rapidly, mercury containing lead acting much more energetically upon the copper solution than when perfectly pure. Another advantage derived from the addition of a small quantity of sulphate of copper is, that mercury under certain conditions, when exposed to the solution, forms a minute amount of copper-amalgam, which causes the metal to act with a greater intensity in the decomposition of the silver-sulphide than when perfectly pure.

The whole of this goes to show that the treatment used by Mr. Railey in his pans was justifiable, and that he possibly would have saved a fair percentage of the bullion if he had crushed the ore dry and then treated it in his pans, the same as is now done by the Waihi Gold- and Silver-mining Company. At all events, it is well known he lost a considerable portion of the bullion by the water carrying it off, and to this may be attributed the failure.

Recently another plant has been erected on the same site where Mr. Railey's battery stood, at the side of the Waitawheta Creek, by the Crown Company, which is partially formed with English capital. This plant consists of a stone-breaker and a Lamberton mill, together with Railey pans and settlers, as well as a large plant erected by the Cassel Company to extract the bullion from the pulverised ore by dissolving the precious metals in a solution of potassium-cyanide and precipitating them by zinc.

The Lamberton mills are quite a new reducing-machine in this colony, but, as the principle is fully described in the description of the plant belonging to the Mr. Ferguson's Syndicate Company, at Te Aroha, a further description is not required here. The only difference in the mill used here was that a forty-mesh grating was used for a screen, and the ore crushed wet. The manager, Mr. Coward, who came out from England a couple of years ago for a home syndicate to report on some of the mines in Coromandel, seems to have had no experience with the working of these mills, which were never intended to be used for wet crushing; and the consequence was that the wear-and-tear on the balls with wet crushing was very great, and they did not last any time. He also made the same mistake as Mr. Railey in using water to pulverise the ore, as a large percentage of the sulphides was carried away with the water, and, moreover, the plant first erected by the Cassel Company could not treat the pulverised ore in a wet condition, consequently the pulverised material was treated in the Railey pans, which proved a complete failure to extract a fair percentage of the average assay-value of the ore. The Cassel Company then constructed a plant to treat the ore in a wet state, but this was not completed when Mr. Coward resigned the managership; but the new manager is to crush the ore in a dry state, and get it treated in the first plant erected by the Cassel Company.

Cassel's Process.

Tanks.—The ore, after being dried and crushed so as to pass through a fine screen, is conveyed to the percolation-tanks, which are made of kauri timber 4in. thick, each tank being 9ft. wide by 12ft. long and 3ft. 6in. in depth. The planks in the bottom, sides, and ends of the tanks are held together by screw-bolts passing through the timber, forming, as it were, wide slabs. Afterwards the bottom and sides are rebated about ½in. in depth, to take the sides and ends, and are held together with screw-bolts of 1in. in diameter.

Filter-bed.—A filter-bed is formed in the bottom of each tank. This bed is made by first putting on a coating of coarse pebbles over the bottom, then a layer of smaller ones, sizing them down to about ¼in. or ⅛in. in diameter. On the top of this battens of 1½in. in thickness and 2½in. in width are laid on the flat about 1ft. apart, having the spaces between them filled up with clean sharp river-sand, smoothed off on the top. The filter-bed is about 6in. in thickness.

Charging the Tanks.—To insure the best possible percolation, the ore is carefully charged so that there shall not be any lumps amongst it, and when a depth of from 4in. to 5in. has been put in and evenly spread over the tank, it is thoroughly wetted, by means of a watering-can, with a solution of cyanide of potassium; afterwards another layer of ore is put on and sprayed the same as before, and so on with each successive layer until the tank has received its full charge, a sufficient space being left between the last layer of ore and the top of the tank to receive the whole of the potassium-cyanide solution necessary for dissolving the whole of the gold and silver.

Potassium-cyanide Solution.—The quantity of solution necessary is about one-half the weight of the ore to be operated on, and the amount of potassium-cyanide varies, according to the composition, from one-quarter to three-quarters of 1 per cent. That is, for every ton of ore 112 gallons of solution is required, which means that from 2·8lb. to 8·2lb. of potassium-cyanide is required, according to the composition of the ore, to make the necessary strength of the solution to one ton of ore. This solution, after being filtered through the ore, is made up to the necessary strength and used again; so that, although the first tank requires this amount of potassium-cyanide, very little is required for the next tank.

Filtering.—During the charging of the tank the discharge-pipe is closed, but on the charge being completed it is opened, when generally the liquor flows freely for a short time. The first liquor discharged, which may amount to twenty or thirty gallons, is returned back to the tank, as it had not sufficient time to act on the gold and silver. The tap in the discharge-pipe is so regulated that the solution shall not pass through the ore in less than thirty-six hours, as it has been found by experiments that it takes this time to get the gold and silver in solution. When the whole of the solution has passed through, it is deprived of the gold and silver it contains, as will be shown further on, and then used a second time; and when this has all been filtered from the ore a washing of pure water is made. The last two washings may be allowed to pass through as quickly as possible, and may be assisted by artificial suction. Indeed, the faster these two pass through, the more perfect the operation. After these washings, the tailings should be practically free from gold and silver, and are removed from the tank. Unless with very free-percolating ore, the filter-bed has to be removed after each charge, as the sand gets impregnated with slimes to such an extent as to render it unfit for filtration.

Precipitation of the Gold and Silver.—The precipitation of the gold and silver from the potassium-cyanide solution is effected by means of metallic zinc, which should be used in such a state as to expose the greatest amount of surface to the solution. This is best gained by granulated zinc, or zinc reduced to the state of fine ribbons, such as zinc-turnings. To obtain the best granulated zinc for this purpose the metal is melted at a low temperature, and poured from a height of from 10ft. to 12ft. into a tub of cold water. It is then sifted with a sieve having holes of about ⅛in. square, and only that which will not pass through the sieve is used, the finer portion being remelted.

The solution from the percolating-tank may, if thought fit, be directly passed through the towers containing the zinc, or it may be run into an intermediate tank, which is considered the better plan.

Precipitating-towers.—The precipitating-towers will be better understood by referring to the annexed sketch. There may be any number, but eight or ten are found sufficient. These towers are made of wood. They are slightly barrel-shaped, and stand about 17in. high, and are 5in. in diameter at the ends. Each tower is fitted with a false bottom, B, which is of thin perforated sheet-iron, having small holes. The inject-pipe leading from the tank, which is a ¾in. gaspipe, passes under the false bottom. The towers are filled with granulated zinc, or zinc-turnings, above the false

bottom to within 1in. of the eject-pipe, E, and the liquor passes up through the zinc and goes from the top of the first tower to the bottom of the second, and so on through the whole of the series. All the top and bottom pipes which are in the towers are joined together by an indiarubber tube, D, so that any one of the towers may be removed from the series and be replaced by another by simply slipping back the indiarubber over C and E on both sides of the tower to be removed.

When once the flow is regulated the operation goes on day and night uninterruptedly, and requires little or no attention. If the ore operated on be rich in either gold or silver the precipitate will form rapidly in the first tower, and will retard the flow of the solution. When this happens to be the case the first tower is removed, in the manner already described, and the whole series moved forward, so that the second tower now becomes the first, and another tower is placed at or near the end of the series. The exhausted solution is tested periodically by boiling down a known quantity to dryness and assaying the residue. Mr. Napier, who has been conducting experiments with this process for the Cassel Company, and who kindly supplied me with the particulars in connection with this mode of treatment, informed me that in analysing the exhausted solutions he never found more than a few grains of gold to the ton of solution. By boiling down a known quantity and assaying the residue the strength of the exhausted solution is ascertained, and it is made up to the necessary strength by a fresh solution of potassium-cyanide, to be used on fresh ore. The loss in this way is said to be very little.

Recovering the Bullion from the Towers.—The contents of the charged towers are washed into a small tank. They are then emptied on to a sieve of about $\frac{1}{16}$in. mesh and washed: the fine precipitate, which has the appearance of black mud, passes through, and the unconsumed metallic zinc remaining in the sieve is returned to the towers to be used again for precipitation. When the fine metallic mud has sufficiently settled the greater portion of the wash-water is decanted or siphoned off. Sulphuric or muriatic acid is then added to the residue, which dissolves any zinc which may have passed through the sieve. This is then well diluted with water and allowed to stand for some hours, then filtered through a calico filter and washed with hot water until all the zinc salts are washed out. The residue is then dried, and melted with suitable flux into bullion. The following table shows the results obtained by the Cassel process at the Karangahake trial plant:—

Date.	Assay-value of Ore per Ton.		Extracted per Ton.		Percentage Extracted.		Percentage of Potassium-cyanide used on Ore treated.	Locality of Ore treated.
	Gold.	Silver.	Gold.	Silver.	Gold.	Silver.		
1889.	Oz. dt. gr.	Oz. dt. gr.	Oz. dt. gr.	Oz. dt. gr.				
July 6	0 19 4	10 1 17	0 16 14	7 2 0	86·52	70·4	0·50	Kenilworth, Karangahake
" 13	0 19 14	10 1 17	0 17 23	7 9 1	91·7	73·8	0·50	" "
Sept. 23	1 12 16	14 14 0	1 11 1	11 7 0	95·0	77·2	0·50	" "
Oct. 9	1 12 16	17 12 0	1 7 9	11 9 3	83·9	62·2	0·40	" "
" 19	1 12 16	16 6 16	1 6 4	9 6 1	80·1	56·9	0·25	" "
Aug. 1	1 17 13	1 17 13	1 14 7	1 4 12	91·2	65·1	0·50	Silverton, Waihi.
" 3	1 17 13	1 17 13	1 12 16	1 2 21	87·1	60·6	0·50	" "
" 8	2 2 4	2 4 2	1 19 18	1 12 16	94·2	74·3	0·25	" "
" 26	2 2 11	2 4 2	2 0 20	1 1 6	96·0	47·7	0·25	" "
" 27	0 11 10	3 11 20	0 9 10	1 19 4	82·4	54·4	0·25	Martha, Waihi.
Sept. 13	1 12 16	5 14 8	1 7 19	4 3 8	85·0	72·8	0·25	Mixture of Kenilworth,
" 16	1 19 4	6 4 3	1 15 22	4 18 0	91·8	79·0	0·40	Silverton, and Martha.

Each of the above tests was made on one ton of ore. It will therefore be seen from the foregoing table that the quantity of potassium-cyanide required is not large, and that one-quarter of 1 per cent. in the solution gives nearly as good results as the larger percentage; and, as this is not all consumed in the operation, the expense of the reagent is not great. Admitting that every ton of ore requires 4lb. of potassium-cyanide, the cost of the reagent is about 6s. per ton.

The only plant of this description in the colony is erected at Karangahake in conjunction with the Crown Company's mine. It seems this company entered into an agreement with the Cassel Company to supply a certain quantity of pulverised ore regularly, and of a certain minimum value, and the Cassel Company on their part were to give the Crown Company a certain percentage of the assay-value. The ore was to be delivered in a dry state; but, as Mr. Coward, the manager, deemed it more advisable to crush the ore in a wet state, the process proved a failure. They had to construct another plant to treat the wet material, as they found the amount of slime in the wet-crushed ore destroyed its porosity, so that the solution in the vats they had previously constructed would not permeate through it. To obviate this another method was adopted.

A plant was constructed having circular vats, with a vertical shaft and a number of arms placed in the centre of the vats. These shafts were set in motion, and acted as agitators as soon as the charge and the cyanogen solution was placed in them. After these agitators had been working amongst the ore and solution for a sufficient time to allow all the precious metals in the ore to be dissolved, the pulp was drawn off and forced into a filter-press by a force-pump, the press being similar to that used in breweries for pressing the liquor out of hops after they have been boiled in water. The liquor coming from the filter-press passed through the zinc-towers, as already described, and the ore was taken out of the press and again charged into a second circular vat with a cyanogen solution, which had to undergo a similar operation with the agitators, and was then forced through a second filter-press, and the liquor sent through the zinc-towers. The ore was again taken out of the press and put into a third vat with agitators; but in this operation nothing but clean water

was used to wash the ore thoroughly, after which it was again put through a filter-press and the zinc-towers, and both the liquor and ore was then thrown to waste.

This new plant has not been tried to see how it will do, and, as the intention is to pulverise the ore in a dry state, the original method will be adopted. The new method may be capable of extracting a good percentage of the gold and silver if the ore is crushed dry; but it will be found that, crushing the ore in a wet state, the pulp will not give the same assay-value as the raw ore coming from the mine, on account of the water carrying away a portion of the sulphides. The Cassel process for the treatment of complex ores coming from Spain to Glasgow is said to prove a great success in extracting a large percentage of the precious metals, but it has not been sufficiently tested here to establish its value on the ores found in the North Island.

Woodstock and Kenilworth Companies.—These companies have agreed to amalgamate their properties and form a new company, with 55,000 shares of 10s. each, on the following basis: The Woodstock shareholders to receive 28,750 shares; the Kenilworth shareholders 23,818 shares fully paid up, and 2,432 shares to be held in reserve, to be afterwards disposed of by the directors of the new company as they may deem most advantageous. This amalgamation will be the means of forming a good company, as the amalgamated mine can be worked more advantageously than by the previous system. During last year scarcely any work was done in the Woodstock Mine, but seven tributers have been employed in the Kenilworth Mine, and 45 tons of ore was sold on assay-value for £1,660, and 45 tons are stacked which is said to be worth from £30 to £40 per ton. The ore in these mines contains a large percentage of silver in proportion to the gold.

Ivanhoe and Truro Mine.—There have been twelve men employed in this mine, and a considerable amount of prospecting has been done. From the different lodes and leaders 449 tons of stone has been crushed, which yielded 374oz. of gold.

Adeline Amalgamated Company.—This company hold the ground formerly belonging to the Adeline, Dubbo, and Diamond Companies, and, although not doing a great deal of work, they are carrying on prospecting, and so long as this is legitimately done every encouragement should be given them. According to their annual balance-sheet for the year ending the 7th of August last, the expenditure amounted to £633, of which £218 was for wages, but whether the balance of the expenditure was in working the mine the balance-sheet does not show.

Waihi.

There has not been a great deal of work done in the mines since my last visit. The claim-holders are anxiously looking forward to see if the plant erected by the Waihi Gold- and Silver-mining Company is going to be a success. The first plant erected by this company has been partially dismantled—that is, the rolls and Globe mills have been taken down, and a thirty-head stamping-battery erected instead. The battery is of American pattern; the stamps are 900lb. each, and work remarkably well. The process now adopted is as follows:—

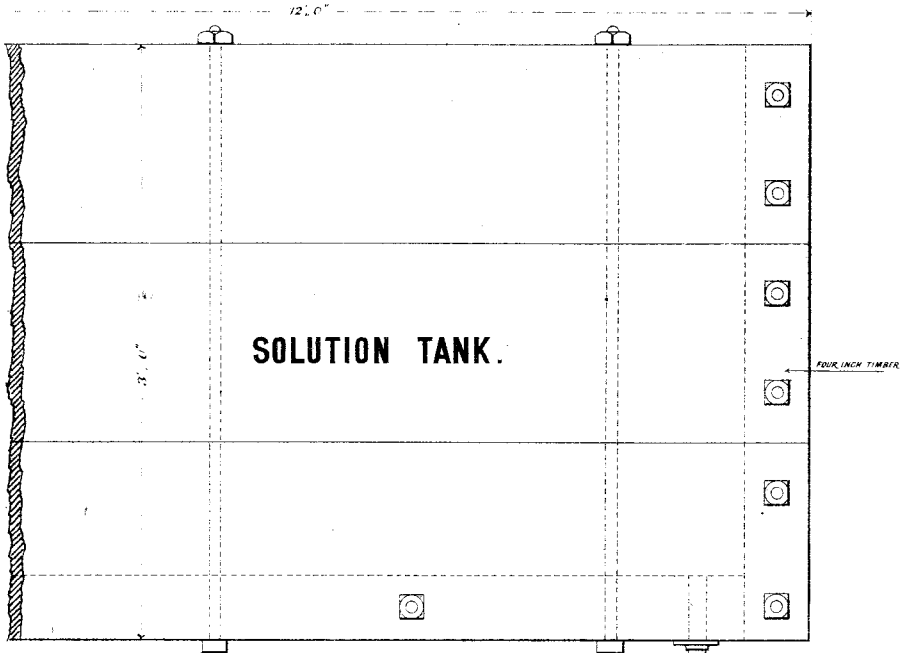
Drying-kilns.—The ore as it comes from the mine is dumped into the drying-kilns. These kilns are excavated in the ground, and made in the shape of a kiln for burning lime. Before putting any quartz into the kiln, firewood is placed in the bottom, and set on end around the sides; a layer of ore is then dumped on top of the firewood, and on top of this layer more firewood is put in, and so on until the kiln is full. Judging from the amount of firewood used in the kilns, the object is to partially roast the ore, as well as have it thoroughly dry. As soon as the kiln is burnt the ore is drawn out, and run in trucks to the bottom of the poppet-legs, and from there lifted by the winding-engine and dumped on the grizzly in front of the rock-breaker.

Grizzly.—The grizzly is made of round iron bars 1½in. diameter, 11ft. long, and set 1½in. apart. The coarse particles that do not pass through this grizzly go down to the rock-breaker, and are there reduced to a maximum of 1½in. diameter. The stuff then passes down into a hopper or bin, and thence into a Challenge ore-feeder, which feeds the stamps.

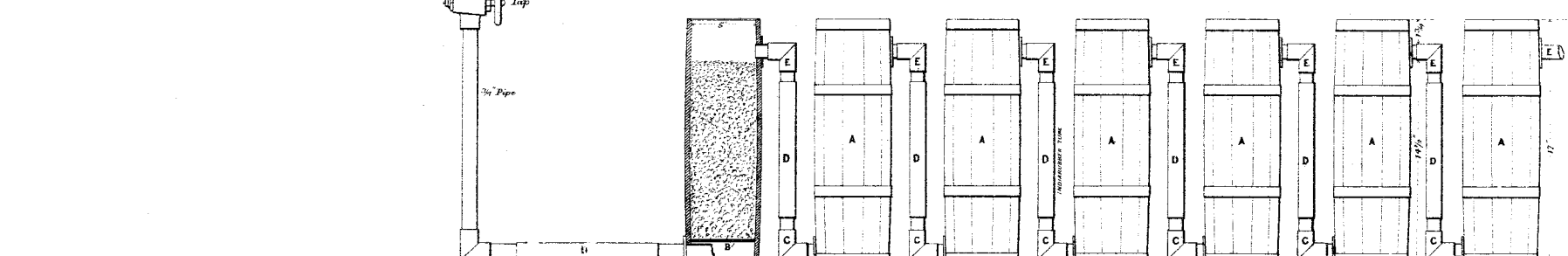
Battery.—The crushing-battery consists of thirty heads of American stamps, 900lb. each, with cast-steel discs and cams. Only ten heads of stamps were at work at the time of my visit; the other batteries were not completed. These have a lift of about 8in., and make about ninety drops per minute. The ore is fed into the mortar by the Challenge ore-feeder, and crushed dry through a forty-mesh grating; but Mr. Russell, the manager, informed me that he intended to use a sixty-mesh grating. The crushed material, on coming through the grating, falls into a longitudinal trough in front of the grating, into which an archimedean screw is fixed, and as the screw revolves the dust is moved along into a chamber, from which it is lifted by means of an elevator and delivered into trucks, and is then dumped into the combination-pans. The mortars of the crushing-battery, and, for some distance up, the stamp-shanks, are all housed in with tongued-and-grooved lining-boards, and there are pipes coming from this housing to convey any of the very fine particles of dust into a room constructed to receive them, which is also constructed of tongued-and-grooved lining-boards. Notwithstanding that everything is done to collect the dust, the quantity floating about in the battery-house was, at the time of my visit, very considerable: even the outside of the walls and roof had all the same whitish-grey colour, denoting that dry crushing was going on inside the building.

Combination-pans and settlers.—There were eight combination-pans and three settlers erected in position at the time of my visit. Each pan holds a charge of about 1 ton of pulverised ore. When the pans are charged a little sulphate of copper and salt are added, and also the requisite amount of water to keep the charge in a state of fine pulp; a charge of 400lb. of mercury is then added, and each pan is worked for about four hours, the water being heated by a jet of steam from a boiler. The mullers of these pans are driven at a speed of from seventy to eighty revolutions per minute, and after working each charge for about four hours the slime is drawn off into the settler, and there worked for a similar period, with a continuous stream of clean water falling on the top. The revolving arm of the settler makes about seventeen revolutions per minute, and is kept working

CASSEL'S PROCESS.



PRECIPITATING TOWERS.



until another charge is ready to be run off from the combination-pan. The slime is gradually drawn off from the settler, and the quicksilver and amalgam collects in the bottom of the pan, and is drawn off into a canvas straining-bag, where the amalgam is finally collected.

In addition to these appliances there is a revolving Howell roasting-furnace; but they were not using this at the time of my visit. Mr. Russell informed me that they found no benefit in chloridizing the ore before amalgamation; at the same time, he admitted he was only saving about 60 per cent. of the silver in the ore. He was erecting a Frue vanner to try experiments with concentrating the ore. The operations at this company's works have consisted in nothing but experimenting as to the best class of machinery to adopt. For the past twelve months machinery has been erected and pulled to pieces again and again, and another class of machinery tried. Explosives have even been used to break up some of the original plant, without any other apparent reason than to prevent its remaining a memento of the experiments. There is, however, a good plant now erected, and it is to be hoped that there will be an abundance of payable ore to refund the shareholders for the large outlay and money spent in foolish blundering, which would not have been tolerated had it belonged to local proprietors; but, unfortunately, the money spent is foreign capital, and unless the mine possesses some rich ore to recoup the outlay it will be the means of retarding the introduction of capital into the colony for mining ventures.

The whole of the machinery was at the time of my visit driven by a horizontal under-type semi-portable steam-engine; but the company were erecting two Pelton water-wheels of 7ft. diameter and 15in. face, and intended to utilise the water from the Ohinemuri River as a motive-power. An underground tail-race has been constructed from the Ohinemuri River to the battery-house, to carry off the waste water from the Pelton wheels. A large shaft or paddock is sunk at the head of the tail-race and strongly timbered. In the bottom of this shaft or paddock the wheels are erected, where they are under an available head of water of 50ft., which will give about four and a half effective horse-power for every sluice-head of water they use on the wheels.

A dam has been constructed in the Ohinemuri River, and also another dam has been constructed in one of the branch creeks, as a supplementary supply. The water-race from the main dam to the battery is about 212 chains in length, and the dimensions of the ditch are, 3ft. 6in. on the bottom, 9ft. across the top, and 2ft. 9in. in depth. Assuming that it is capable of conveying water to the depth of 2ft. 6in., this would be equal to about twenty sluice-heads; the fall or gradient of the ditch being 1 in 2,000.

A pumping and winding shaft is sunk to a depth of about 130ft., and all necessary gear erected, but no workings had been carried on from the shaft at the time of my visit. There were eight men employed in breaking out ore from the adit-level, and twelve men employed in the construction or completion of the underground tail-race, as well as a number of mechanics engaged in the erection of the plant. A large quantity of ore was on the surface ready for treatment.

Since writing the above description of this plant, Mr. J. W. Walker, at the request of the Inspector of Mines, Thames, supplied him with a full description of the reduction plant and gold-saving appliances used by the company of which he is manager; and, as his remarks thereon are interesting to those engaged in the treatment of auriferous and argentiferous ores, and worthy of notice, the following is his reply to Mr. Wilson's letter:—

"Sir,— "Waihi Gold-mining Company, 8th April, 1890.

"Agreeable to your request dated 21st March, I send the following description of our reduction and gold-saving plant:—

"*Engines.*—One semi-portable compound forty-horse power; and one horizontal with Cornish boiler—diameter of cylinders 16in., stroke 3ft. The former is used for operating the rock-breaker and as much of our milling-gear as it is equal to on occasions when we run short of water. The latter is used for winding and pumping and furnishing steam for ore-treatment.

"*Water-power.*—By means of two large dams on the head branches of the Ohinemuri River we have raised these streams at that point 16ft., and by means of fluming and open channels the water is conveyed to the works, two miles and a half. The race is capable of bringing twenty-five sluice-heads. The power is obtained from two Pelton wheels placed at the bottom of a pit 52ft. deep, whence the waste water is conveyed again into the river at the lowest available point by a tunnel 1,200ft. long. The Peltons are 7ft. diameter over all, and are fed by a column 42in. in diameter, supplied with double nozzles for each wheel and with regulating-valves. The power is conveyed from these wheels to the gear on the surface by a rubber belt 20in. wide.

"*Reduction Gear.*—We have two large rock-breakers, but use only one. This is capable of reducing 40 to 50 tons in eight hours fine enough for our stamps.

"*Stamps.*—Thirty stamps, each 9cwt., run ninety-two to ninety-five beats per minute, fed automatically, and stamping through steel-wire gauze, 3,600 perforations each square inch, reduce in twenty-four hours 45 to 50 tons of ore to finest pulp, which falls into a trough carrying a special conveyor, which passes it along to the elevator; thence it is raised to the rotary roaster or, optionally, to an ore-bin capable of containing 50 tons.

"*Amalgamating-pans.*—These are known as the 'Combination mills,' similar to the old 'Wheeler'—5ft. diameter. We have eight of these pans, and treat about one ton as a charge for each pan. As our pulp has already been fined sufficiently, no pan-grinding is necessary, and therefore from three to four hours' agitation with 400lb. of mercury and chemicals, with steam, completes amalgamation, when the charge is allowed to flow into the settling-pans—8ft. diameter—where the mercury and amalgam are separated by gravitation, the pulp being gradually floated off, while the metal finds its way into cast-iron tanks, after being self-strained through inverted conical canvas bags.

"*Clean-up Pan.*—The crude amalgam in due course is periodically taken from the canvas bag and dressed in a 4ft.-diameter pan, and again squeezed—this time into balls, ready for the retort.

"*General Remarks.*—Ours being a dry-crushing process, it is necessary to have the ore quite free from moisture before treatment, and therefore it is dumped direct from the mine into kilns—of which we have ten—where it is not only dried but calcined. As we sink on our reefs doubtless more perfect calcination will be necessary to deal with the base ore usually found under water-level. We shall then use the rotary roasting-furnace on the ore when pulped by the stamps; meantime our rock is 'free-milling,' and we find that kiln-roasting suits our purpose.

"One ton of firewood treats one ton of ore; consequently fuel costs 1s. 3d. per ton. This expense, however, is more than balanced in rendering the ore brittle, and thus saving tear-and-wear of shoes and dies; and I may here state that I do not think a pulp so fine as we are milling is otherwise obtainable than by preliminary roasting of the ore.

"Two things in this connection stand out incontrovertible—first, that without fine grinding a large proportion of gold must pass off unliberated in the tailings; and, second, that the oftener and finer tailings are ground and reground the oftener you continue to add to the gross extraction.

"The wear-and-tear per ton on our stamps is less than that on wet stamps, as stamping is generally done elsewhere, and the actual cost is certainly not much greater.

"The duty performed comparatively by each process may perhaps be best judged of when I place figures side by side: thus, the finest gratings used on the Thames have 196 perforations in each square inch,—*i.e.*, 14 x 14. We are using mesh with 3,600 holes per inch—*i.e.*, 60 x 60.

"It has been said that fine stamping of the matrix means also necessarily fine pulverising of the individual particles of gold, and thereby adding to the difficulty of saving. This is true if gravitation is depended on principally, and it may also hold good in berdan or any such treatment, where the feed and discharge are continuous; but gravitation plays no part in our pans—fine particles have no extra chance of escape.

"From each charge of pulp put into our pans is taken a measured sample every morning. All these samples are mixed, quartered, and assayed. We thereby know what proportion of assay-value the process is giving. If it is not satisfactory it must be varied, at the discretion of the mill-manager, until results improve.

"Certain ores require more time in the pans, others less; and so also with the quantities respectively of salt, copperas, &c., in order to get perfect amalgamation. These are details I need not dwell on, and I will sum up by stating my opinion that five years hence there will be found more dry-crushing mills on this peninsula than wet ones. This I am certain of—namely, that, applied to the general classes of up-country ore, our process will produce from 50 to 100 per cent. more gold than any old-style mill now in use in the district.—I am, &c.,

"The Inspector of Mines." "J. W. Walker.

Silverton Mine.—All the workings in this mine were suspended at the time of my visit: the shareholders are waiting anxiously to see the Waihi Gold and Silver Company's reduction plant properly tested before forwarding any ore for treatment. They have a considerable quantity of low-grade stacked at the mine.

I have to express my thanks to Mr. McDonald Scott, who forwarded the balance-sheets of the different companies he is connected with in the Thames and Ohinemuri districts, which offered information in respect to the mines which cannot otherwise be obtained.

Te Aroha.

In my last annual report attention was directed to the new reduction-works which were erected by the Te Aroha Silver- and Gold-mining Company at Waiorongomai, and which were expected to quite revolutionise the systems adopted for the treatment of auriferous and argentiferous ores; but the venture has resulted in a disappointment to the company who erected the works, inasmuch as they spent their capital on the erection of a plant without ascertaining whether the quantity of ore necessary to keep it going could be procured from their mine. It will be recollected that the nucleus of this plant was purchased by an Australian syndicate from Messrs. Firth and Clark, of Auckland, who sent their manager, Mr. H. Adams, over to the Pacific Slope a few years ago, to get a knowledge as to the best appliances for the reduction and treatment of complex auriferous and argentiferous ores. On his return from America Mr. Adams was a fellow-passenger with Mr. W. R. Wilson, who has been successful in mining enterprises at Broken Hill, in New South Wales. The description of the lodes at Te Aroha given by Mr. Adams to Mr. Wilson induced him to form the Te Aroha Silver- and Gold-mining Company, to purchase the property, and to erect one of the best plants in the whole of the Australasian Colonies for the reduction and treatment of the auriferous and argentiferous ores which were said to be almost inexhaustible; but no sooner was the plant erected than the company found out that the quality of ore they were led to expect was in the lode did not exist in sufficient quantity to keep the plant at work. Indeed, it is the same old story—instead of spending several thousands of pounds in prospecting and testing the mine, the company had full confidence in the information they received, and spent their capital in the erection of a plant.

From a recent examination of this company's property one cannot help being impressed as to its value; but a large capital is required to develop it. There is what is termed the Main, or Buck Reef running along the backbone of the range for over three miles in length, with good shots of auriferous stone occurring here and there. In fact, it is the largest quartz lode in New Zealand, being from 10ft. to 20ft. in width; and the greater portion of the gold extracted from the Te Aroha field has been taken from the New Find Mine, which is on portion of this Buck Reef, and which now forms portion of the syndicate's property. Also, at the northern end of this property Mr. Ferguson's Glasgow syndicate have opened out this reef, and have got a valuable auriferous deposit on the outcrop, which is likely to yield several thousand ounces of gold. The natural facilities afforded for opening up and prospecting this mine cannot be excelled in any part of the world, as it can be worked giving as much as 2,000ft. of backs by adit-levels. In addition to this large Buck Reef there

are several other lodes in the property which have been proved to be payable for working by a proper process of treatment, such as this syndicate is now in a position to apply.

It cannot, however, be expected that the whole of this main lode will pay for working, for it is well known in every country where quartz-mining is carried on that the gold runs in shots and ledges, and nowhere is this shown more than in New Zealand. A shot of payable stone may be found for 400ft. in length, and possibly for not more than 70ft., and then comes, as it were, a blank in the lode; afterwards another shot may be found further along its course. Sometimes even in these shots there will be ledges where there is far more gold in the stone than in other places. For instance, on or near the outcrop a rich patch of gold may be found, and after going down for a few feet the stone gets poor; then another rich patch may be got deeper down. This is characteristic of the auriferous lodes that have hitherto been worked in the North Island, and it is not to be expected that the lodes in the Te Aroha district will prove an exception to the general rule. There is no gainsaying the fact that comparatively little prospecting has been done on this Buck Reef or main lode, unless in the New Find Mine, and here the shot of gold has been carried down to a depth of over 300ft.

The company now proposes to construct a low-level adit from the side of a creek near the Fern Spur, to cut the main lode at a depth of 900ft. below the outcrop, and then continue the same level along the lode to under the workings in the New Find Mine, which would necessitate about 5,600ft. of driving; and they also propose to construct uprises on the lode at different intervals. By this means the lode would be prospected systematically, and there is fair reason to believe that a valuable mine would be opened up. With the plant now erected very low-grade ore could be made to pay for working. From the point the adit commences to the lode is 1,800ft., and from the place where it cuts the lode to under the workings of the New Find Mine, 3,800ft. The construction of this adit is estimated to cost about £30,000. In constructing this adit it would cut the Silver King reef at about 1,030ft. from the mouth, the Werahiko reef at 1,340ft., and the Welcome reef at about 1,570ft. The whole of these reefs are auriferous and of a good thickness. When the adit was under the New Find workings there would be about 1,180ft. of backs. The proposed adit is a bold project, but it is one where success is likely to attend the undertaking.

Although the Te Aroha field has been opened for seven years, the amount of prospecting done is very limited. Auriferous quartz has been discovered on both sides of the main lode, and the direction of all the lodes on each side of the main one tends to show that they are only branches, or, at least, that the whole of them join the main reef.

The amount of gold got from this field, according to the battery returns, up to the end of 1888, was 26,313oz., the number of tons crushed being 35,146; thus giving an average yield of 14dwt. 23gr. of gold per ton. Since the present company commenced treating the ore—that is, from the 1st March, 1889, up to the 18th January, 1890, 4,045 tons of ore have been treated, which has yielded bullion to the value of £5,094: this gives an average yield of about £1 per ton. In addition to the original purchase, the present company have expended—

	£
On plant and machinery, exclusive of concentrating plant	15,599
On concentrating appliances	3,248
On tramway	1,788
On water-races	2,145
Total	32,780

The area of ground held by this company includes a special claim of 130 acres, and five licensed holdings, comprising in all 213½ acres.

Reduction-works.

The present system of working is described by Mr. John Howell, a mining expert from America who was engaged by the company to erect their reduction-works, and who is now engaged by the Broken Hill proprietary to conduct their operations during the absence of Mr. Patten, the general manager, who has had to leave on account of ill-health.

The quartz is conveyed in trucks from different mines by branch lines to the ground-tramway, constructed by the Piako County Council at a cost of over £18,000, of which amount the Government contributed £9,000. This line of tramway extends for a distance of three miles from the place where the reduction-works are erected, following round the face of the range on three different levels, and having three steep self-acting gradients.

The ore when it arrives at the battery-platform is discharged direct from the trucks on to the grizzlies or gratings, the bars of which are fixed 2in. apart, and all the small material amongst the ore drops through the gratings into hoppers, and is thence fed direct into the stamp-mortars by means of automatic self-feeding machines, known as the Challenge ore-feeder. The coarse ore passes down over the gratings to the rock-breaker platform, and is thence fed into Blake's patent rock-breaker, three of these machines being erected. The ore, after being reduced in the rock-breaker, is discharged into chutes, which conveys it into the Challenge ore-feeder. The rock-breakers are driven from a shaft by means of an independent Pelton water-wheel of thirty-horse power, and they are each capable of breaking 50 tons of quartz per day of twenty-four hours.

There are sixty heads of stamps erected, forty of which are of the pattern generally used throughout the colony. Each of these stamps weighs about 850lb. The stamps of the old pattern have a drop of about 10in., and generally run at about sixty-five strokes per minute. Mr. Howell states that these forty stamps have a crushing-capacity of only about 40 tons per day, or about 1 ton to each stamp. This seems to be a small average, considering that the quartz has been through the rock-breaker; but some allowance has to be made for this statement when it is taken nto account that Mr. Howell is making a comparison with the crushing-capacity of a new battery

which he had constructed on the American principle, the stamp-mortars of which were patented by himself in America. While admitting that the American battery is superior to the ones in general use in the colony, the difference in their crushing-capacity is not so much as Mr. Howell claims for them. The new battery consists of twenty head of stamps of the same weight as those of the old pattern, with a drop of 7½in., and run at a speed of ninety-five strokes per minute. These stamps are said to be capable of reducing 40 tons of quartz per day, being 2 tons for each stamp. This battery is furnished with steel cams, which are constructed in the form of an involute curve, and are much superior to the cams in general use in the batteries throughout the colony. The stamp-shanks are also provided with steel discs, which are held to the shank by means of vertical concave keys, the concavity being slightly less in radius than the shank of the stamp, and this key is held against the side of the shank by two cross-keys, one near the top end of the disc or tappet, and the other near the bottom. At the back of each stamp—that is, the side opposite the cam-shaft—there is a hinged wooden bar to hold up the stamp when required. When any or all the stamps are required to be hung up a thin piece of wood is placed on the top of the cam, and this raises the stamp sufficiently high to admit of the wooden bar being placed under the disc, which also allows the cam to revolve without coming in contact with the tappet. By this means any of the stamps can be hung up at a moment's notice without affecting the speed of the adjoining battery. The stamps are driven by two Pelton water-wheels of fifty-horse power each, one of these wheels being used to each thirty head of stamps.

The pulverised material is forced through the gratings, and passes directly over quicksilvered-copper plates, and which are about 4ft. in length, upon which the most of the free gold is said to be retained (this is, however, very doubtful, as it will depend on conditions to a great extent), while the coarser particles, and all the sulphides containing either gold or silver, escaping over those copper plates, are conveyed direct to the concentrating plant through iron pipes by means of a current of water. The gold and silver caught on the plates is cleaned up at intervals and treated in the ordinary way.

The concentrating plant consists of twenty Frue vanners, twelve of which are used for treating the material from the forty head of old stamps, and eight are used in treating the material from the twenty head of new stamps. The concentrators perform a most important work—namely, the separation of all base sulphides from the valueless quartz and gangue; and this result is attained by means of a simple arrangement, giving a lateral and side motion to the machines. Each machine is provided with an endless indiarubber belt 3ft. 6in. wide and 28ft. long, over which the pulverised material passes. The belt has an inclination of about 8in. to 12ft., and travels at the rate of about 2ft. per minute, while the vibratory motions sideways are about 200 per minute. The crushed material, as it is discharged from the pipe that conveys it from the copper-plated tables, drops on to the concentrator distributor, which distributes the material evenly across the whole width of the belt as it moves round. A spray of water from a perforated pipe is continually playing on the ore as it falls on the belt, and washes away the light particles, which are termed tailings, while the uphill travel of the belt against the stream carries over the denser metallic grains into a receiver underneath which is filled with water. The travel of the belt through this receiver washes all the particles off it, and leaves it clean to receive a fresh deposit as it comes round on top again.

The general all-round assay-value of the Waiorongomai ores crushed at the company's battery since its present proprietors commenced operations has averaged about £1 15s. per ton for gold and silver. The quality has of course greatly varied, a considerable quantity obtained from the New Find portion of the company's property having averaged £3 to £4 per ton. About 60 per cent. of the gold and silver contained in the ore is associated with base-metal sulphides which forms about 3 per cent. of the weight of the crude ore; so that by means of the quicksilvered-copper tables and the Frue vanners from 75 to 85 per cent. of the assay-value of the crude ore is saved.

Analysis of the concentrates show that they contain the following:—

	Per Cent.
Sulphide of lead	8·44
Sulphide of copper	3·35
Sulphide of zinc	12·80
Bisulphide of iron	48·50
Tersulphide of arsenic	0·17
Silica and silicates	26·05

These concentrates are removed from the receivers underneath the vanners, and fed into an elevator which discharges them direct into a Howell patent revolving-cylinder furnace, 5ft. in diameter at the widest end. This furnace revolves at a speed of five revolutions per minute, and has an inclination from the feed- to the discharge-end of 6in., the length of the furnace being 24ft. The result attained by passing the concentrates through this furnace is that fully 90 per cent. of the sulphur, together with all other volatile matter, is driven off by the action of the heat and atmospheric air passing through the furnace. As the roasted ore is discharged from the furnace it passes into a receiver, and is thence conveyed to the reverberatory or slagging furnace, where it is mixed with a percentage of lead-ores and subjected to a strong heat: the result is that it is raked out at the discharge-end in the form of slag, partially fused, and is then ready for smelting. The revolving cylinder-furnace is capable of treating 40 tons of concentrates per day of twenty-four hours, and the slagging-furnace half that quantity (20 tons) in the same time. The fuel used for heating the furnaces is partially wood and partially coal.

The slagged ore, and also the fuel and any other material required, is conveyed direct from the battery to the water-jacket furnace by means of a tramway and trucks. The latter are discharged direct on to the feeding and mixing floor, immediately above the furnace. Here the ore is mixed with the necessary fluxes—such as limestone, iron-ore, iron-filings, lead, &c.—and is then fed into the blast-furnace in layers with coke fuel.

The blast for the furnace is supplied by a Baker's No. 4½ blower, having six air-pipes, into the side of the furnace, driven by a Pelton water-wheel of about fifteen-horse power. The ore passing in through the smelter is subjected to a heat of about 4,000° Fahr., which reduces the whole of the contents of the furnace to a thin fluid. By the action of this intense heat the gold, silver, and lead are completely liberated from the ore, and, from chemical affinity and by their specific gravity, combine together and sink down through the molten liquid into the bottom of the furnace, known as the lead-well. The contents of the well are dipped out at intervals by means of ladles. The well here referred to is outside the furnace, and connected with the bath in the bottom of the furnace, and shows the height of the molten metal. The metal is taken from this well and poured into moulds, from which it is subsequently turned out in the form of bar-bullion, and stacked ready for shipment to the refineries. There is an opening in the water-jacket above the lead-well, which is stopped up, but is tapped at intervals to allow the residue or waste substance to run into slag-pots, where it is allowed to cool before being turned out.

It is not essential that all ores should be concentrated prior to smelting, as there are raw ores that are suitable to be mixed with the necessary fluxes and fed direct into the furnace, just in the same way that concentrates are, and smelted. It has been clearly demonstrated, however, with regard to the general run of ore mined at Waiorongomai, that it is suitable for concentration, and more cheaply treated by this method; whilst ores from other portions of the goldfield—Karangahake—have been found unsuitable for concentration owing to the low specific gravity of the sulphides contained therein—namely, that portion which covers the precious metals.

The water-jacket furnace is capable of smelting from 20 to 30 tons per day, exclusive of fuel and fluxes, the quantity varying according to the character of the ore under treatment. The general value of the bullion obtained has been about £60 per ton.

For the treatment of ores which cannot be satisfactorily dealt with by means of crushing and concentration, &c., the "Boss" plant is used. This plant consists of three grinding-pans, six amalgamating-pans, and two settlers, which are driven by a Pelton water-wheel, and are capable of treating about 30 tons of ore per day. The precious metals saved by this plant are found in the form of amalgam. The ore, previous to being treated in the plant, is crushed, and, if found necessary after assay, chloridized in the White-Howell revolving furnace, which is capable of roasting and chloridizing about 30 tons of ore per day. When the ore requires roasting after crushing, it is crushed in a dry state.

The present plant erected by this company is capable of treating about 100 tons of ore per day of twenty-four hours, and the cost of crushing and concentrating is said by Mr. Adams, the present manager, to be 3s. per ton. In connection with the works there is a very complete laboratory, fitted up with all the necessary appliances for making elaborate assays of the ore.

The following tables, supplied by Mr. Adams to the proprietor of the *Te Aroha and Ohinemuri News* of 30th November, 1889, show the cost of treatment of the ore at this company's works:—

Treatment of Siliceous Custom-ores and Company's Concentrates.

	£ s. d.		£. s. d.
To Labour	643 0 11	By Value of 155¼ tons concentrates produced from 4,536½ tons ore—assay-value	3,221 14 10
Four flasks quicksilver	40 0 10		
Freight on supplies	16 6 9		
Miscellaneous supplies	42 5 5		
Blacksmith's slack	6 9 11		
Oil, screens, &c.	43 8 0		
	791 11 10		
Less charges for treating custom-ores £28 12 7			
Supplies on hand 60 0 0			
	88 12 7		
	£702 19 3		£3,221 14 10

This shows the cost of crushing and concentrating to be about 3s. 1d. per ton of crude ore, or, the cost of producing the concentrates was £4 9s. 2d. per ton.

Roasting and desulphurising the concentrates in the Howell revolving furnace:—

	£ s. d.	
Labour	11 16 11	
44 tons of firewood	12 2 0	
Total	23 18 11	= to about 3s. per ton of concentrates.

Cindering of concentrates, lead, and siliceous custom-ores in the reverberatory furnace:—

	£ s. d.
Labour	252 5 7
Furnace-tools	1 15 9
15 tons fine coal	18 10 2
89 tons ordinary coal	86 15 9
245½ tons firewood	81 12 0
Total	440 19 3

Ore-treatment Memorandum.

Tons	cwt.	
156	12	concentrates
257	0	Broken Hill lead-ores
103	19	siliceous custom-ores
517	11	ore and concentrates treated in the reverberatory furnace at a cost of £440 19s. 3d., or about 17s. per ton.

Smelting of cindered concentrates and siliceous custom-ores in the water-jacket furnace:—

	£	s.	d.
To Limestone (72 tons)	55	8	11
Fluor-spar (11¼ tons)	9	0	6
Labour	359	10	7
Scrap-iron	64	15	7
Miscellaneous freights and supplies	8	17	6
Coke (139 tons)	288	6	7
	785	19	8
Less products of custom-concentrates	3	1	7
Total	782	18	1

This shows the net cost of smelting 517 tons 11cwt. of concentrates to be about £1 10s. per ton.

Summary of Expenditure.

	£	s.	d.
To Crushing and concentrating	702	19	3
Desulphurising and roasting	23	18	11
Cindering in reverberatory furnace	440	19	3
Smelting in water-jacket furnace	782	18	1
Total	1,950	15	6

This is equal to about £3 15s. 5d. per ton for crushing, roasting, cindering, and smelting.

The water-jacket furnace was charged on the 18th September, 1889, and continued running at intervals until the 1st November, during which period the furnace was under charge and tap for thirty days, treating an average of 20½ tons per day of twenty-four hours. The highest assay of slag from the tap was—Gold, *nil;* silver, 1oz. 12dwt. 16gr. per ton; and lead, 10 per cent.

Records of Water-jacket Smelter.

	£	s.	d.
To 156 tons 11cwt. concentrates, assay-value	3,405	16	10
257 tons lead-ore, assay-value	1,985	11	7
103 tons 19cwt. siliceous custom-ores at assay-value	2,440	17	6
Base bullion from tailings plant	622	19	2
Base bullion purchased from old battery company	15	0	0
	8,470	5	1
By 125 tons 10cwt. auriferous silver-lead bullion shipped to London	8,258	3	11
Estimated value of lead-well, &c., on hand	100	0	0
	8,358	3	11

This is equal to 99½ per cent. of the assay-value of the concentrates and base bullion treated. Or, suppose the £100 added as the estimated value of the lead-well, &c., were deducted, then the saving would be equal to about 97½ per cent. of the assay-value.

Although the present plant at Waiorongomai is the most complete there is in the whole of the Australasian Colonies, it must not be supposed that it is suitable for every class of auriferous and argentiferous ore that is met with in the North Island. For instance, Mr. Cornes, manager of the Champion Mine, at Tui Creek, informed me that his company got 23 tons of ore treated at these works, and only got about 46 per cent. of the assay-value of the ore; but it must be borne in mind that the ore from the Champion Mine is the most complex and refractory ore found in the colony, and none of the plants in Europe have as yet been able to treat it satisfactorily owing to the large quantity of zinc-blende the ore contains. There are also large bodies of ore containing sulphides, selenides, and tellurides of silver, which are not suitable for concentration; and it is very questionable if the Boss plant is capable of extracting a large percentage of the silver in this class of ores. Each class of ore has to be treated on its merits, and this means that it requires at each reduction-works an experienced metallurgist to conduct the operations in connection with the treatment of the various ores that come to hand.

Ferguson Syndicate Company.—This company's mine, or special claim, adjoins the northern end of the Te Aroha Silver and Gold Company's properties. It will be remembered that some two years ago Mr. Ferguson went Home to try and float a company to work this ground, and succeeded in getting a Glasgow syndicate to take the property up. Mr. Ferguson has lately discovered a rich shot of gold in the Buck, or Main, Reef a few chains further to the northward than where the gold

was first discovered in the Premier Company's ground. The reef at this place is about 8ft. in thickness, but the very rich run of stone is only about 12in. wide. A winze is being sunk on the lode, and stone stacked ready to send down to the battery as soon as it is completed. This discovery is from 1,800ft. to 1,900ft. above sea-level. Adits and winzes are being constructed so that the stone can be sent down in passes from one level to another to the hoppers at the head of the tramway. About a ton of picked stone has been bagged and taken down to the battery-house, which, according to assay, will realise £100, and there were about 50 tons of ordinary ore, which would give about 2oz. of gold per ton, stacked alongside the new discovery. The quartz will be taken from the hopper near the mine to the battery which is erected at the side of Waiorongomai Creek by a self-acting inclined tramway, having two separate grades and being worked with brakes at the top of each incline.

Reduction Plant.—The ore is dumped into an ore-bin at the bottom of the inclined tramway. Thence it is led by gravitation over a grizzly, and what passes over this is led into a hopper, which feeds a Blake stone-breaker, where the ore is reduced to about 1½in. in diameter. The fine material that passes through the grizzly, and also the material from the stone-breaker, falls into a hopper, and from this hopper the broken ore passes into a drying-furnace.

Drying-furnace.—This furnace is built with brick on an inclination of about 1 in 1, being 20ft. in length on the slope, having a width of about 3ft. and a depth of 6in., and in its length it has thirteen steps, which prevents the ore from running down too fast. On the back of the steps there is a flue coming up from the furnace-box, which is placed at the bottom, and on the top end of the flue there is an iron chimney or funnel to carry away the smoke, in which a damper is placed to regulate the draught. On the front side of the drying-furnace there are as many cross-plates of iron as there are steps, and these cross-plates stand on edge and keep the ore in position while drying. When the ore is sufficiently dried the door at the bottom of the furnace is opened, and the material is run over a second grizzly, and all that does not pass through falls into a hopper, and passes through a second stone-breaker and is reduced to about the size of walnuts; thence it passes into a hopper, which feeds the Lamberton mill.

Lamberton Mill.—This consists of a cast-iron pan, having a convex circular top. It is about 3ft. 6in. in diameter, and about 2ft. 6in. deep. The convex top is bolted to the sides as well as the bottom of the pan. All the joints are made air-tight. In the inside of the pan there is a cast-steel false bottom with a circular groove for cast-steel balls to rotate in. These balls are 10in. in diameter, and there are ten of them in each pan. On the top of these balls there is a cast-steel disc-plate having a shallow groove on the under-side, which has the effect of keeping the balls steadily in their course while revolving. There is a hollow vertical shaft which passes through the cover of the pan and also through the disc-ring, and it is through the centre of this shaft that all the ore is fed into the mill. Above the disc-ring there are circular plates of cast-iron, which are merely used as weights so as to have a weight equal to 2 tons pressing on the balls. On the top end of the shaft there is a bevelled pinion, which is driven by another bevelled pinion placed on a short horizontal shaft having a fast-and-loose pulley on the outer end, and driven by a belt from an intermediate shaft. The disc-ring is made to rotate at the rate of from 100 to 110 revolutions per minute. The effect of this is that it sets all the balls rotating, and the centrifugal force causes the balls to press hard on the side of the groove in the false bottom next to the periphery, and no doubt will form a very effective grinding-machine; but it is questionable if the wear-and-tear on the balls will not be too great to justify their adoption. This has proved to be the case with the same class of mills at the Crown Claim, Karangahake, when wet crushing was carried on, where some six sets of balls were worn out in crushing 60 tons of ore; but Mr. R. Ferguson states that in crushing dry there is very little wear-and-tear. However, this has yet to be proved in dealing with the hard New Zealand ores.

The gratings proposed to be used with these mills are made of ¼in. mesh. Each grating is 2ft. long by about 1ft. deep. Four of these are used in each mill. The reason assigned for using such coarse gratings is that a large quantity of the material gets pulverised fine enough to pass through a sixty-mesh screen, and it is better to get clear of all the fine material as soon as possible, and whenever coarse grains come through the gratings they are caught on the shaking-table and lifted with elevators back to the mill to be reground.

Shaking-tables.—As soon as the crushed material comes from the mill it passes on to two shaking-tables, which are 6ft. long and 2ft. wide, having bottoms of fine wire, gauge thirty-mesh. These tables make 250 shakes per minute, with a 2½in. stroke. The fine dust, going through the screen, is then in a fit condition to be either amalgamated or treated by the Cassel process.

Amalgamating-pans.—There are eight Mackay or Fraser pans, and four settlers, for treating the ore that is suitable for amalgamation. Where pulverised ore has to be reduced to a fine state the Mackay or Fraser pans have no equal as grinding-pans, but they are not good amalgamators, as they flour the mercury considerably. The plant for the treatment of the pulverised ore by Cassel's process was not constructed at the time of my visit.

Tui Creek.

There is very little work being done in the mines in this district. There were only three men employed in the Champion Mine at the time of my visit. A good deal of stone has been taken out near the surface along the cap of the reef from the saddle downwards, or to what is known as the "blow," where cinnabar is found in the centre of the lode. Two adit-levels have been put in from the side of the range, and stone taken from the lode. In the lower adit-level the lode cut out going northwards, but coming southwards it was from 5ft. to 7ft. in thickness, and contained a good deal of galena, zinc-blende, and a little copper. A parcel of 23 tons of ore was forwarded to Waiorongomai for treatment. Average assays were made from this parcel with the following result:—

No. 1 sample—6dwt. 12gr. gold per ton;
31oz. 7dwt. 4gr. silver per ton.
No. 2 sample—3dwt. 6gr. gold per ton;
13oz. 7dwt. 4gr. silver per ton.

The ore was crushed wet and was then concentrated, but only 46 per cent. of the bullion was saved by this process, which gave the Champion Company £16 net after the expense of treatment, which was not sufficient to justify them forwarding any more for similar treatment at the Waiorongomai Works. The manager, Mr. Cornes, informed me that the English directors of the company had given instruction for 500 tons of ore, assaying to the value of £9 per ton, to be forwarded to England for treatment, in order to see if a process can be got to deal satisfactorily with this class of ore, which is very refractory and complex, owing to the large quantity of zinc-blende it contains.

The company have erected an aerial tramway one and a half miles in length to convey the ore from the mine to the flat. This will cheapen the cost of transit of the ore considerably. They estimate the expense of working the tramway, including wear-and-tear, to be equal to about 9d. per ton. This tramway was constructed by Mr. R. J. Johnstone, who was for some years at Reefton, where these tramways have been used, and it works very satisfactorily; the cost of erection and material being about £1,500. The same gentleman is now engaged in superintending the erection of two similar tramways at Tararu Creek; and no doubt, when once introduced at the Thames, the mine-proprietors will find them more economical for conveying the ore from the mines to the battery than by using horses and drays as they do at present.

In concluding my report on the quartz-mines in the North Island, they are gradually getting more developed year by year, and, although the rich finds of auriferous ore are not so generally met with as in the early days of the fields, the improvements in mining appliances, as well as the knowledge gained in regard to the occurrence of auriferous and argentiferous lodes, and also the special attention that is now being given to the treatment of the different ores, are tending to place mining on a better basis, and this will ultimately result in being able to make poorer lode-stuff pay for working. Many of the lodes that are now considered of too low grade to work will be taken up and made remunerative ventures, and in developing them other discoveries will be made. The whole of the Hauraki Peninsula is full of auriferous and argentiferous lodes, many of which may not prove payable for working; but a great many of them will be made remunerative with improved appliances. The time will come when there will be large reduction-works on the different fields where ores will be purchased according to their assay-value; and, instead of each company spending its capital in the erection of small inefficient plants, the money will go towards developing the mines and prospecting the ground. The system of each company having a crushing plant of their own is fraught with many difficulties. There is no one system that is suitable for the treatment of all the ores found in the North Island, and small companies have not the capital to erect expensive works to treat the ore properly, neither does the extent of their mines warrant a large expenditure on plants of this description. If the present companies on such a field as the Thames were to combine together and erect a central reduction plant for the field, where experienced metallurgists were employed, and to get from 90 to 95 per cent. of the value of the bullion in the ore, less the cost of treatment, there is many a claim that would pay for working that does not at present.

The total quantity of material crushed last year in the North Island districts, according to the returns from the several crushing-batteries, was 42,513 tons of quartz, 2½ tons of picked specimens, 29,595 tons of mullock, and 7,856 tons of tailings; which yielded 67,323oz., representing a value of £130,961. This value includes £3,000 for ore exported from Karangahake, and, as the value of the bullion last year from this field was £1 7s. 6d. per ounce, it would be equal to 2,182oz. This is not added to the above total of gold obtained, but it is added in the following table.

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.	Yield of Gold.	Average Yield of Gold per Ton.
Coromandel—		Oz.	Oz. dwt. gr.
1st April, 1880, to 31st March, 1881 ...	720	4,960	6 18 0
" 1881, " 1882 ...	3,358	7,351	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
Totals	15,101	56,231	3 14 11

District.	Number of Tons of Quartz and Mullock crushed.	Yield of Gold.	Average Yield of Gold per Ton.
Thames—		Oz.	Oz. dwt. grs.
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
Totals	441,388	556,878	1 5 6
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
Totals	10,956	15,649	1 8 14
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
Totals	40,040	46,729	1 3 8
Grand totals from North Island	507,485	675,487	1 6 16

* This includes 29,595 tons of mullock crushed last year.
† The gold obtained includes £3,000, value of ore exported, at £1 7s. 6d. per ounce.
‡ The value of the bullion obtained from Te Aroha was 11s. 6d per ounce.

COLLINGWOOD.

Red Hill Company.—This company was floated in England with a capital of £150,000, in 150,000 shares of £1 each; but out of this 34,450 shares were not issued, thus leaving 115,550 shares actually issued. The company have acquired properties in the vicinity of the Red Hill, Collingwood, for which they paid £100,000, of which amount £2,000 was paid in cash, and the balance was given in 98,000 shares fully paid up. Such is the position of this company as stated in the Nelson *Colonist* of the 19th February last, which adds: "The company thus started with an available capital of something under £18,000, and had the fond dreams which were indulged in turned into veritable facts, the sapient business people of London who so willingly joined in the speculation would have had about one-fifth of the profits to divide amongst them, while those from whom they purchased, and who are nameless, would have pocketed £80 out of every £100, made without any risk."

In three years it appears that £11,764 7s. 10d. was spent in New Zealand, of which amount £4,695 had been expended on a water-race, £2,117 on plant, £1,012 on contracts, £1,164 on wages, £808 on salaries and honorarium, £119 on cablegrams, and, amongst other items, no less than £410 on travelling and miscellaneous expenses. Machinery was purchased in London for £2,401 0s.6d.; but this was reduced to the extent of £690 by £600 claimed by the Hydrogen Amalgam Company and £90 for machinery sold. Current expenditure, including £4,416 brought forward from 1888, is set down as £6,083, the largest items for the year being £1,200 for directors' fees, and £1,144 in connection with office-expenses and interest on debentures, &c. These figures are taken from the annual balance-sheet made up to 31st August, 1889.

According to the report published in the *Money Review* of the 7th December, the chairman stated at the meeting that, as serious dissensions had broken out among the local board of management, the directors sent out the secretary of the company, Mr. Cousins, who is a Fellow of the Chemical Society, and was at one time one of the instructors in the Royal School of Mines, to examine and report on their property; and on his arrival in the colony he found affairs in almost a hopeless condition — work at the mine suspended, creditors clamouring for payment of their accounts, miners for their wages, law-suits impending, leases not kept up—in fact, the company were in serious danger of losing their property, and the local managers at daggers-drawn with one another. Mr. Cousins, in his report to the directors, states that the company has

a quartz-mine of undoubted value (which is, indeed, questionable), and regrets that nothing has been done to open it out since it was owned by the company, and goes on to state the thickness of the four leaders which have been previously worked in the claim, &c. The manager, Mr. Johnston, informed me that this company holds mineral leases of 640 acres and 570 acres respectively; also 44 acres as a quartz claim, and 30 acres of alluvial ground; thus making a total of 1,284 acres: and at the time of my visit there were four men employed in the alluvial claim, and two men prospecting in the quartz-mine. These were the total number of men employed by the company.

Quartz Claim.—The workings, with the exception of a low-level adit, are confined to the upper level. This is carried into the hill for a distance of 411ft., going at about right-angles to the leaders of quartz that have been worked. There are four leaders cut in this adit-level, varying from 2in. to 5in. in thickness, all of which are apparently auriferous. The quartz from these leaders also contains large quantities of copper-pyrites. They seem to have been worked from this level to the surface, but whether they will prove payable for working downwards is a question yet remaining to be proved. At the end of the upper adit-level the present company are constructing a winze, which was down at the time of my visit to a depth of 28ft. The No. 4 leader was cut in this winze—or, rather, it may be termed a monkey-shaft, since it was sunk vertically with the view of cutting No. 3 leader, which is about 15ft. to the westward of this shaft. There are also several small string-like veins of fine quartz running here and there in the sandstone, which the manager informed me carried gold; but these veins would require to be extremely rich to pay for working. The same may be said of the leaders. There is no regular quartz lode yet found in this company's ground, but it resembles to some extent the small leaders found in the Tokatea Range, at Coromandel; but, unfortunately, they do not appear to carry so large a percentage of gold.

The low-level adit is constructed from the side of the range facing Appo's Gully, at something like 300ft. above the level of the machine-site. This adit-level was subsidised to the extent of £300 by Government. At a little over 600ft. in from the mouth a small leader was cut which is supposed to be a continuation of the No. 2 leader found on the upper level. The quartz from this leader in the low-level is highly mineralised, and has every appearance of being auriferous; but the cost of working all these leaders will be very considerable, as a large quantity of the country rock has to be taken out before a ton of quartz can be obtained. Scarcely any work has been done in the quartz-mine since this company acquired the property; indeed, it may be said they are only beginning to prospect the mine with the two men they have employed in the construction of the monkey-shaft before referred to. The manager showed me a mullocky reef which he said contained a little gold, and it seems to be the same as that mentioned in Mr. Cousins's report, which states that Mr. Price Williams originally reported it to the company after his visit to this district as being 9ft. in thickness. There are, however, grave doubts whether this mullock will pay for working.

Head-race and Dam.—A weir is constructed across the Parapara River to raise the water sufficiently to enter the boxing that has been constructed to convey the water along the side of the range. This boxing or flume is a mile and a quarter in length, and terminates at the mouth of a tunnel leading from the Parapara side of the range into the head of Appo's Gully. The boxing is 3ft. wide by 1ft. 7in. in the clear, having the bottom 2in. and the sides 1½in. in thickness, and strapped with scantling every 3ft. All the boards have been close-jointed, so that battens over the joints are dispensed with. There are several inverted queen-truss bridges over breaks and gullies, having wire-ropes under the queen truss, made fast at each side of the gully, to support the bridge. The whole of the head-race is constructed on a gradient of 1 in 528, or 1½in. to every 12ft. in length, and at the time of my visit was conveying about six sluice-heads of water.

The tunnel between the Parapara side of the range and Appo's Gully was constructed at both ends for a certain distance, but it still requires about 200ft. to be driven before it is completed. From the lower end of this tunnel the ground is benched ready to lay stringers and boxing, which will convey the water to a point on the side of the range at an elevation of about 160ft. above the level of the machine-site.

Alluvial Claim.—The company, at the time of my visit, was utilising the water from the head-race on the upper side of the tunnel to sluice away a deep run of alluvial ground which appears to run through into Appo's Gully. They have constructed a line of tail-boxes to the Parapara River, a distance of 1,100ft., on a fall or gradient of 3½in. to 12ft., the boxes being 20in. wide, with sides 1ft. high, all of timber 1½in. in thickness. The water for sluicing is taken from the head-race for a certain distance by a wrought-iron pipe 11in. in diameter, the end of which is at an elevation of about 35ft. above the bottom of the tail-race. There is a connection at the end of this pipe whereby the water is conveyed in two separate canvas hose 5in. in diameter, at the ends of which are brass nozzles 2in. in diameter. The total elevation of the head-race above the tail-race is 80ft.; but the most of the pressure due to this head is absorbed in friction in the canvas hose, so that it is of little service for breaking up the mullock-bars in the ground. This portion of the workings is carried on in a very primitive style, all the stones above or about 6in. in diameter being picked out and thrown into a small iron truck, and carried some distance by a tramway to the stone-tip.

This run of deep ground or gut going through the hill has been worked for many years at a high level, and a large quantity of gold has been taken from it. Now this company are working it at a much deeper level, but are not yet on the bed-rock. The gold seems to be distributed in layers amongst the wash. There are four men employed here working the ground, and the manager informed me he can get sufficient gold from these workings to pay all other expenses, including the expenses in prospecting the quartz-mine. Previous to commencing to work this deep ground they had made a commencement to sluice the ground in Parapara Flat, which was taken up by Mr. Keep for the company; but Mr. Cousins states that the company will be fortunate if they get back the money—namely, about £2,000—they have expended on this claim. He also states that there is 20 acres in Appo's Gully that is reported to be rich ground.

Crushing-plant.—A crushing-plant has been partially erected in Appo's Gully, which consists of a Blake-Marsden rock-breaker, one of Askam's patent centrifugal pulverisers, size H, two of Mumford and Moodie's separators, two vertical mixing-machines, and six of the Askam-Malloy hydrogen amalgamating-pans; the whole of which is to be driven by a Pelton hurdy-gurdy wheel of 5ft. diameter. There is also a large brick furnace built for assaying, smelting the bullion, and retorting the amalgam. This is entirely a different description of reduction plant from any yet erected in the colony, and a description of it may be of some interest to those engaged in the treatment of auriferous quartz.

Blake-Marsden Rock-breaker.—This machine has been already fully described in my previous reports on machinery at the Melbourne Exhibition. It is only necessary to state that the machine is placed on the floor where the ore coming from the mine will be dumped. The quartz is fed into the machine by hand-labour, and the material, after passing through the rock-breaker, falls into a chute which conveys it to the pulveriser.

Pulveriser.—This machine consists of a strong circular cast-iron casing about from 2ft. 6in. to 3ft. in diameter, and 4ft. in length, having a wire mesh screen on the end, through which all the fine pulverised material passes into a recess in the cast-iron casing, and then into a bin below. A horizontal shaft passes through the centre of this casing, on which heavy cast-iron beaters or arms are placed. These are set at certain angles to drive the material to be pulverised from one arm to another, and, as the shaft on which these arms are placed makes 250 revolutions per minute, the material, after going through the stone-breaker, gets pulverised to fine dust and passes through the screen at the end. It is almost impossible to describe this machine without a diagram or plan, but the time at my disposal at this company's works would not admit of this being made. As stated previously, it is a pulverising-machine not known in the colony, and it would be premature to condemn it before it had a proper trial; but, judging from its construction, there will be a great wear-and-tear on the arms and casing, and to all appearances it is a machine which does not commend itself as a grinder for quartz ores.

Separators.—These machines have a wrought-iron casing, which is about 5ft. in diameter on the top, with vertical sides for a foot or fifteen inches, then the rest of the casing resembles an inverted cone, having an opening in the bottom of about 4in. Inside the casing on the top there is a cast-iron circular trough, with tubes and openings, which revolves, and there is a hopper placed outside the casing for receiving the pulverised material from the bin where it is deposited from the pulveriser. It is lifted from this bin by small buckets placed on an elevating-belt, and discharged into the hopper, and thence passes inside the casing, where a current of air separates the fine from the coarse particles and places them in separate divisions, the fine material passing into a chute which conveys it to the mixers, and the coarse particles pass into another chute, which conveys them into a bin below, where they are again lifted by an elevator-belt and discharged into a chute leading to the stone-breaker, and again passes through into the pulveriser.

Mixers.—These are circular tubs or drums about 3ft. in diameter and 4ft. deep, made of wrought-iron. In the inside of these there is a vertical shaft from which arms project, resembling the shaft and arms of a pug-mill. As this shaft revolves, the fine material, along with a small stream of water coming in, is converted into pulp, or in a condition suitable for amalgamation.

Askam-Malloy Pans.—These are the same description of pans that were tried at the Thames, and the results of their trial there was far from satisfactory. Each of these pans is said to be capable of treating 4 tons of pulverised ore in twenty-four hours, so that, although the pulveriser is said to have a grinding-capacity of 40 tons per day, the amalgamating plant has only a capacity of 24 tons.

This plant is meant for dry crushing; but if the English shareholders sent out this description of quartz-mill as an economical machine, it would have been better that their mill could be either used for wet or dry crushing, according to the character of the ore to be treated. Indeed, the whole plant looks like something sent from England as an experiment to test its capabilities. If so, it would have been well had the patentees sent out a man who understands the working of it, or else the millmen here are likely to condemn it without giving it a fair trial.

In concluding my remarks on this company's quartz-mine the present prospects are not very encouraging. It is a locality which justifies the expenditure of money in prospecting, as probably a lode of moderate thickness will be found; but there is very little hope from what is found in the mine yet of the company being repaid the capital they have expended on machinery and plant and for the purchase of the property. The manager informed me that the expenditure on the works, machinery and plant, &c., by this company up to the time of my visit was a little over £20,000. This sum corresponds in a measure with the company's last balance-sheet, which shows that in addition to the capital paid up £4,565 was raised on debentures, and the amount owing sundry creditors was £3,665. It is almost impossible for this company ever to be recouped for their outlay. The large amount given away in paid-up shares for the property, and the expenses of management, which is exclusive of the manager's salary—according to their balance-sheet for the year ending 31st August, 1889, £2,485 15s. 6d., but including £440 for interest on debentures—requires a large profit to pay interest on the capital. Whenever a company is handicapped in this manner it requires a very rich mine to pay any interest on the outlay. The only hope of this company being enabled to repay the shareholders who advanced the capital is to write off a large number of shares and re-form it on a more economical basis.

Johnstone's United Gold-mining Company.—This company holds a quartz claim at the head of Bedstead Gully, and the workings show the most peculiarly lying quartz lode in the colony. The lode to a certain extent may be termed in many places a quartz conglomerate, lying nearly horizontal, and varies in thickness from 5ft. to 10ft, which the manager, Mr. Johnstone, informed me averaged about 5dwt. of gold per ton. The mode of taking out the quartz resembles that of working a deep alluvial mine; and it can be safely worked on this principle if properly opened out, so that the ground

can be cut into blocks, and the worked ground either filled up with rock or with plenty of crib-work. But the workings are neither one thing nor the other, and the manager has been served with notice that it is essential for the safety of those employed underground to work the ground on a different method from that now adopted. Several falls have already taken place from the roof; but whe e these have occurred the workings were abandoned. Large excavations are made by stoping out the whole of the quartz and leaving the roof supported with props, or what are termed "sodgers," placed here and there, with no stone fillings. The travelling-roads are carried in alongside the solid, but through the worked ground, which is in some instances taken out for a chain in width. If the roof were to give way (and the sodgers are very little support) whilst the men are at work, there is no escape for them. At the time of my visit the workmen had to go up an uprise for 78ft. from the main adit-level into the stopes; but the manager had men employed in constructing a second travelling-road in case of anything occurring to damage the uprise. There is a good adit-level constructed in solid ground for 880ft., and also good ventilation in the workings; but the lode, being horizontal or nearly so, requires a different method to be used in stoping it out.

The quartz is conveyed in trucks along a tramway from the mouth of the adit to a hopper, which is constructed directly above the machine-site. The crushing-plant consists of twenty heads of stamps, with the ordinary quicksilver- and blanket-tables and two berdans, and the manager stated the crushing-capacity of the plant was about 150 tons of stone per week.

Mahakipawa.

There has not been a great deal of work done on the quartz reefs in this district since my last visit. Still, prospecting has been steadily carried on, and a great deal more now is known respecting the reefs. Three of the claims—namely, the Mahakipawa, Kapai, and Waikakaho—have been acquired by the Ravenswood Gold-mining Company, London, which is represented here by Mr. Turner. They formerly held the quartz-mine at Jackson's Head now belonging to the Endeavour Inlet Antimony Company, and they also had a claim in the Maori Gorge, at Wakamarina. It has not transpired yet what is to be paid for these properties; but provision has been made for £25,000 of working capital, and this company will shortly take possession of these properties and work them.

Mahakipawa Licensed Holding.—The reef here has been sunk on for some distance from the outcrop, and the stone proved to be payable for working. A low level is being constructed, and is now in for 180ft., but requires to be driven another 120ft. before it will cut the reef, when there will be 160ft. of backs. There have been two men employed constructing this level.

Kapai Licensed Holding.—This is situate near the top of the saddle between the right branch of the Mahakipawa Creek and the Waikakaho Creek. There have been two men employed on this holding, constructing an adit-level on the lode from the side of the range. This level is constructed for a distance of 155ft. along the lode, which gives about 145ft. backs. The lode varies in thickness from 2ft. to 8ft., but would average 4ft. to 5ft. for the whole of the distance. Samples of quartz sent Home, which were said to be taken from the heap as it came out of the lode, went at the rate of 2oz. 15dwt. of gold per ton; while similar samples sent from the Mahakipawa Claim went at the rate of 1½oz. of gold to the ton. There is some really good specimen-stone to be found in the Kapai lode, and the gold is in some of it very coarse, while in other portions of the stone it is of a tolerably fine character; and the lode-stuff carries a great deal of pyrites, which appears to be rich in gold. It is estimated that there is 4 per cent. of pyrites in the ore, so that concentrators will be required here in the treatment, or else a large percentage of the gold in the ore will be lost.

Waikakaho Licensed Holding.—This holding is situated on the Waikakaho side of the range, and adjoins the Kapai near the saddle. There have been five men employed in prospecting this claim. An upper adit-level was driven along the lode for 250ft., when it pinched nearly out, still leaving clearly-defined walls, with indications that it will widen out again some distance ahead. This lode is 6ft. wide at the mouth of the adit, but in the 250ft. in length it varies considerably in thickness, but would average for the whole distance from 2ft. 6in. to 3ft. The stone from this lode is highly mineralised, and contains gold all through the lode. The manager has tested many samples by crushing them in a common mortar and panning them off in a tin dish, and then weighing the gold. He estimates the whole of the stone to contain about 2oz. of gold per ton. This level gives 255ft. of backs.

Another adit is constructed at about 145ft. below the upper one. This adit is taken in at nearly right-angles to the line of reef, and it cuts a lode about 3ft. 6in. in thickness, containing a fair amount of gold, and highly mineralised. This lode is supposed to be the same as that first discovered in the Kapai Claim, which runs parallel with the Waikakaho and main Kapai lode, and about 120ft. distant.

There is about 1,000 tons of stone from these claims on the surface, ready for crushing, and there seems little doubt but that these are good mining properties. There is a large body of ore in sight, but what is between the levels and the surface no one yet knows: the natural supposition is that, where the lode carries gold at the surface, and also at lower levels, that it is auriferous between, and will not vary a great deal in the quantity of gold the lode-stuff contains.

The company intend to construct an aerial tramway from the Waikakaho adit to the flat below, when there will be about 1,520ft. of fall in two miles, which is the proposed length of tramway. This means that the average gradient will be about 1 in 7 from the mine to the battery-site. They also propose erecting a crushing-battery of ten heads of stamps, in the first instance, with provision for an additional ten heads, and to have stone-breakers, concentrators, and amalgamating-pans, which will be driven by a Pelton hurdy-gurdy wheel. There will be about five sluice-heads of water to be got from the creek in ordinarily dry weather, and this can be brought in at an elevation of 320ft. above the machine-site.

Southern Cross Licensed Holding.—This holding adjoins the Waikakaho's lower boundary,

and has the same line of reef going through the ground as that found in the Kapai and Waikakaho holdings; only the lode in this claim is greatly broken up, and looks more like decomposed quartz, whereas the quartz in the other claims is of a solid, hard character. However, the lode-stuff in the Southern Cross claim contains a good deal of gold near the cap of the reef. At present there are four men employed in driving an adit-level, which was constructed at the time of my visit to this field for a distance of 160ft., but it requires to be driven for another 130ft. before they expect to cut the lode which they found on the surface, but they expect to cut the second Kaipai lode in a few feet further. This adit will give them 160ft. of backs. Before commencing to construct this adit they sank a winze for 35ft. on the lode, which is from 3ft. to 4ft. in thickness, all of the same decomposed nature, which could be broken out with a pick, without any blasting.

The lodes in this district are generally running in a north-westerly and south-easterly direction, and dipping south-westerly at an inclination of about 1 in 2, while the general dip of the adjoining rock is north-easterly. The lodes therefore cut through the strata. With the exception of these claims there has been no prospecting done on any of the other holdings taken up. It would appear from the gold being found at the head of the Prospectors Creek that other reefs will yet be found in this district, and probably richer than those yet discovered.

Wakamarina.

A good deal of prospecting was done in bygone years for quartz reefs in this district, but none were found that promised to prove payable for working. Some of the creeks and gullies leading into the Wakamarina River have contained very rich deposits of auriferous wash-drift, and the gold was intersected with quartz. This induced the miners to look for an auriferous-quartz reef on the range between the heads of two of the richest creeks that lead into the river—namely, Deep Creek and Dead Horse Creek. There is a large quartz lode projecting above the surface on the face of the range on the fall into Dead Horse Creek, which resembles at a distance the Buck Reef which runs along the Te Aroha Range. The foot-wall projects in places above the surface on the lower side as much as 30ft., with the quartz standing up against it in places. This outcrop seems to have been prospected without finding anything payable for working. About six years ago a company was formed, known as the Golden Bar Gold-mining Company, to prospect this lode. They constructed an adit-level a little below the outcrop, and drove for some distance on each side of this level on the lode, which was about 8ft. in width of quartz, but contained a horse of mullock in the centre, so that it formed two lodes, each 4ft. wide. The lode-stuff contained a little gold, but was considered too poor to pay for working. On visiting these workings six years ago my opinion then was that the lode should be prospected from a lower level (*vide* annual report, 1884); but the company suspended operations, and have only recently constructed an adit-level about 160ft. below the former one, and cut the lode at about 250ft. from the mouth.

The quartz lode in the low level is well defined, and is about from 5ft. to 6ft. in thickness, containing a good deal of pyrites. The quartz in the lode has a foliated appearance, resembling the quartz-schists in Otago, only the foliations are wider apart. Some of the seams contain pure-white quartz, which, to use a miner's phrase, has a very hungry appearance. There are other seams of bluish quartz having different-coloured veins, which have every indication of being auriferous, and from these seams one would expect to come on specimen-stone here and there. There was no one at the mine at the time of my visit, but I inspected the workings and examined the lode and the quartz lying at the mouth of the adit; but failed to see much gold. The appearance of the lode would lead one to suppose that patches of gold will be found in some of the narrow seams, but not generally distributed through the whole width. It is a quartz reef, however, which carries gold, and, although it may not prove payable for working in places, there is little doubt but that portions of it will be payable. It is well-known that gold occurs in shots and ledges in the reef, and these shots in New Zealand do not run for long distances along the lode, only occurring here and there, and there is no reason to suppose that this one will prove an exception to the general rule. It may be termed a true fissure-lode, as it cuts through the strata of the adjoining rock; but it requires further prospecting before anything definitely is known respecting it.

There is a great drawback to prospecting in this district, as there is no crushing-battery where the quartz can be from time to time tested: the mere fact of finding specimen-stone here and there is no criterion that a lode will pay for working. A small crushing-battery is wanted on the field, where bulk-tests can be made; and a plant in this particular place should be erected so that it can at any future time be added to, as the lode is large, and will be found to contain a great deal of low-grade ore, which requires a large quantity to be treated to make it a profitable venture.

Another adit-level is being constructed higher up the creek than the Golden Bar Company's workings, and also at a lower level. The country rock at this place is not of so hard a character, nor will the adit require to be constructed for a great distance before it cuts the line of reef. A little above this, again, prospecting is being carried on in the bed of the creek, apparently with the view of discovering the reef where it crosses, but so far the prospectors have not been successful in finding it.

The miners who worked the alluvial drift-wash in the creek in the early days state that the gold here was greatly mixed with quartz, and numbers of very pretty specimens of quartz containing gold were found. This all goes to prove that the gold in the creek-bed originally came from a reef either crossing the creek or alongside it, and that by landslips, decomposition of the rocks and denudation, the water in the creek carried away the particles of less density, the more heavy substances were left behind and deposited in the bed of the creek, which formed a ground-sluice. Small lodes of quartz are also found on the range between this creek and Deep Creek, some of which were prospected years ago without anything being found payable for working. Some of these have again been applied for as licensed holdings.

Reefton District.

The state of the quartz-mining industry in this district is equally as good as it was at the end of the previous year. Still, there is nothing discovered to lead one to anticipate a larger return of gold than there was last year. Some of the gold-producing claims have almost suspended operations, such as the Welcome Company, at Boatman's; and, unless a new lode be struck, there is little hope of this being for the future a remunerative venture. Still, there is some chance of getting a payable lode to the south of the shaft or at a lower level, or an entirely new lode may be discovered. There has been a falling-off in the yield of gold from this district during the year to the extent of about 2,308oz. from what it was for the previous year. During last year 32,394 tons of quartz was crushed, which yielded 17,780oz. of gold, and the approximate quantity obtained from the alluvial workings was 2,715oz.; thus making a total of 20,495oz. of gold, representing a value of £79,991, as against 22,803oz., representing a value of £88,585, for the previous year.

When visiting this district last year the time at my disposal was too short to admit of inspecting the whole of the mines, and I have to thank the managers and others for sending me the balance-sheets of the different companies, which afford useful information, and show the value of the mining property in the district better than by any other means.

Keep It Dark Company.—This has been one of the most regular dividend-paying companies on the field, but during the last year the returns of gold from the mine have not been so large as in former years. Their main shaft is 500ft. in depth, and a monkey-shaft has been sunk in the No. 3 level about 500ft. from the bottom of the main shaft, and No. 4 level has been opened out from this second or subsidiary shaft. The winding is done from the No. 4 level, by attaching a rope to the winding-rope in the main shaft, leading it under a pulley at the main shaft, and along the No. 3 level on small pulleys to the shaft sunk down to No. 4 level, where there are low poppet-heads erected in an excavated chamber, and the winding is done the same as from the main shaft. The stone from No. 4 level has proved to be of very low grade and of very limited dimensions, the block being only about 35ft. in length. They have still a considerable quantity of stone between the No. 2 and No. 3 levels that is expected to give good returns; but the directors were anxious to continue prospecting operations on No. 4 level with the hope of discovering another block of stone. Their annual statement for the year ending December last shows that 7,170 tons of quartz have been crushed during the year, which yielded 4,056oz. of melted gold, representing a value of £15,835, out of which dividends were paid to the extent of £9,000; thus making the total dividends paid by this company £104,166 13s. 4d. The total quantity of gold obtained from this mine has been 57,168oz., representing a value of £221,636, and the total expenditure has been £125,194. There was 104,299 tons of quartz crushed, which gave an average yield of about 10dwt. 23gr. of gold per ton; but if the returns be taken for the year ending March last there were 5,757 tons of stone crushed, which yielded 2,538oz. of gold, representing a value of £9,899, out of which £6,500 was paid in dividends.

No. 2 South Keep It Dark Company.—This company's mine is adjoining the Pandora, and their shaft is used by the latter company, it having been sunk on the boundary by the two companies conjointly. The main shaft is down to a depth of 280ft., and a level has been driven on the reef from the bottom of the shaft, and at the end of this level there is a second shaft put down to a further depth of 160ft., and from this the workings of the mine are carried on. During the six months ending the end of March last 392 tons of quartz was crushed, which yielded 285oz. of gold, representing a value of £1,117, out of which dividends were paid to the extent of £600. According to the expenditure of the company for this period, which amounted to £988 18s. 10d., the actual profit on the working of the mine for the six months has been £127 17s. 11d.

Hercules Company.—This company have acquired the property belonging to the Nil Desperandum Company, and have been prospecting the mine, and are extending the No. 6 level. Up to the end of February last 31½ tons of quartz was crushed, which yielded nearly 58oz. of gold. This was obtained from between the 5th and 6th levels; but on sinking a winze from the 6th level they found the lode pinch out. The total expenditure of this company in prospecting and working the mine has been £654 5s. 1d., and the value of the gold obtained £224 11s. 9d.

Wealth of Nations Company.—This company has been carrying on prospecting operations for some years without finding much encouragement. Nevertheless, their perseverance has enabled them to discover what is thought to be a payable lode. Their main shaft was sunk at the end of an adit-level which is 800ft. in length, and the shaft is 200ft. in depth below this level. From the bottom of the main shaft a prospecting-drive was put in for a distance of 540ft., when a broken lode was met with, and on following this lode for a further distance of 150ft. it formed into solid stone about 5ft. in thickness. About 50ft. of this lode has been driven on, and the quartz is considered to be of a fairly payable character. During last year they crushed about 85 tons of quartz, which yielded 27oz. of gold, and 206oz. of gold was obtained from the quantity of tailings crushed, the total value of the gold obtained being £902.

Inglewood Extended Company.—This company, conjointly with the Phœnix Company, constructed a deep adit-level about 600ft. below the outcrop of the lode on the surface, and they are now working between this and the intermediate level. They have also a block of stone with 150ft. backs above the intermediate level, which has not been touched yet. There are two lodes in this mine, with only about 8ft. between them, which will probably yet join: both the lodes are of about equal value. These lodes are stoped out by contract, the contractors getting £1 per cubic yard for the quartz delivered in the paddock, and finding all the material. Some wages-men have been employed in prospecting, but no new discoveries have been made. For the year ending the 31st of January last 2,297 loads of quartz were crushed, which yielded 1,329oz. of gold, representing a value of £5,108 19s. 3d.; while the actual expenditure during this period was £3,583 0s. 5d.: thus showing a profit on the working of the mine of £1,525 18s. 10d. Of this amount £600 was paid in dividends and all debts previously contracted, still leaving about £493 in hand to pay current accounts and to carry on future operations. This shows that this company's

affairs are in a healthy condition. Since the formation of the company gold has been obtained from this mine to the value of £16,742; and the total expenditure on the mine, plant (including a crushing-battery of ten heads of stamps), and all taxes and charges has amounted to £22,918.

Golden Treasure Extended Company.—This company took up the ground originally held by the Golden Treasure Company, who expended a large amount of money in prospecting and also in working it, but were never reimbursed for the outlay. The present company have constructed an adit-level from the Murray Creek Road for a distance of about 700ft., and from this level they have sunk a winze 100ft., also constructed a level from the bottom of this winze, and are stoping out the lode from this level. About 700ft. to the northward of the adit they discovered a lode containing a good deal of antimony, and they intend to send a quantity of this ore to England and Germany to be treated, in order to ascertain its value. About 5 tons of this ore is now on hand. The total value of the gold obtained since this company acquired this property up to the end of November last was £1,611; and the expenditure up to the same date amounted to £3,205.

Venus Extended Company.—This company have stoped all the main lode in their mine above the No. 3 adit-level, and at about 900ft. in from the mouth of this adit a shaft has been sunk to a depth of 110ft., and a cross-cut put in for 40ft., but this is not yet up to the lode. A new lode has been discovered at about 250ft. above No. 3 adit-level, and they are at present getting out stone from this new find, to test it as soon as their crushing-battery is put in repair. According to their balance-sheet, up to July, 1889, the total value of the gold obtained from this mine was £17,638, and moneys received for crushing for other parties £1,653; thus making their total receipts £19,291: while their expenditure amounted to £19,943. But they have a crushing-plant and aerial tramway connecting the mine with the crushing-battery, so all the heavy expenditure is now made, and if the stone recently found be proved of a payable character they will soon be recouped for their original outlay with good interest; but during the year ending March last only 70 tons of stuff have been crushed, which yielded 30oz. of gold, representing a value of £111, while calls have been made to the extent of £800.

Globe Company.—This company's mine still continues to give fair returns. There were 8,274 tons of quartz crushed last year, which yielded 4,041oz. of gold, representing a value of £15,962, out of which dividends have been paid to the extent of £4,950. The shaft from which the workings are carried on is 385ft. in depth, and a No. 3 level is constructed from this shaft, and stoping is being carried on between this and No. 2 level. The winding was formerly done by an overshot water-wheel erected at their crushing-battery on the side of the Inangahua River, and about a mile and a quarter distant from the winding-shaft, the power being transmitted by wire-rope; but they have now discontinued this winding-appliance, and have erected a steam-engine of twenty-horse power alongside the shaft to do the winding. This company has a crushing-battery of twenty heads of stamps and a concentrating plant of six Triumph concentrators. The stone is brought from the mine by a self-acting aerial tramway. The crushing-capacity of the plant is said to be about 200 tons a week, working twenty-four hours a day, while some of the improved batteries recently erected in the North Island districts, with the same number of stamps, can pulverise 240 tons clean quartz, such as that coming from this mine, fine enough to pass through a grating with 3,600 holes to the square inch, whereas the gratings used by this company have no more than 400 holes to the inch. The total quantity of gold obtained from this mine up to the 1st of June, 1889, was 13,077oz., representing a value of £51,414, and the total expenditure to that date was £38,116; thus showing a profit on the working of the mine of £13,298.

Progress Company.—This company's mine is near the junction of the Oriental and Devil's Creek. It was formerly held by the Oriental Company, and worked on the upper levels. Since this company acquired the property they have constructed a low adit-level for 1,470ft. from the face of the range to the point where it cut the lode, and afterwards drove about 150ft. on the lode eastward, and connected it with the upper workings, which are about 200ft. above this level, the lode proving of a payable character for working for the whole distance between the levels. According to the annual statement of this company's affairs, it shows that up to July, 1889, the total value of gold obtained from the mine since this company took possession was £11,227, while the expenditure up to that period amounted to £17,006. During the year ending March last there was 5,000 tons of quartz crushed, which yielded 1,649oz. of gold, representing a value of £6,559.

Merrijigs Company.—This company's mine was considered at one time by a good many to be likely to develop into a valuable property. There is a band or belt of sandstone about 60ft. in width full of auriferous-quartz stringers, and the whole of this belt is thought to be payable for working. The company has constructed an adit-level for 700ft., and has sunk two shafts, one 45ft. and the other 84ft.; but the workings are being carried on at present from the adit-level, where the lode or belt of auriferous sandstone is about 38ft. wide. They are breaking out the material from this belt of country, and intend to have a trial-crushing to test its value as soon as the road now in course of construction is completed.

Sir Francis Drake Company.—Great expectations were formed respecting the value of this company's mine which have never yet been realised. The stone found in the lode contains sufficient gold to pay for working, but leaves very little over to go to the shareholders. A low adit-level was constructed two years ago, and the lode has been stoped out from this to the surface. A winze has been sunk to a depth of 180ft. below the adit-level, carrying a lode of about 5ft. in thickness. During last year 2,119 tons of quartz was crushed, which yielded 426oz. of gold, representing a value of £1,543.

Happy Valley Company.—This company's mine adjoins the southern boundary of the Sir Francis Drake. Although a considerable amount of prospecting has been done, very little gold has been obtained. Up to the end of November last 127 tons of stone was crushed, which yielded 28oz. 12dwt. of gold, representing a value of £111; and the expenditure up to the same date amounted to £2,493.

Gallant Company.—This company's mine is on the northern boundary of the Sir Francis Drake. They have constructed an adit-level for 525ft., and then followed on the lode, which is about 4ft. in thickness. It is about three years since this ground was taken up, and up to the end of November last no gold had been obtained, while the expenditure of the company amounted to £1,208. It is said that recently 300 tons of stone from near the surface was taken out and crushed, but the result of this is not exactly ascertained; still, it is known to be somewhere about 100oz. of gold.

Inkerman Company.—A considerable amount of work has been done in this company's mine. A new shaft has been sunk to a depth of 138ft., over which poppet-heads have been erected. There is a new portable steam-engine erected for winding, with new winding-rope, cages with covers, and safety-catches. The lode is stoped out from the 68ft. level in the shaft, and a new chamber has been constructed at 118ft. level, and they are now driving to cut the lode. The lode in the upper level was about 5ft. in thickness, and, according to the quality of the stone crushed last year—namely, 1,658 tons, which yielded 2,195oz. of gold, being an average yield of 1oz. 6dwt. per ton—this property should be highly remunerative for working. The total receipts of this company last year were £8,641, out of which they declared £2,000 in dividends.

Golden Lead Company.—This company's property is on the same line of country as the Merrijigs claim. An adit-level has been constructed for about 200ft. in some quartz leaders in sandstone, in which gold is found. Recently 100 tons of this sandstone with quartz stringers has been crushed, but the result showed that the material was not payable for working. Up to the end of February last the company had expended £70 16s. 2d.

In the claim adjoining the Golden Lead Company's ground a thin leader of quartz has been traced for about 300ft. in length along the surface, and from the crushings made here with a hand-stamp the yield would average 40oz. of gold per ton.

Scotia Company.—This company has obtained very good returns from their mine last year. The lode they are working on does not run regular for any long distance, but runs out in places and comes in again. A winze was sunk to a depth of 80ft. from No. 1 level in the centre of the block of stone they had been working on: the stone pinched out at about 25ft. down the winze, but on driving into the foot-wall in the winze at a depth of 45ft. the lode was found about 1ft. in thickness, showing gold freely. During last year they crushed 593 tons of stone, which yielded 1,272oz. of gold, representing a value of £5,017, out of which dividends to the extent of £3,000 have been paid.

Big River Company.—This company has passed through many vicissitudes, the shareholders being elated at one time with the prospects obtained from the mine, and at other times the shares have been unsaleable. The lodes in this district do not seem to continue for either any great length or depth. At times the appearance of the lode-stuff is very encouraging, and in a distance of a few feet it seems to change its character. Great expectations were formed in regard to the value of this mine several years ago, before the road was completed to Reefton, but none of these have yet been realised. During last year 700 tons of stone was crushed, which yielded 350oz. of gold, representing a value of £1,363, while calls have been made to the extent of £1,700.

Other Claims at the Big River.—There are prospecting operations being carried on in the Alexandra, Prima Donna, and National Mines. At the latter mine about 50 tons of stone is stacked ready to send to the crushing-battery as soon as a road now in course of construction is completed; but in the other two claims the workings are all of a prospecting nature.

Energy Mine.—This is the mine that was worked for many years by the Energetic Company. It was acquired by a company under the title of the Energy Company, who let the mine to a party of tributers. They crushed last year 2,071 tons of quartz, which yielded 800oz. of gold, representing a value of £3,100. These tributers have now purchased the mine.

Royal Quartz-mine.—An adit is being constructed from the Murray Creek side of the range to cut the same lode which was worked in the Golden Fleece ground. The adit is now constructed for a distance of 1,181ft., and there is still a further 200ft. to construct before it strikes the Golden Fleece boundary.

Boatman's.

Welcome Company.—This company has paid more dividends to the shareholders than any other company in the district, but the lode is now about worked out at the lower levels, which will be about at least 1,500ft. below the surface at the boundary of the Homeward Bound Mine. The lode in the lower level is greatly broken up, and not of a payable character for working. The company has been carrying on prospecting and getting out stone to the south of their shaft. The total value of gold obtained from this mine amounts to £238,258, and the total expenditure has been £137,022. The paid-up capital of the company is £8,211, while the amount of dividends paid to the shareholders has been £110,250. Only 249 tons of stone was crushed last year, which yielded 731oz. of gold.

Fiery Cross Company.—This company's main shaft is down to a depth of 450ft., and from the level going away from the bottom of the shaft a monkey or subsidiary shaft has been sunk down to a depth of 150ft. The reason of this mode of working being adopted is that, the shaft being sunk on the foot-wall side of the lode, the level at 600ft. would have required to be a considerable length; they therefore sank a shaft in the 450ft. level, and have erected winding-gear in this shaft, so that the winding can be done from the winding-appliances in the main shaft. This principle of carrying on the workings is a questionable one as regards economy. The element of "penny-wise and pound-foolish" enters largely into this style of working. This mine has been worked by the present company for the last eight years, and the total quantity of gold obtained in this period amounts to 15,313oz., representing a value of £69,172; while the expenditure for the same period was £57,480. The amount of capital actually paid up was £13,169, and the amount of dividends paid to the share-

holders has been £15,300. During last year, ending 31st March, there were 1,522 tons of stone crushed, which yielded 1,000oz. of gold, representing a value of £3,953.

Long Star Company.—This company's mine does not hold out any encouraging hopes that it will become a remunerative one for working. Up to the end of March last all the gold obtained was about 42oz., while the expenditure on the mine, aerial tramway, and other charges, have amounted to £5,081. Recently a level has been constructed for a distance of 170ft., and about 40ft. of cross-cut. An uprise was also constructed for 40ft. to cut the reef, but the reef found here was very small and irregular, and also containing low-grade ore.

Other Claims at Boatman's.—There has not been a great deal of work done in other claims in the Boatman's district. Prospecting has been carried on in the Homeward Bound, Specimen Hill, Just in Time, and Reform Mines; but no quartz has been crushed from any of them except from the Reform, and this was only a small parcel of 70 tons, which yielded 50oz. of gold, representing a value of £194. The Homeward Bound Claim should be worked more energetically, as the Welcome Company got good gold in the lode right on the boundary of this claim, and this is likely to continue for some distance, at least, beyond the boundary.

Nenthorne.

This place presents quite a different appearance from what it did on my first visit some twelve months ago. A small township has now sprung into existence, with commodious hotels, stores, and other places of business, besides the large number of corrugated-iron cottages which are dotted here and there over the place, giving it an important appearance. The population of the field is said to be about four hundred.

The workings are confined wholly to quartz, and the number of lines of reefs or lodes that has been found in the district may be termed Legion, running almost parallel in an easterly and westerly direction, and underlying to the northward. Gold has been found in a large number of these lodes, or what may be termed more like gash-veins, and no doubt a considerable quantity of the precious metal will be found near the surface, but the question of these lodes or veins carrying gold down to any great depth is a problem still remaining to be solved. So far the best prospects have been obtained near the outcrops. The whole of the workings are confined to within about 60ft. from the surface. That is where the lode or veins have been stoped out, and it is only in a few instances where this depth has been reached, with the exception of a few low-level adits which are being constructed a few feet above the level of Deighton Creek. But in none of these adits at the time of my visit was the lode-stuff of a character payable for working.

It would be premature to pass a decided opinion at the present stage of the workings on the permanency of the field, as there is little work, comparatively, done beyond constructing cross-trenches on the surface, looking for the caps of the reefs; but the general impression one has after examining the field is that, although there will be a considerable amount of gold obtained from many of the lodes near the surface, the character of the country and the way in which the lodes occur leave a considerable doubt as to whether they will not cut out as they go down. Indications of this are already to be observed in some of the claims. The country, however, is traversed by a network of auriferous-quartz leaders and veins, and prospecting is being carried on which may result in discovering lodes of much greater dimensions than heretofore found: even some of those already discovered may prove to be of a permanent character.

Crœsus Company.—This company holds three licensed holdings of 30 acres each, which were formerly known as the Hibernian, Crœsus, and Old Ireland; but their workings are confined to one of these holdings. Still, they have done more work than any other company on the field. The reef or lode is from 9in. to 18in. in width, and has been proved to be payable for working down to a depth of about 50ft. At the time of my visit about 300ft. of the lode had been stoped out to a depth of 40ft., and 700 tons of stone had been crushed, which yielded about 1oz. of gold per ton. The hanging- and foot-walls of the lode are of moderately hard schist rock, which stands in many instances whilst stoping is carried on, without timber; and where the ground does not stand without timber the stopes are filled in directly they are taken out, and whatever timber has been used is generally drawn and used again. All the stone that has been stoped out has been hauled up by manual labour; but the company is sinking a shaft 11ft. by 4ft. in the clear, having three compartments—namely, two for winding, and one for pumping and also for a ladder-shaft. This shaft was, at the time of my visit, down to a depth of 100ft. A cross-cut from the shaft to the reef was constructed, and the reef driven on for a considerable distance on each side of the cross-cut—in all, about 212ft.; but at this depth the manager informed me there was little or no gold, and the lode pinched out in places.

The material from the shaft is hauled by a small vertical engine, which also works a pump; but the pumping- and winding-gear is constructed in a very primitive manner. The style of engine is not suitable for the work, so that the whole appliance may be termed a perfect rattletrap. The prospects of this company's mine at the present time do not appear very encouraging—they cannot prospect it to a greater depth with the present machinery. The best way to prospect this ground would be for the two adjoining companies—namely, the Blue Slate and the Victoria—to combine with the Crœsus Company to sink in some portion of the ground a shaft from which each company could work its claim, or, failing this, to sink the shaft on the Crœsus ground and test it at low levels, and, in the event of payable stone being discovered, the Crœsus Company to refund to the other two companies the amount of money they had contributed. Unless the reefs on this field are proved to go down carrying gold none of the mining ventures will be worth much as a commercial transaction.

Almost as soon as the Crœsus Company discovered the outcrop of the reef in their ground they made arrangements to erect a crushing-battery to crush the stone. This battery is erected at Deighton Creek, about two miles and a half from their mine, and consists of ten heads of stamps of the very old type, and the ordinary quicksilver-tables. The battery is driven by a traction-

engine, and, judging from the manner the battery was working, the company will be fortunate to get 50 per cent. of the gold the quartz contains. It is said that the pyrites, of which there is a considerable quantity in the stone, contains a good deal of gold. There is, however, no appliance for saving the pyrites. Since the company have commenced crushing they have got about 700oz. of gold, representing a value of about £2,700. They were employing at the time of my visit about thirteen men.

Victoria Company.—This company's ground adjoins the southern boundary of the Crœsus. The reef or lode is running about 5 chains to the southward of the Crœsus line, and has a north-westerly and south-easterly direction, and seems likely to join the Crœsus line in the Blue Slate Company's claim. The ground has been stoped out for 130ft. in length, and to a depth of 40ft. on one end and 54ft. on the other, and there is about 400 tons of stone on the surface ready to send to the crushing-battery, which is now in course of erection. The lode varies considerably in size, from 6in. to 2ft., consisting of similar crystalline quartz to that in the Crœsus lode, and contains a good percentage of iron-pyrites, the joints and seams in the stone being coated with oxide of iron and manganese. A trial-crushing of 2 tons was taken from the cap of the reef, which went nearly 3oz. to the ton; but, judging from the appearance of the stone on the surface, the bulk crushing will fall far short of this yield. The company are sinking a new shaft, and erecting a horse-whim to wind the quartz from the mine. They hold an area of 60 acres, and have ten men employed. The mining-timber for this district comes from Waikouaiti, and costs delivered on the ground £10 per 100 pieces of manuka, 6ft. 6in. long and from 6in. to 7in. in thickness, while laths cost £3 10s. per 100.

Blue Slate Company.—This company is held by a few individuals. The registered capital is £12,000; but £9,000 of this amount is declared paid, so that the available capital is £3,000. A considerable amount of work has been done in this ground, which is 30 acres in extent. At the time of my visit there were twenty men employed in sinking a main shaft and in stoping out quartz. The lode they are working on is the same line of reef that goes through the Crœsus ground; but they expect to cut the junction of the Victoria and Crœsus reefs in their ground. They were working the reefs from two shafts at a depth of about 45ft., and have about 120 tons of stone on the surface ready to send to their crushing-plant. The lode varies in size from 4ft. wide to 2in. In places it almost pinches out, leaving nothing but a thin seam of pug to mark the division between the hanging- and foot-wall. On the 45ft. level the lode is very small, and the indications show that it will either cut out as they go down, or occur here and there in bunches. There is, however, too little work yet done to form a decided opinion respecting it.

This company have erected one of the Huntingdon centrifugal roller-mills 5ft. in diameter, having a stone-breaker and Challenge ore-feeder attached, at the side of Deighton Creek, about 60 chains from their claim. These are worked by a steam-engine. The gold is to be collected on copper plates and in quicksilver-wells, and finally the material is to pass over blanket-tables; but there is no appliance to collect the pyrites that the ore contains. This mill is estimated to crush about from 18 to 20 tons of stone in the twenty-four hours. Mr. Kitchener, the manager and part proprietor, informed me that the whole cost of the crushing-plant and opening out the mine at the time of my visit was not over £2,000.

The engine employed to drive the mill is one of Park and Lacey's—of San Francisco—horizontal high-pressure engines, and certainly one of the cheapest-got-up engines that can be manufactured. It has a 10in. cylinder and 16in. stroke, and is to run at a speed of 140 revolutions per minute, which the manufacturers estimate will give thirty-five-horse power. The cost of coal on this field will be considerable, and the question of "penny-wise and pound-foolish" enters largely into the class of engine to be worked with the greatest economy. No doubt a compound condensing-engine would cost more in the first instance, but it would save it itself in a few months. This class of engine would not consume more than one-half of the fuel required to supply steam for a high-pressure engine.

On my second visit to this company's reduction-works in March last, the mill was being kept steadily at work. The pulverised material from the mill has to pass through a No. 10 slot screen, which is equal to about 1,400 holes to the square inch. Judging from the muddy water that passes over the quicksilver-tables, it is impossible that this company can save a fair percentage of the gold in the quartz. The fine gold will be carried away in slimes into the creek.

Break of Day Company.—This company holds an area of 90 acres, which includes three licensed holdings, known by the names of the Close of Day, Break of Day, and the Jubilee. There was no work being done on this ground at the time of visit. A trial-crushing was taken from the cap of the reef, which gave 6oz. 6dwt. per ton; but there is not much work done to prove the payable character of the lode. It is the same line of reef that the Victoria Company is working on, and similar in size, and lies to the eastward of that company's ground.

Zealandia Company.—This company is working on two lines of reef further south than the Victoria line. They have three winzes down on the lode, the main one being 62ft. in depth. The reef varies in thickness from 1ft. to 2ft., and a little gold can be seen in the stone. There were eight men employed in opening out the ground, and getting stone ready for crushing as soon as the public crushing-battery is erected. They had a trial-crushing of 2 tons, which went 2oz. to the ton.

This public battery is being erected at the side of Deighton Creek, and consists of two rock-breakers, with Challenge ore-feeders, and two Huntingdon centrifugal roller-mills 5ft. in diameter, which are proposed to be worked by a fifty-horse-power high-pressure engine. This plant and engine was purchased some time ago; but since the arrival of Mr. Peterson, who came over from San Francisco with a plant for the Consolidated Company, and has been appointed consulting engineer for this company, they are trying to dispose of this engine, and get either one or two compound condensing-engines; and, instead of having their two mills at one place, it is deemed more suitable and convenient for the claimholders to have each mill erected separately in different places. Of course,

this will entail more expense in working the plants, but some of the companies which use the mills will save a considerable item in the cost of transit of the stone. A commencement has been made in the erection of the plant, but it is not yet finally decided whether the company will have the mills separate or not. There will be, when this plant is erected, four Huntingdon mills on the field, which will give a very good trial to this class of crushing machinery. It is the first time that it has been used in this colony, and from the manner in which the small mill is working at the Prospectors' Claim they are likely to be used in future, especially where the cost of transit forms a heavy item in a crushing-plant. This public crushing-plant will accommodate the Reliance, Golden Chariot, Eureka, Crystal Cave, Home Rule, Glenkeris, Gladstone, and Zealandia Companies, as well as several other private parties who have claims in this neighbourhood. The site of the plant is about two miles in a south-east direction from the township of Nenthorne.

Reliance Company.—This company holds an area of 90 acres, comprising three licensed holdings, known by the names of the Otago, Renown, and Reliance. A winze has been sunk on the lode which is said to be 50ft. in depth, but no one was at work here at the time of my visit, and the winze was full of water, so that there was no opportunity of examining the reef. There is a few tons of stone on the surface. This line of reef is further south than that on which the Zealandia is at work.

Eureka Company. —This company holds an area of 60 acres, comprising the licensed holdings of the Premier and the Eureka. A considerable amount of trenching has been done on this company's ground, a winze has been sunk to a depth of 50ft., and a level opened out at 40ft. The lode is from 1ft. to 2ft. wide, and at the time of my visit some very rich specimen-stone was being obtained near the cap of the reef. About 60 tons of stone was stacked on the surface, and eight men were employed in the mine. Preparations were being made to commence sinking a main shaft for winding and pumping.

Home Rule Claim.—This claim belongs to a private party, eight shareholders. They hold 60 acres, which includes the Parnell and Home Rule licensed holdings. The reef has lately been discovered, and is about 400 yards south of the Eureka line, and about a mile and a half from the township of Nenthorne. The party which discovered it had been prospecting for some time with the view of cutting the Gladstone line of reef, and were about giving up when they discovered the lode, which is about 1ft. in thickness, carrying very rich specimen-stone near the cap. In one place on the foot-wall of the lode there is a vein of antimony from which Mr. Peterson informed me he had made several assays, and had found it to contain a good deal of gold, and also a little bismuth. Very little work has yet been done on the lode beyond opening a trench on the surface, but from the appearance of it in the trench it is likely to have very little underlie. There were three men employed getting out stone from the trench at the time of my visit.

Gladstone Company.—This company's ground, which comprises 60 acres, adjoins the western boundary of the Home Rule, and has a somewhat similar lode passing through it, carrying fair gold. They have a shaft down for about 40ft., and were arranging to sink it to a further distance of 40ft. Until such time as the public crushing-plant is erected there will be no opportunity to test the value of the stone.

Glenken's Claim.—This claim appears to be on the same line of reef that passed through the Eureka Company's ground. It has been found at a small gorge; but, instead of constructing an adit on the lode, there are two men employed in sinking holes and trenching the surface here and there to try and discover the cap of the reef

Prospectors' Claim.—When the reef in this claim was discovered about 2 tons was taken from the cap of the reef and forwarded to Melbourne for treatment, and the result gave nearly 3oz. to the ton. Since then they have erected one of the Huntingdon centrifugal roller-mills, 3ft. 6in. in diameter, with rock-breaker and Challenge ore-feeder, and have been crushing stone from the mine for a considerable time; but so far the returns have been disappointing. The ore has not given more than 10dwt. of gold to the ton. They have stoped out a considerable length on the lode where the trial-crushing was taken from, and also have sunk a winze on the next terrace on the lode to a depth of 30ft., and are at present stoping out the lode from this winze. The lode varies considerably in thickness, being from 2in. to 2ft. They are constructing a low-level adit from Deighton Creek, where the crushing-mill is erected. It was at the time of my visit 130ft. in, and had to be constructed for a further distance of 170ft. to get under where the first shot of gold was discovered. The adit is being constructed on the lode, but it shows only a thin vein of quartz. This adit will give about 110ft. of backs if the lode proves payable for working from this depth, which, from the indications, is really very questionable. However, it will be a means of the upper stone being taken out more cheaply, as it can be sent down in passes and taken by trucks to the paddocks at the crushing-mill.

Consolidated Company.—This company's ground extends on both sides of Deighton Creek, but chiefly on the eastern side. They got gold in the lode where it crops out on the terrace, and have done a good deal of prospecting. At the time of my visit they were constructing low-level adits; but the appearance of the lodes in these adits does not give very encouraging hopes that they will continue to go down to any great depth, or that the lode will pay for working.

The Consolidated, Break of Day, and Victoria Companies have combined together, and are erecting a crushing-battery on the side of Deighton Creek, which will consist of ten heads of American stamps, one of the Gates crushers (third size), with two Challenge ore-feeders, two combination-pans 4ft. in diameter, one settler, and three Frue vanners. The whole of this plant was made at the Pacific Ironworks, San Francisco, and differs considerably from the crushing-batteries now used in this colony. The mortars have recesses cast to receive the dies, which are held in position by a small dovetail. After the dies are set in and given a slight turn into the dovetail groove, sand is thrown into the mortar, which keeps the dies firm in their places. The gratings or screens are made so that they can be lowered as the dies wear, and be by this means always kept at nearly a uniform height above the top of the dies. The stamps are each 850lb., with the

faces 8in. in diameter. The discs are cross-keyed on to the shank of the stamp, and not screwed on and keyed in the ordinary way. Mr. Peterson, the engineer sent out by the Pacific Ironworks Company to erect this plant, states that this plant will crush 150 tons of quartz per week if worked continuously.

The Gates crusher is said to be capable of reducing 8 tons of ore to 1in. in diameter per hour, and it is principally by using this crusher that the stamps are made to do so much work. After the crushed material leaves the battery it passes over a table 20ft. long, which is covered with silvered-copper plates; and thence the material passes through an amalgam-trap, which prevents any mercury escaping. This trap is made in the form of the letter U, having a silvered-copper plate on one side and a zinc plate on the other, with a division in the centre, which comes down to near the bottom. There is a certain quantity of mercury in the bottom of this trap, and the whole of the material must pass through and over this mercury. The fine particles of mercury escaping from the copper plates on the tables are caught by the copper plate in the trap, or, if they do not adhere to this, the zinc plate catches them on the other side before getting out of the trap. The material then passes over the concentrators; afterwards the material goes into the combination-pans, where it is ground up and amalgamated, with salt added, having a jet of steam sent into the pans to heat the water and material to a certain temperature. The reason for heating the water is, that when the mercury is heated it gets into a porous condition, and is in a much better state for adhering to the gold. Mr. Peterson intends to use only rock-salt if he can get it; but, failing to get rock-salt, he will use common salt with a little sulphate of copper in the pans. After working the charge in the combination-pans for about four hours they are discharged into a settler, 6ft. in diameter, where the mercury and amalgam is collected, and the waste material from the settler then passes through a second amalgam-trap to collect any particles of mercury escaping from the settler; afterwards it passes through sluice-boxes, or a chute with ripples, and thence into the creek.

This plant is very complete, and, although it may be more costly in the first instance than any other plant in the field, there is no doubt it will soon pay for itself if the lodes contain sufficient gold to pay for working. It will be the most complete crushing-plant, when erected, in the Middle Island, and will save a much higher percentage of gold than has been saved heretofore. The introduction of a new class of machinery on this field will have a beneficial effect on the mining industry in the colony, and will no doubt be the means of dispelling some of the old conservative ideas of mill-men and mill-proprietors, and of directing their attention to different methods of saving gold from those they have hitherto been employing.

There are several other claims on the field in which gold has been got, amongst which are the Justice, Golden Chariot, Buster, Tip, Jacob, Enterprise, and Golden Causeway; but the work done is purely of a prospecting character.

In concluding my remarks on this field, it is one where there are a good number of small shots of gold-bearing stone near the surface which will pay for working, and a country where there are a large number of small auriferous lodes; but these may be more properly termed quartz leaders running through the schistose rock, cutting through the strata in places, which is a good indication for the lodes continuing to go down. Still, judging from the manner in which these lodes pinch at the depths they have already been proved to, it leaves an impression that they will generally cut out at a comparatively shallow depth. Some of them may be found to go down and prove payable for working; but the whole of the work yet done on the field is purely of a preliminay nature, and until such time as the lodes have been tested and proved to a depth of at least 200ft. very little can be said concerning them.

To prospect this district will require a good deal of capital; and many of the present holders of claims would do well to hold out good inducements for people with capital to join them in the undertaking. There are large areas held by those who have not the means to prospect them, but are merely holding them with the view of selling.

Old Man Range.

The reefs here do not appear to carry a sufficient quantity of gold to pay for working on a large scale. So far there have been patches of loose rubbly quartz in bunches here and there, apparently slips from the main range; but they are not of any great extent. White's Reef Company are extending the adit-level with a view of further prospecting the ground; but, with the crushing-battery and appliances they have for saving the gold, they require to get rich stone before it can be made to pay for working. The quartz is full of mullock, and contains a good deal of iron-pyrites. The thick muddy water coming out of the mortar on to the quicksilver-tables must carry away a large percentage of the fine gold. Indeed, when such imperfect appliances are used and no steps taken to test the bulk by constant assays, the company have no idea what gold they are really losing.

Bow and Bell Claim.—Messrs. Kemp and Symes discovered a reef at the side of Butcher's Gully which showed a fair prospect on the cap, but on sinking down it did not prove to be payable for working. There was a considerable quantity of water to contend with, and the appliances they had for keeping down the water proved inadequate, so that they suspended operations.

Cromwell.

Cromwell Quartz-mining Company.—This company or syndicate was formed in London, and acquired this property, from which very rich auriferous quartz was obtained some years ago, but from the state of the old workings, and the quantity of water in the old mine, the original company who held this ground could not carry on prospecting operations. Since this syndicate acquired the property they have commenced sinking a shaft to the northward of the old workings, and it was down at the time of my visit in March last to a depth of 420ft., but they intend sinking it to 530ft. before commencing to open out. From the old shaft there was a level constructed at 430ft., and the lode driven on for over 1,000ft.; on this level a winze was sunk for 22ft., when it came upon a

new lode of stone about 18in. in thickness, which yielded nearly 3oz. of gold to the ton. It is this block of stone, or new lode, that they intend to open out on.

The sinking of the shaft was suspended at the time of my visit, on account of there being no water to drive the pumping and winding machinery. The manager stated that he had only been able to work in the shaft four days and a half from the beginning of January to the 21st March, the date of my visit, and was engaged in erecting a small steam-engine to connect with the pumping-shaft, so that he could use steam to work the pumps when water was not available, or could use both water-wheel and steam-engine, as the case might be, when a small supply of water was available. This engine was being connected to the pump-shaft in such a manner as it appeared to me very questionable if it would work the pumps, as the gearing of the engine to the pump-shaft limited the travel of the piston to about 180ft. per minute, and therefore, unless the steam was kept at a very high pressure the engine would not do the work, the cylinder being only either 10in. or 11in. in diameter.

The shaft is 12ft. by 5ft., and close-timbered with 2½in. planking. A plunger-pump 9in. in diameter is fixed at 250ft. from the surface, and below this there is a common lift-pump which has a bucket of the same diameter as the plunger, and the quantity of water to lift at the depth the shaft was sunk to at the time of my visit averaged about sixty gallons per minute. The works are lighted at night with the electric light. The pumping machinery is well constructed—all the framing for foundations is substantially put together; but the winding-plant is merely a makeshift, being constructed from old castings and gear on the ground at the time this syndicate acquired the property.

There is also one of Ford's air-compressors for working rock-drills; but the manager does not seem to think that rock-drills are any advantage. The rock is very hard, and he stated that the rate of sinking when in full work averaged from 5ft. to 7ft. 6in. per week. He expected to get down the shaft to the required depth in about five months from the time of my visit.

Considering the large quantity of gold that has come from the lode running through this syndicate's property, and that the lode can be traced in a northerly direction for a long distance here and there on the surface, there appears to be a reasonable prospect of the syndicate getting well paid for their venture; at all events, it is a mine well worthy of spending money to prospect, even if the new lode that they intend working proves unremunerative. By constructing a level along the course of the lode in a northerly direction, with uprises some distance apart, they are likely to come across another shot of gold in the lode.

Skipper's.

There has been comparatively little work done in the quartz-mines in this district during last year. The only mine where the workings have been carried on with remunerative results is the Gallant Tipperary. Mr. Evans has done a considerable amount of prospecting on the Butcher's Gully reef, but the stone did not prove remunerative for working. Although this district has been very rich in alluvial auriferous deposits, the quartz lodes have been, as a rule, very disappointing. No sooner is a rich patch of stone got, and the hopes of the claimholders buoyant with great expectations, than it is found to either cut out, or the percentage of gold in the stone becomes less: at all events the returns from the quartz-workings in this district show that the amount of gold extracted from the quartz lodes is very small in comparison to that obtained from the alluvial drifts.

Phœnix Company.—Prospecting has been carried on in this company's mine for the last two years without finding any body of auriferous stone that would pay for working. Indeed, the prospects of finding another patch of stone were beginning to appear hopeless. It will be remembered that the Phœnix Extended Company took up a special claim on the north-west side of the Phœnix Company's ground, and sunk a shaft at the side of the creek to a depth of 150ft. After constructing a cross-cut to the southward for about 100ft. the company suspended operations and subsequently went into liquidation, when the Phœnix Company purchased the ground, and have put in a cross-cut in a northerly direction from the shaft for a distance of 90ft., and cut what is considered a continuation of the middle lode. The reef here is about 9ft. wide, and shows a good deal of gold in the stone, the richest portion of the lode being close to the hanging-wall; and, judging from the manner in which the principal gold-bearing stone is found in the lode, there is a probability of it getting richer as it goes down.

The company were at the time of my visit erecting a small winding-plant, which is to be worked by compressed air. The air is to be stored in a receiver, and the compressor is to be worked by means of electrical power derived from their plant, which is erected in the right branch of Skipper's Creek. The engine used for winding is very small, and, indeed, the whole of the winding appliances are of a temporary character. They are also constructing a quartz-paddock, and a tramway to convey the stone to the crushing-battery. This new discovery was only struck on the 6th March last. None of the stone had been tested at the time of my visit, but it was expected to give an average yield of nearly 1oz. of gold per ton.

Gallant Tipperary Company.—This company have got their mine into much better order than it presented on my former visit. They have extended the intermediate level for about 70ft., and are now engaged in stoping out above this, where they have about 175ft. of backs to the surface. The passes, stopes, and main level are in good order as far as the safety of workmen is concerned, but great carelessness is displayed in having detonators lying loosely about at the side of the main level. The attention of the manager has been directed to this, with a request for remedy. The lode on the north end in the intermediate level is split up in two sections, with a horse of mullock in between them; but each of these sections is about 4ft. wide, and both contain payable stone. About 1,500 tons of stone have been crushed during the year, which has yielded 961oz. of gold. The extremely dry season has necessitated the crushing-mill being stopped for want of water, so that the company at the time of my visit had only five men employed in their mine.

Macetown Reefs.

The only quartz companies at work in this district are the Surprise, the Advance Peak, and the Premier Companies. Indeed, very little work is being carried on in the Premier Mine: they have understoped as much of the lode as they conveniently can, and are now working from the main adit-level on a leader about 20ft. south of the main lode. This leader is from 1ft. to 1ft. 3in. in width. It has been carrying gold for about 12ft. in length, and they have stoped it out to a height of about 40ft. About 80 tons of quartz has been crushed during the year, which has given an average yield of about 1oz. of gold per ton. There were only four men employed in the mine at the time of my visit. About twelve months ago one of the directors went to London, with a view of re-forming the company with a larger capital, so that they could work the mine systematically: but no word has yet been received as to whether the company has been floated on the London market or not; so that it may be said the legitimate working of the mine is held in abeyance, pending the re-formation of the company. As soon as satisfactory accounts are received from London, it is intended to construct a low-level adit and open out the mine systematically, when the quartz can be delivered at the crushing-battery at a far less cost than has been done in former years. Ever since this mine was opened it has been worked in a primitive manner, adopting all manner of makeshifts to get the quartz stoped out at any cost, and had it not been that there was a good percentage of gold in the stone the company would have been in difficulties long ago.

Sunrise Company.—This company's workings are on Advance Peak, about 5,400ft. above sea-level. An adit is constructed for 248ft. to cut the reef, and then the reef is driven on for 170ft., and stoped out to an average height of 30ft., where the quartz cuts out. The reef is from 1ft. 3in. to 2ft. in width, running in a west-north-west direction, and underlying to the north-west on an inclination of about 6in. to the foot. The hanging-wall is clearly defined in places, but the foot-wall is not well defined, the quartz and country rock merging into one another in many places without showing the least sign of a clean parting. The appearance of the hanging-wall in places shows signs that the lode is portion of a slip, or, at least, that a slide has taken place at some time. The mine has been well opened out and carefully worked so far, but, being at a high elevation, work cannot be carried on during the midwinter months.

A winze has been sunk from the main adit-level to a depth of 38ft., carrying down the lode, which averages about 2ft. 6in. They have now commenced, on the opposite side of the peak, to construct a lower adit, which will give 160ft. of backs. During last season 148 tons of quartz has been crushed from this mine, which yielded 324oz. of gold, being an average yield of nearly 2oz. 4dwt. to the ton. The company have erected comfortable huts and a snow-shed at the mouth of their adit-level; but, notwithstanding this, they could not work last winter for about ten weeks, everything being completely snowed up. The mining-timber, delivered on the ground, costs about 16s. per set, the props and caps being about 7in. in diameter.

Tipperary Company.—The directors, having failed to re-form the company, have suspended operations in the mine, and before any further stone can be got a considerable capital will have to be expended, both in permanent works and also in prospecting.

ALLUVIAL MINING.

Collingwood District.

Although Collingwood may be said to be the oldest goldfield in the colony, comparatively little work has been done for the thirty-two years that mining has been carried on. This may be accounted for by the discovery of rich alluvial deposits of gold in the drifts in Otago, which caused the most of the mining population to leave this portion of the colony to search for treasures at the new El Dorado. Notwithstanding all the rich fields that were discovered from time to time, this place has always maintained a small mining population, and, being in a great measure isolated from all the other goldfields, the primitive methods of mining are to a certain extent still adhered to. There are still large areas of auriferous-drift terraces that would pay well for working by hydraulic sluicing if a good supply of water were brought on to the ground, and there are large supplies of water that could be utilised for sluicing purposes.

There is a large area of auriferous drift-wash on what is known as the Quartz Ranges, about sixteen miles back from the sea-coast, on the eastern side of the Aorere River, where water could be brought on at a high elevation from the Boulder Lake, and the same run of drift-wash seems to come down to the sea-coast near the Parapara tidal lagoon. The cost of bringing water on to these terraces would be small in comparison to the cost of the water-supplies constructed in Otago and on the West Coast by private individuals, and in most instances there is an excellent fall for tailings, and, with the exception of a few places, there are not many large boulders in the wash-drift. The claims that are being worked on this run of ground at Richmond Hill and Glengyle Gully seemingly give very fair returns for working, although they are worked in a very primitive manner. Still, the shareholders are satisfied with the proceeds, which could be largely augmented by working with modern appliances.

There are great complaints amongst the miners and business people in this district about the large areas granted by the Nelson Waste Lands Board as mineral leases and prospecting areas; also, my attention was called to the coal leases that were held from year to year without any work being done, but more especially to the mineral leases which were apparently held for speculative purposes, and on which there is auriferous drift-wash, which the miners state would be prospected were the lands not locked up. The following are the areas held as leases on which no work, or, at least, very little work, has been done;—

Names of Lessees.	District in which Lease is granted.	Area.	Rental per Annum.	Minimum Rental per Acre.	Maximum Rental per Acre.	Date of granting Lease (Term, 21 Years).
MINERAL LEASES.		Acres.		s. d.	s. d.	
Kerr and Adams ..	Aorere ..	142	First two years, £3 11s.; remainder, £7 2s.	0 6	1 0	1st January, 1884.
J. H. Keep	Parapara	598	First two years, £15; remainder, £30	0 6	1 0	1st July, 1887.
Red Hill Gold-mining Company	Aorere ..	640	First two years, £16; second two years, £20; remainder, £64	0 6	1 0	1st January, 1887.
Red Hill Gold-mining Company	Aorere ..	571	First two years, £16; second two years, £32; remainder, £64	0 6¾	2 3	1st January, 1887.
Total	..	1,951				
COAL LEASES.						
Kerr and Adams ..	Pakawau	640	First two years, £16; next three years, £32; remainder, £64	0 6	2 0	1st January, 1886.
Kerr and Adams ..	Pakawau	450	First two years, £16; next three years, £32; remainder, £64	0 8½	2 10	1st January, 1888.
J. Marshall	Pakawau	320	First two years, £22 10s.; next four years, £45; remainder, £112 10s.	1 5	7 0	1st January, 1888.
Total	..	1,410				

The mineral leases have been held from four to seven years without being worked, and, as these are granted with no conditions to keep a certain number of men employed, so long as the rent is paid no notice is taken with reference to the output of any mineral. "The Mining Act Amendment Act, 1887," provides for mineral leases being granted by the Warden, to the extent of 320 acres, at a minimum rental of 2s. 6d. per annum, and also provides for a certain number of men being employed. The latter condition being wanting in the leases granted by the Nelson Waste Lands Board is the cause of the complaint amongst the inhabitants of this district.

Adams and Logan's Claim.—This claim was recently taken up, and a company is being formed to work the ground, which comprises a special claim of 100 acres, and they have also got the right to mine on Mr. Travers's freehold. The ground is situate directly above the head of the Parapara tidal lagoon, and takes in portions of the slopes and foot of the ranges adjacent to Messrs. Washbourn Bros.' paint-works. No work has been done with the exception of prospecting-holes being sunk here and there all over the claim. There seems to be a deep run of quartz-gravel wash going from the Parapara River towards Messrs. Washbourn Bros.' paint-works, on which a little working was done several years ago; and, on inquiry, one of the parties who worked here —H. Washbourn—stated that a good deal of gold was obtained, but the supply of water was far too small to be of any utility for working the ground systematically. Mr. Logan showed me a large number of prospects he obtained while sinking the prospecting-holes. Each prospect or small quantity of gold he had in separate parcels, being the results of washing a tin-dishful of stuff. The character of the ground makes it specially adapted for hydraulic sluicing, and to all appearance these parties have a property which will prove remunerative for working with a modern plant and a good supply of water. Mr. Washbourn stated that when he left off working the ground it paid him 12s. a day, and the reason of giving up his claim was that he started the hæmatite-paint works, and could not attend to both; and also, that the supply of water he had was too small, and at too low an elevation to work the ground advantageously. This company intends to construct a water-race from the Parapara River, where they will be able to bring in the water at an elevation of about 280ft. above the level of the flat, or 240ft. above the saddle where the horse-track crosses into the valley of the Parapara River, and to work the flat with hydraulic elevators, and the slopes and foot of the ranges by hydraulic sluicing. Judging from the formation of the country and the character of the wash-drift, there is at least a large portion of their claim that will pay for working along the low slopes and foot of the ranges, if a sufficient supply of water can be obtained at the proposed elevation and a good modern plant put on the ground, with a man in charge who thoroughly understands the modern methods of hydraulic sluicing. The quantity of water available for this company in the Parapara River at the time of my visit was about seven sluice-heads; but a good supply could be obtained for at least eight months in the year.

Glengyle Company.—This is a private company, consisting of four working shareholders. Their claim is situate in Glengyle Gully, on the western side of the Parapara River, about a mile and a half up from its mouth. The claim also takes in a portion of Appo's Gully. The ground is worked by ground-sluicing—that is, the whole of the water comes over the face, and the fine material is carried away in sluice-boxes, which are 2ft. wide, and have a gradient of 5in. to 12ft. The large boulders are partly built up in the paddock and partly carried away on a truck by a tramway alongside the sluice. This company have been five years at work, including the time they were engaged in bringing in a water-supply. This supply is taken from the Parapara River in boxing for the whole of the distance, which is a mile and a half. The boxing is laid on a bench, in most instances cut out of rock through a narrow gorge; it is 2ft. wide and 1ft. 4in. deep, laid on a gradient of 1 in 144, or 36ft. 8in. to the mile, the depth of water flowing in this box being 11in., which would be equal to about seven sluice-heads. This supply is brought in at an elevation of about 110ft. above the head of their sluice, or level at which they are working. Their present workings are confined

to a narrow gut, the sides of which are from 60ft. to 70ft. in height, with loose rock and boulders among the surface wash, very liable to slide into the workings in wet weather. Indeed, they informed me that a recent slip had taken them a long time to clear away. The ground in this gully in the early days had been driven out from an adit-level, but the present bottom they are working on is about 5ft. above the old workings. They informed me that the quantity of gold from the gut they are at present working averages about 40oz. for every 12ft. in length. If the water were taken down in iron pipes from their head-race, and a derrick erected, with a small Pelton hurdy-gurdy wheel, to lift the stones and boulders, they could have worked the same amount of ground in eight months that has taken them about two years and a half. They have a 3in. pipe from the head-race for supplying water for a small nozzle, but the most of the pressure or head is absorbed in friction, so that it is of very little use. The shareholders in this company are satisfied that they are working their claim in a disadvantageous manner; but, having expended their money in the construction of the head-race, they want to get sufficient gold out of the ground to enable them to put a proper hydraulic plant on their claim. But hydraulic sluicing will never be carried on here systematically until some new company commence extensive operations, and show by actual demonstration the large amount of ground that can be sluiced away with very little manual labour.

Washbourn Bros.' Hæmatite-paint Works.—The same plant that was in use on my former visit three years ago is still kept working, and turning out several shades of hæmatite paint. The proprietors have commenced a new industry in connection with their works—namely, manufacturing knife-polish from a felspathic porphyry stone which they find in the neighbourhood, and which, when ground up and dried, forms an excellent knife-polish. This is sold in 1lb. tins, and costs 4s. per dozen. The proprietors expect to be able to create a considerable trade in this as soon as they get it properly introduced. They have also erected a one-stamp quartz-mill—Washbourn's patent—to test any parcels of auriferous quartz found in the neighbourhood. They have also a small hand-mortar, which is used to test 14lb. or 28lb. of stone, as the case may be, which would be useful to those prospecting quartz reefs, as this small machine would enable the miners to ascertain the quantity of gold in the stone, such as they might expect from an ordinary crushing-battery, and therefore would be a more authentic way of getting at the actual returns than by making assays from small pieces of stone, as the assay value is never fully realised when treating the lode-stuff in bulk. This small machine is not more than three times the weight of an ordinary pestle-and-mortar which is at present used in connection with prospecting.

Appo's Gully.—Very rich patches of gold were found in this gully in former years, but the workings are now limited to about three men, who have claims in different parts of the gully. One of these—F. West—has a claim at the lower end of the gully, where it widens out into the flat. He has traced a run of deep ground going down the flat, but has not been successful in finding a rich lead of gold. It appears to have been a deep gut, at one time forming the channel of the creek, but slips have come down from the side of the range and filled it completely up, changing the course of the creek from a deep channel to the terrace alongside, and therefore a rich lead of gold is not likely to be found in this gut with the exception of the wash-drift on the bottom. Mr. West is working his claim by an inclined tramway, the wash-dirt being hauled up in a truck by a small overshot water-wheel, and emptied into a paddock alongside the creek, where it is washed in sluice-boxes. On the end of the shaft of the water-wheel there is a small crank which works a pump 3in. in diameter, which is distant from the wheel about 2 chains, and by a very simple and effective method he works the pump from the wheel by a connecting-rod of common telegraph-wire, the wire being made fast to the T-bob and run along on the top of wooden posts driven into the ground, having a staple driven in over the wire. The spear, or rods, of the pump are weighted so as to keep a tension on the wire. On the end of the wire at the wheel there is a common link which slips over the pin or crank, and the wire always being kept in tension by the weighted rods makes this simple arrangement work the pump very smoothly.

Mahakipawa.

The field still continues to support a large population for the small area of payable ground that has been discovered. There are about a hundred and fifty miners at work in the main creek, and about twenty-five in the right branch. There are also about thirty-three men employed in the different gullies—namely, in Maori Gully, seven; Waikakaho, seven; Prospectors' Creek, ten; and on the reefs nine men—making a total of about two hundred and eight men actually employed in claims. This would mean that the field is the means of supporting a population—including business people, women, and children—of about at least eight hundred and fifty persons. The claims in the right branch are getting pretty well worked out, and there are a few claims abandoned in the main creek; but many of those working at the lower end of the main creek will take three years yet to work out, while the claims on the flat near the township, if the lead of gold be discovered, will last for many years to work. The ground on the flat will be very deep and will contain a good deal of water, and will require expensive plant to work it. A good deal of money has already been spent here in prospecting for the deep ground, and small pumps have been used to lift the water, which have been found useless; but the holders of those claims are now beginning to erect more substantial plants, which are likely to enable the flat to be prospected.

The following are the principal claims at work on the field:—

Mahakipawa Claim.—This claim is the lowest down on the flat, about 30 chains below the township. It is held by a company who have sunk a shaft to the depth of 40ft. and have erected a water-wheel and pumping-gear to work a pump 9in. in diameter, the whole of which had just been completed at the time of my visit, and they were ready to commence sinking again. There are six men employed in the claim.

Alice Fell Claim.—The owners of this claim have sunk a shaft to a depth of 80ft. on a sidling reef, but they went through the reef for some distance and put in a drive from near the bottom of the shaft towards the flat, and struck the wash drift at about 110ft., where they got a few colours of gold. They have continued this drive for another 60ft., but have lost the reef on the bottom, showing that the deep run of ground lies further to the eastward. They intend to drive across the flat until they come on the reef on the opposite side, and then to sink monkey-shafts in the drive to prospect for the lead of gold which so far has been found in the deep ground in the creek claims. There are six men employed in this claim. The shaft is 9ft. by 4ft., well timbered, and they have an overshot water-wheel 18ft. in diameter, which works a pump 9in. in diameter. At the time of my visit this pump had a stroke of 6ft., and was working ten strokes per minute, and had to be kept pumping full to keep down the water. Although this is the best plant at present on the field, it is questionable if it will be powerful enough to contend with the water when once the ground is opened out. They have erected a flume 20 chains long to bring water from the creek to work their wheel, and have constructed the whole of their works in a strong and substantial manner.

King Solomon's Mine.—The company who hold this claim, which adjoins the Alice Fell higher up the creek, are constructing a flume, water-wheel, and pumping-gear before commencing to sink. There were four men at work here at the time of my visit.

British Empire Claim.—This claim is in the township, and joins the eastern boundary of King Solomon's Mine. A shaft has been sunk for about 18ft., and a commencement made to construct an overshot water-wheel and pumping-gear; but, as the owners of this claim are depending on water from the side creeks to work their machinery, it seems very questionable if they will get a sufficient supply except in wet weather. There were four men employed in this claim, but at the time of my visit the works were suspended.

Hibernian Extended Company.—This company's claim adjoins the upper boundary of King Solomon's Mine, in the mouth of the gorge in the Mahakipawa Creek. They first tried to work the ground by paddocking, but found that it was too deep to work by this means. They have sunk a shaft to a depth of 51ft., and have a pump 8in. in diameter, worked by an overshot water-wheel 10ft. in diameter; but this wheel is not sufficiently powerful to keep down the water. They are going to erect a larger wheel before doing any more work. Every flood in the creek stops their workings for some time by causing more water to percolate through the ground than their pump is able to lift. There are six men employed in this claim, and they have got about 70oz. of gold out of the ground.

Lucky Hit Claim.—There are four men working in this claim, driving out the ground from a shaft which is 44ft. deep. They have an 8in. pump worked by a water-wheel, and are now in a fair way of working the ground. Although they have held this claim for eighteen months, it is only recently that they have got down their shaft, and since they have commenced to drive out the ground they have got about 50oz. of gold.

Te Oreore Claim.—There are three men working here and getting very fair gold. Their shaft is about 40ft. in depth, and the ground is drained by a 6in. pump worked by a small water-wheel.

Wairarapa Claim.—This is one of the best claims on the field. It is held by three men, who have other three wages-men employed in working the ground, which is about 30ft. in depth, and is drained by a pump worked by a water-wheel. The claim has been held since the first of the field; but it is only since May, 1889, that they commenced to drive out the ground, and since then the shareholders informed me they have got about 800oz. of gold. The width of the run of gold up the creek varies from 14ft. to 30ft.

Never Surrender Claim.—There are six men employed in this claim, which is worked from a shaft about 35ft. in depth, and the wash-drift taken out to a height of about 5ft. The ground is drained by a 7in. pump, worked by a small overshot water-wheel. They have been working about eighteen months, but it is only recently that they have got gold. On bottoming their shaft they took out 40oz. of gold in one day. The shareholders stated that they had got about 200oz. of gold out of the claim.

Long Time.—This claim is worked from a shaft 35ft. in depth, and the ground is drained by a water-wheel working a small wooden pump. There are eight men employed, who are said to be getting over 20oz. of gold per week.

Nesbit and Party.—This party consists of six men, who are driving out the ground from a shaft, the water being drained by a pump worked by a small water-wheel. The ground is about 30ft. in depth, and during the last twelve months they have got about 280oz. of gold.

Try Again Claim.—This is what is termed a terrace claim, but, nevertheless, it is in the bed of the creek. The creek claims are only supposed to have a width in the creek-bed of 30ft., and where it widens out to over 30ft. the ground is taken up as terrace claims. In some of the so-called terrace claims it has been found that the original bed of the creek went through them. There are eight men employed in this claim, who have got out of the ground about 150oz. of gold. The shaft they are working from is 40ft. in depth, and they are driving out the ground.

Boys' Own Claim.—There are four men employed in this claim. They work the ground from a shaft which is about 34ft. in depth. It is only recently that they commenced to get gold. They informed me that in one day they got 47oz. of gold, and that they have taken out of the claim altogether about 130oz.

O'Leary and Party.—This is a terrace claim, which is worked by two men from a shaft about 38ft. in depth. The ground is drained by a pump worked by a small overshot water-wheel, and it is said to pay good wages for working.

Breen and Party.—This is a terrace claim where three men are employed, and it is said to have paid very well for working. It is a difficult matter to ascertain the actual amount of gold got, but one of the shareholders informed me that they had taken out about 200oz.

Golden Hope Claim.—There are six men employed in this claim. They are driving out the ground, which is drained by a tail-race, and have taken out about 250oz. of gold for the last four months. They average the value of their ground to be about £9 per lineal foot in length of the lead.

Venture Claim.—This claim is worked by a tail-race, the ground being about 14ft. deep. There are four men employed, and they state that during twenty months they have been at work here and in a terrace claim they have got gold to the value of £2,500. Of this amount gold to the value of £800 has been taken out of their present claim, and £1,700 from the terrace claim, where there were six men employed.

Homeward Bound Claim.—There are eight men employed in this claim, working it by the aid of a tail-race, and it is said to have paid very well for working.

Maori Girl Claim.—This claim is held by three men, and is worked with a tail-race, but there has never been much gold got here.

Gallaway and Party.—This party consists of six men, who are working the ground from a tail-race. They were a long time before they got much gold, but the claim was said to be paying very well for working at the time of my visit.

Grattan and Party.—This is a terrace and creek claim. The ground is about 30ft. in depth, the wash-drift being driven out from a shaft. There are three men employed, who are said to have obtained a great deal of gold from this claim.

Waihi Claim.—There are seven men employed in this claim, which is worked by the aid of a tail-race, the ground being about 12ft. in depth; but they have never got a great deal of gold out of the ground, although it has paid them small wages for working.

Greig and Party's Claim.—There are four men employed in this claim. The ground is from 8ft. to 12ft. in depth, and is worked by the aid of a tail-race, and a large quantity of gold has been taken out. It is reported to have been one of the best on the field, as they have been getting gold from the time that it was taken up.

Prospectors' Claim.—This claim has never produced a large quantity of gold. It is said that the prospectors of the field have never made wages during the whole time they have been at work, and they consider it a hardship that they are not paid a bonus for the discovery of the field, which, according to the quantity of gold obtained that has been entered for duty for exportation to the end of March last, amounts to somewhere about 7,000oz. The best of the gold has been found lower down the creek than the Prospectors' Claim. The claims in the main creek above the Prospectors'—namely, the Whalers' Claim, with four men; Scott and party, four men; and MacIntosh and party, four men—have not got large deposits of rich auriferous wash. The two latter claims may be said to pay wages for working, but the Whalers' Claim has been very poor.

Right-hand Branch.—A great many heavy pieces of gold have been found in this branch, and generally combined with quartz; but the greater number of the claims that were originally held in this branch have been worked out. There are still five claims being worked here—namely, Pulman and party, four men; Hen and Chickens Claim, eight men; the Egmont Claim, four men; Watson and party, four men; and a sluicing claim where two men are employed—but none of these are said to be paying more than wages, and some of them are getting very poor for working. The depth of the ground is from 20ft. to 40ft.

Specimen Gully.—There are two parties of miners working in this gully, both of which are said to be doing very well. The gold is very coarse, generally what may be termed specimen-gold—that is, intersected with quartz—which apparently has come from the cap of the reefs at a higher elevation.

Maori Gully.—There are three parties of miners working in this gully—altogether about seven men—all of whom are doing fairly well. This gully runs up partly through the licensed holding known as the Kapai Quartz-claim, and one of those parties—namely, Corley and two others—is working the alluvial ground in the gully on the licensed holding, and is said to be making good wages.

Prospectors' Gully.—This is a small creek coming out of the range and joining the main Mahakipawa Creek at the Prospectors' Claim. Some parties have tried to work this creek near the lower end, but have never been able to get to the bottom of the alluvial ground. An adit-level was commenced at the side of the creek where the track crosses, to drive into the side of the range and get under the bed of the gully higher up; but it was found that the side of the range where this adit was commenced was a slip, and the adit, not being properly timbered, collapsed, and no further attempts were made to work this portion of the gully. There are ten men altogether working in the upper portion of the gully, but, with the exception of the upper claim, which is paying very well for working, the others have not yet been bottomed.

Waikakaho Creek.—At the time of my former visit to this creek there were several claims being worked, and steam-engines were being used on the flat to prospect the ground; but all of these claims are either abandoned or protected. There are only about seven men at work in the Waikakaho Creek and branches, and none of them are getting much gold.

Davis and Carr's Claim.—This was one of the first terrace claims taken up on the field. It is situated on a terrace on the west side of the Mahakipawa Creek directly opposite the township. The terrace on which they are working appears to have been a slip from the main range at some period, and not to be connected with the run of gold coming down the main creek. They have recently formed a company, and have brought in a water-race to work the ground by hydraulic sluicing, and are now carrying on sluicing operations.

The tailings coming from the workings up the creek are beginning to fill up the bed of the creek opposite the township, and as the creek claims get worked out there is no doubt but that alluvial drifts will be found on the side of the range that will pay for working by sluicing. At present all the water is required in the creek-bed to drive the water-wheels used for pumping and washing purposes, but the day is not far distant when the whole of the creek-bed in the flat will be

filled with tailings from sluicing claims, and the question of an outlet for these tailings will most undoubtedly crop up. The whole of the gold got in the creek is of a coarse character—plenty of pieces like peas and beans, and without any of that fine scaly gold that is got elsewhere. It is all greatly waterworn, but evidently has not travelled a long distance or else it would be more ground up than it is. At the head of the gullies it is very little water-worn, as many of the corners and projections are quite sharp and angular, showing that it has come a very short distance, and indicating that rich quartz reefs are likely to be met with on the range, or, at least, the indications show that there was a time when the caps of the reefs have either been broken off by slips taking place or by the atmospheric action disintegrating the exposed rocks on the range, causing the high ranges to be denuded, and filling the gullies and creeks with *débris* which water has swept away, leaving a golden harvest for the present reapers.

Koromiko.—There are about seven men working in the valley leading down from the head of the left branch of the Mahakipawa Creek towards the Koromiko Railway-station, and getting a little gold, and it is said there are some large reefs on this side range. A little gold is also found in White Pine Gully, which is a similar formation to that of Mahakipawa—namely, the older quartzose-schist rocks that occur in Otago. This same formation seems to run past the head of the Kenepuru Sound, and underlies the more recent formation found on Mount Stoke, and passes into the sea at Jackson's Head. The country between Mahakipawa and Twofold Bay is well worthy of being prospected, and, judging from the formation of the country, it is likely that auriferous drift-gravel will be discovered in the belt of country which will pay for working.

Wakamarina.

There is very little alluvial mining being carried on here, and what little there is may be termed fossicking, with the exception of the work recently done in the gorge of the Wakamarina River, at the foot of Deep Creek. Three different companies have tried to work this gorge, two of which failed entirely, and the present one has suspended operations after expending £1,880 of capital, and incurring liabilities to the extent of £550, which makes the total cost of their works £2,430. The former companies are said to have expended nearly £6,000, and never could get the water pumped out. The present company has been more successful. They have constructed new and substantial dams at both ends of the gorge, and have cut a channel for the water in the river through solid rock for a distance of about 3 chains. The dams are all made on the solid rock, having squared logs and sheet-piles scribed down to the rock on each side of a puddle-wall. The top of the puddle-wall is covered with bags and planked over, so that the water in the river can flow over the top without damaging the dams. The logs and sheet-piles are all held down to the bed-rock by iron bolts. By this means the dams have been made practically watertight, and the gorge has been pumped dry in about three days.

The present company have two steam-engines, one of which is connected with a centrifugal pump whose outlet and intake pipes are 9in. in diameter. The centrifugal pump and engine are fixed on a cast-iron bed and placed in a punt, with a vertical steam-boiler for supplying steam for the engine. The other engine is a double-cylinder portable steam-engine and boiler. The vertical boiler that stands on the punt is not capable of supplying sufficient steam to work the pump at its proper speed, and a steam-pipe is connected to the steam-cylinder attached to the pump from the boiler of the portable engine on the bank, to supplement the steam from the vertical boiler. This enables the pump to be worked at a speed which takes the whole of the water out of the gorge in three days, and when once the water is out a hand-pump is said to be able to keep it dry. As soon as the dams were completed and the punt carrying the pump placed in position, they commenced operations at the upper end of the gorge, and got about 20ft. to 30ft. of the bed clear of shingle, and obtained about 10oz. of gold out of the crevices of the rock. They also stripped a considerable quantity of shingle from another bench, when a flood occurred, a few weeks prior to my visit, which stopped their workings. The whole of their capital being expended, they suspended operations during the winter months, and intend raising fresh capital to prosecute the work next summer.

This company deserves credit for the substantial manner in which they have constructed their works; but they seem not to have carried on their operations in the bed of the gorge, after the works were completed, with as much energy as they should have displayed. Where mining is carried on in river-beds liable to be flooded, work should be carried on with as many hands as can profitably be employed, and working carried on continually day and night. There is a large quantity of shingle in the bed of the gorge in which there is not sufficient gold to pay for washing. This is filled into trucks and hauled up an inclined tramway by a horse, and the shingle deposited in the river-bed. The gold seems to lie on the bed-rock and in the crevices. They expect to get the richest deposits in the centre of the gorge, where they say there is a bar of rock, and also at the lower end. The depth of the deepest portion as yet ascertained is about 30ft. below ordinary water-level. Assuming that they have expended £2,430, and that they will require another £570 to prosecute the work, exclusive of actual working-expenses in connection with lifting the shingle, they will require to get at least 1,000oz. of gold to reimburse the capital expended.

Westland District.

There is still a large population in this portion of the West Coast, and a great many of the alluvial mines here are doing very well. There is no gainsaying the fact that the gold is becoming more difficult to get. The shallow placer-workings are getting worked out, and, although there may be equally as much gold on the drift near the bed-rock, there is a large quantity of superincumbent drift to remove before the auriferous wash-drift is reached, which greatly increases the cost of obtaining the gold. The most economical method of working ground, wherever dump can be got for tailings, is by hydraulic sluicing and a plentiful supply of water. This method is getting,

year by year, more fully recognised. The miners now are using far more water than they were some years ago, and find it is the most profitable method of getting away the ground. All the known payable terraces to which water can be brought are taken up, and the water-rights from every available stream adjacent to alluvial workings are secured.

The whole of the available sea-beaches, as well as some of the river-beds, are taken up in dredging claims, and, although many of them may prove unremunerative for working, there will be a good proportion of them that will pay with having good appliances for working. The dredging is likely to become a large industry, affording employment to a considerable population. Each of the dredges now working in Otago employs about twelve men—that is, when they are working continuously for twenty-four hours. There is a very large area of auriferous beaches and back-leads in lagoons in Westland which can be profitably worked with good dredging appliances, and offers a good field for the investment of money in dredging ventures.

Kumara.

This is by far the largest field where hydraulic-sluicing operations are carried on in the colony. The most of the ground is held in ordinary and extended claims, although there are some special claims and licensed holdings. Some of the latter have been cut up and sold in small blocks to parties of individual miners at very high figures. Indeed, large areas of ground should not be granted in this locality, as the whole of it can be profitably worked in small claims, and the granting of large areas on this field is only encouraging a system of blackmail to be levied on the individual miner, which, to say the least, is very objectionable, and only putting the money into the pockets of a few speculators, who do not work the ground themselves, at the expense of the large majority of the miners on the field, as the money they have to pay in purchasing blocks of ground as their claims get worked out ought to go towards the further development and opening-out of the field. The whole of the available water-rights are taken up and held by Mr. Holmes, the Government, and the Long Tunnel Company, and the ground can only be profitably worked by a large supply of water, and, as parties having claims on this field are dependent on a supply of water from Mr. Holmes's and the Government water-races, there is no necessity for granting large areas of ground to lie idle for years, waiting until such time as water is available, or to allow the holders to sell the ground to other people.

The flat where the workings are situate has no doubt been at one time the bed of a large river; the whole of the boulders and stones in the ground are rounded and smooth, and the gold is flattened out and ground up by the action of these boulders being forced onwards and rolling over by the action of a strong rapid current. Some of the large boulders found in this flat are of such dimensions that no current in any of the rivers at the present day could move them, and apparently they have been brought from some distance by ice, as the same description of rock is not found *in situ* in the vicinity. The workings have so far been carried on in a very coarse boulder drift-wash, and the gold is found in layers through this wash-drift. The bed-rock has never been reached in the flat, neither is there sufficient fall to allow the ground to be worked on the present system to the main bottom.

The Blue Reef is found near the front of the terrace facing the Teremakau River, and it is again found on the foot of the Kapitea Hill; but where the principal gold has been obtained, and the richest claims, are between these points, which have all been worked on false bottoms. There is a great similarity between this place and the ground in Ross Flat, with the exception that the drift-wash is much coarser at Kumara; but the different layers of stuff in which the gold is found have a great similarity. The lead of gold-bearing drift has been traced for a certain distance up the flat, and lost, and it cannot, so far, be traced on the opposite side of the terrace from Larrikins', neither can it be traced for a great distance down the flat; at the same time, there is every indication that this lead will yet be found to extend for a long distance. A shaft was put down near the head of Larrikins' for about 100ft. in depth, without finding any bed-rock; but the quantity of water to contend with was so great that it could not be overcome by manual labour, and the shaft was abandoned.

Judging from the formation of this flat, there is a likelihood of a good deal of gold being found at a greater depth, and, if so, it is likely to extend for a considerable distance, and, moreover, be much richer than the gold-bearing layers that have been worked; at the same time, the expense of working would be considerably greater, as motive-power and machinery would have to be used to work the ground from a shaft. It would enhance the value of mining and other property in this district if payable gold were found at the deep levels, and, where so many men are employed, all of whom are principally interested in the claims on the flat, it would not come to much each to sink a shaft and erect machinery to test the ground, as there is a probability of their being well rewarded for this outlay. The whole of the ground that is known to be payable for working is held in claims, so that no one can take up a claim to test the deep ground unless by going a good distance away from where gold has been found.

The present known ground at the high levels will yet take a large number of years to sluice away, and before this can be all worked the bed of the Teremakau River will be raised by tailings to a considerable extent; indeed, it will become a difficult question where to find room to stack the tailings before the present known auriferous ground is washed away. The day is not far distant when the bed of the river will be raised to such an extent that a flood will carry away the bridge on the Hokitika–Greymouth Road, and the whole of the flat that was formerly grass paddocks will become one bed of shingle.

On the opposite side of the river from Kumara there are a few sluicing claims being worked, but the ground on this side has never been so good as that on Dunedin and Larrikins' Flats. Some new ground has been opened on the terrace close to the Teremakau River, below the Kumara, but there is not sufficient water on the field to admit of much new ground being opened; indeed, the owners of the present claims would take more water than there is on the field.

ARAHURA.

Humphries' Gully Company.—This company has been struggling against difficulties ever since they started operations. They have expended over £70,000 on the claims and plant, and yet, with all this expenditure, they have not a sufficient quantity of water to work the ground. When they were constructing their head-race they employed what they considered practical miners to gauge the water in the creeks they intended to bring in, and the reports of these were so favourable that the company was satisfied that they would obtain a good supply; but if the area of the watersheds of these creeks had been taken it would have clearly proved the utter fallacy of obtaining a steady supply. The company are now well aware of this, but, unfortunately, all their available capital is called up, and to extend their head-race to the Arahura River, where a large supply could always be got, is estimated to cost about £25,000.

The extraordinary dry season last year told very severely on the returns of gold from the company's ground. They have let it on tribute, the tributer paying the company somewhere about 60 or 66 per cent. of the gross yield of gold. During the year ending the 9th February last the value of the gold obtained only amounted to £1,916 8s. Of this sum the company's share amounted to £1,277 12s., while their working expenses, including the expenses of management, amounted to £1,277 18s. This shows that the venture about cleared itself last year; but there is no possible means of it paying the shareholders unless a large and constant supply of water be obtained, and that can only be got by extending the head-race to the Arahura. There is a great depth of auriferous drift in this company's ground, but there do not appear to be any rich deposits: it is only by being able to get through a large quantity of drift that it can be made to pay.

KANIERI.

Kanieri Water-race and Mining Company.—This company has recently been registered, and acquired the old Kanieri Lake Water-race, which they are diverting from about the three-mile peg from Kanieri Lake to bring it on to the ground near the Kanieri Forks. The three miles of old race has been cleaned out and repaired, and there is about two miles and a half of deviation to construct to bring the water to the Forks. This work is in course of construction.

There are a few miners employed at Tucker's Flat, the Eight-mile, Woodstock, and Rimu; but their average earnings do not come up to what they did some years ago. At Back Creek Terrace the claims extend for about two and a half miles. Some of the claims here are said to be paying £10 a man per week, but the general value of the drift is said to be from 6gr. to 12gr. of gold to the load. There are about one hundred miners employed.

A lead of gold was traced some time ago on the south side of the Hokitika River into freehold land belonging to Mr. James Craig, who is now carrying on mining operations within his own land, and has expended something like £1,000 in the construction of water-races, dams, tramways, &c., to work the ground systematically.

ROSS.

This place still maintains a fair population, and some of those engaged in sluicing claims are making fair wages; but the quartz claims have been very disappointing. Neither the William Tell, at Cedar Creek, nor the Donnelly Creek Quartz Company, after getting crushing-batteries erected can find quartz of a payable character to keep them employed. The latter company represented to the Government that the quartz from this mine contained gold to the extent of about 8oz. to the ton, when making a claim for quartz forwarded to the Melbourne Exhibition; but, after getting a crushing-plant of their own, they find the golden anticipations in regard to the richness of the quartz vanish, and can now fully realise that "all that glitters is not gold."

Mont d'Or Company.—This company hold at present the best mining property in this district. They recently acquired the property of the Greenland Company, so that they have now all the available water in the district, and no one can take up any of the ground near them, as there is no water to be got to work it; indeed this company was short of water last season. Still they have managed to pay £3,600 in dividends.

Ross United Company.—This company let all their ground on tribute. They can only get the ground worked that is above the level of the tail-race leading from the flat to the ocean-beach. In Ross's and Donoghue's Flats there are elevators erected to lift all the shingle and tailings from a well into which the whole of the ground is sluiced, and the muddy water passes down the underground tail-race. The value of the gold obtained from the tributers during last year was £1,638 17s., and the value of the sales of water from their water-race amounted to £127 4s., thus making the total receipts £1,766 1s., while their expenditure was £1,701 0s. 7d. This company has been struggling for years to get sufficient capital to erect a powerful drainage plant to enable them to work the deep levels. They have expended about £60,000, and succeeded in finding payable ground for working at the deep levels, being over 200ft. below sea-level; but the quantity of water was too great for the pumping-plant the company erected.

There was a large quantity of gold obtained from the deep levels some eighteen years ago by M. Cassius, the Morning Star, and Excelsior Companies; but the cost of drainage at that time, which was accomplished by steam-power, and the difficulty of getting any one to contribute was so great, that the drainage-plant was sold, and purchased by M. Cassius and the Morning Star Company, who had arranged to amalgamate their claims and form a new company to work the flat; but after stopping the drainage-plant, the new company could not be formed, and finally the ground was abandoned, until the present company came on the scene and got the whole of the principal ground on the flat secured as a special claim. The manager of this company has recently found out that the company has never been working on the same layer of auriferous wash-drift that the former companies got their gold from, but on another layer some 32ft. below the other. Be this as it may, one thing is certain, that they never were working on the same run of brown sandstone wash-drift that was worked from the Cassius' shaft, but in a bluish wash-drift resembling the auriferous layer found at the bottom of the Morning Star Company's shaft.

TUAPEKA.

There has been a great deal of gold got from this district since it was first opened in 1861, and for many years it afforded profitable employment to a large mining population; but the easily-worked alluvial deposits have now become exhausted, and more scientific methods are now adopted to work the ground, which in the early stage of gold-mining were not thought of. Gabriel's Gully, Weatherstone's, and Waitahuna were places that were dotted over with workmen well satisfied with the earnings they were getting by working their claims in the primitive style then adopted; but the scene now is entirely changed. Only a few miners are to be seen here and there, principally Chinese, turning over ground which has been worked and reworked, and is covered over with tailings, and yet there is sufficient gold left to afford them a livelihood. In Gabriel's Gully no trace of the shafts and paddocks are left. All the surface of the gully is covered over with tailings, and a few years ago many of the old residents, who had known the place from its earliest days, were astounded when J. R. Perry took up a claim in these old workings, covered with 30ft. to 50ft. of tailings from the Blue Spur and other claims, and they predicted that the proposed venture would prove a failure.

Notwithstanding these predictions, Mr. Perry commenced operations, and worked the ground on the hydraulic-elevating principle, which has now become the favourite method of working the low flats where the fall for tailings could not be got by ordinary sluicing. The system he adopted was not a new one; it had been used for years previously in working the drift-flats in America, but the principle there adopted was far from giving satisfactory results. Mr. Perry had, therefore, to contend with many difficulties, and to make experiments to perfect his plant to surmount the obstacles he encountered; at last, however, he was able to prove that his venture was a payable one, and to utilise the pressure of water to do the work that formerly had to be done by manual labour, and therefore invented a new system of mining, which is now adopted in many parts of the colony.

Gabriel's Gully Consolidated Gold-mining Company.—This is known locally as the Blue Spur Company, and is the only company with extensive workings in or near Gabriel's Gully. They purchased the properties of Mr. Perry's Tailings Company, the Nelson, Otago, Perseverance, Morrison, and Blue Duck Cement Companies, and also the Tuapeka and Waipori Water-race Companies, with the view of erecting extensive machinery to treat the cement in the Blue Spur; but since they commenced working in April, 1888, their operations have been confined entirely to the ground originally held by the Tailings Company, which is worked on the hydraulic elevating principle. Judging from the manner in which the cement has been worked, having the richest portions driven out and the ground burrowed in every direction like a rabbit-warren, it is questionable if their present operations are not carried on in the portion of their claim that will prove most remunerative.

At the time of my visit there was a scarcity of water, and only two nozzles were at work. One of these nozzles was in a paddock near the side of the road leading up from Lawrence to the Blue Spur. The bottom elevating-pipe lifted the material 14ft. into a flume 84ft. long and 3ft. wide, and then there was another elevating-pipe at the end of this flume, which lifted the material 60ft. into another line of boxes, which carried the tailings clear of the paddock and workings and deposited them in the bed of the gully. The second nozzle was working in a paddock where it was expected that the best of the ground was,—at least, what was pointed out to me on my former visit as the place on which their calculations were based as to the anticipated returns when the company was floated; but, alas! like many of these returns, the calculations had not been carefully made, as the place is one mass of stones from the old tips coming from one of the original companies' workings, which either have to be removed by manual labour, or broken up small enough to send through the elevating-pipe. The latter plan was adopted to get clear of these stones, but this adds materially to the cost of working, and the profits are nothing like what was anticipated.

There are two elevating-pipes at the upper paddock: the lower one lifts the material about 12ft., and the upper one 25ft.; and the tailings are deposited in the old worked ground, the tail-water going down the underground tail-race that was being carried up the bed of the gully on the bed-rock. Mr. Jackson, the company's general manager, informed me that he only got 7oz. of gold for a week's work in what was shown him as the best ground.

In reference to the quantity of material lifted, the manager stated that when he was lifting the material 87ft. 8in. in two lifts—namely, one 62ft. 8in. and one 25ft.—in 85 shifts, comprising 680 hours, he moved 26,920 cubic yards, which would be equal to 40,380 tons; and the gold obtained was 115oz. 11dwt. 16gr., representing a value of £433 8s. 9d., and the expenditure in connection with this work was £198 18s. This, therefore, shows that the quantity lifted to the height mentioned was equal to about 59·4 tons per hour, and that the value of the material was equal to about 2·58d. per ton, and the cost of the work was equal to about 1·18d. per ton. The quantity of water used was 350in.—$8\frac{3}{4}$ sluice-heads—with a head of 450ft., on the 62ft. 8in. elevating-pipe, and 400in. —ten sluice-heads—with a head of 375ft., on the 25ft. pipe. The quantity of water used on the nozzle for bringing the material to the well where the bottom elevating-pipe was placed was 150in. —$3\frac{3}{4}$ sluice-heads—with a head of 375ft.

In regard to the amount of work done with the quantity of water used it appears doubtful if the data supplied are reliable, inasmuch as there is no comparison between the percentage of power employed to lift the material in the 25ft. elevating-pipe and that used to lift the material in the pipe 62ft. 8in. To analyse this, it means that in the bottom 25ft. pipe 10 sluice-heads of water was used under a head of 375ft., which, disregarding friction entirely, would be equal to 426 theoretical horse-power, and the quantity of material lifted, being 59·4 tons per hour, is equal to 2,218lb. lifted to a height of 25ft. per minute, or 55,450lb. a foot high per minute. The quantity of water lifted is equal to the quantity used for elevating *plus* the quantity used in nozzle for breaking-down, namely, $10+3\frac{3}{4}=13\frac{3}{4}$ sluice-heads, or 1,289,062lb. lifted a foot high per minute, thus

making the total weight to be lifted 1,344,490lb., which is equal to 40·7 theoretical horse-power, and shows that 946 per cent. of the power is absorbed in friction. Again, the quantity of water used in lifting the material in the upper elevating-pipe is $8\frac{3}{4}$ sluice-heads under a head of 450ft., which is equal to 447 theoretical horse-power. The weight lifted equals the quantity of water formerly used in the lower pipe *plus* the quantity used in the pipe in question, namely, $10+3\frac{3}{4}+8\frac{3}{4}=22\frac{1}{2}$ sluice-heads, or 84,375lb., together with the weight of the solid material, namely, 2,218lb., lifted to a height of 62ft. 8in., or 5,429,372lb. lifted a foot high per minute, which is equal to 164·5 theoretical horse-power, and shows that in this case only 17·1 per cent. of the power is absorbed in friction. Taking into consideration the loss of head due to friction of water in pipes, the quantity of water given for the work done by the upper elevator is too small or else the quantity given for working the lower elevator is too great.

Clutha Valley.

No one can visit the Clutha Valley and see the large areas of auriferous alluvial drifts without being strongly impressed that it contains very rich deposits of gold. The bed and banks of the Clutha River have yielded up a large quantity of gold since its auriferous character was discovered in 1862 by Hartley and Riley. Twenty-seven years have passed away since then, and still its auriferous deposits are being worked, affording remunerative employment to a considerable population. This valley is nothing but the remains of an immense ground-sluice that has for ages been triturating and washing away the slips from the mountains, carrying all the lighter materials on the bosom of the powerful current of water in the river out to the ocean, and leaving the denser materials behind, depositing them on the beaches and in the beds of the stream until it became so raised as to cause the river to change its course time after time, hence the large deposits of gold that have been found in this valley, and that still remain to be extracted. The present bed of the river has been eroded by the constant action of the stream carrying down gravel and sharp quartz pebbles, wearing down the bed-rock wherever it lies bare into a narrow channel, which now keeps the water of the river within certain bounds.

There is sufficient evidence to show that a period existed when the land on each side of the river rose more abruptly than it does at present, and the high lands and mountains were at greater elevations, and have been worn down by glacial action and denudation. The striations found in many rocks in this valley show that they have been carried some distance by ice. This action, together with the atmospheric influence on the rocks effecting their decomposition, and the immense slips that time after time come from the sides of the ranges into this valley, (which is the outlet for draining a large tract of country,) the immense volume of water that flows through this outlet, and the velocity of the current (which is said to be greater than that of any other river in the world), has separated the light material from the heavier substances which now lie deposited on the flats, low terraces, and in the present bed. Nature has accomplished on a gigantic scale that which those engaged in ground-sluicing are doing at the present day.

The Clutha River, from its source to near the ocean, as well as all its tributaries, passes through an auriferous old quartzose-schist formation, and belongs, apparently, to an older age than the schist rocks in many other portions of the colony. (The same class of rocks occurs at Mahakipawa, and runs from there to Jackson's Head.) The large quantities of gold that have been taken out of the Shotover, Arrow, Kawarau, Nevis, Bannockburn, Lindis, Manuherikia, Teviot, and Tuapeka Rivers show that the whole of the country is auriferous, and that the natural agencies at work for ages prior to man inhabiting the country have left untold treasures to be unearthed and collected by the present and future generations.

In the early days of gold-mining only very primitive appliances were required to collect sufficient of the precious metal to enable those who followed the avocation of gold-mining to earn a livelihood. The gold was found in shallow deposits, and especially so in the beds of the Clutha and its tributaries. The beaches in many places were literally lined with golden sand, the gold being collected by means of the primitive cradle: but so long as shallow-placer deposits could be found no attention was paid to any ground difficult to work. But great changes have taken place in mining within the last ten years. Attention has been more directed to labour-saving appliances, and the old conservative ideas that the gold-miners, as a general rule, adhere to, have, by force of circumstances, been dispelled, as it has been proved conclusively that with the present appliances ground can be made to give good returns for working that formerly, as the miners termed it, "would not pay for salt." There is no doubt that far more gold will be taken out of the Clutha than ever has been got, and there is scarcely a place in this valley but would pay for working if a good supply of water were available at a sufficient elevation; and, even where that cannot be obtained, the current of the river could be utilised to pump and force the water with an equal pressure to what it would have under a head at a high elevation. This is simply a question between the cost of constructing water-races and reservoirs and machinery to lift the water. In the latter case, a constant supply of water could be obtained, and, although it would vary slightly according to the volume of water in the river affecting its velocity, and thereby affecting the motive-power, it would not be affected to the same extent that the streams, especially at a high elevation, would be in dry weather.

Kirkpatrick and Eddie's Claim.—This claim is situate about four miles above the bridge over the Molyneux River, on the main road from Lawrence to Roxburgh, on the southern side of the river, on what is known as the Horse-shoe Bend. The water is taken from one of the streams on the northern side of the river at an elevation of nearly 300ft., and brought across the river in wrought-iron pipes, suspended on wire-rope cables on the same principle as a suspension-bridge, and their claim is worked by hydraulic sluicing, there being sufficient fall for the tailings into the river. This claim is said to pay its proprietors very well for working. It is, however, questionable if the supply of water is constant and sufficient to carry on their operations on a large scale. The whole of

their works are substantially constructed, and must have cost a considerable sum of money, and they deserve to be well compensated for their venture.

Island Block Company.—This company's workings are situate about two miles higher up the river than Kirkpatrick and Eddie's claim. The reason of it being termed the Island Block is that the surface indications show that the river at some former period had a different course from the present one. There is a low depression in the ground on the west side of the river opposite Miller's Flat, and it follows down the valley, leaving high ground between this hollow and the present river-bed, and this joins the present river-bed at or near the place where they have commenced to work. The whole of this land was purchased some years ago by Mr. Joseph Clarke, a Victorian capitalist, and a company was formed in London, which made arrangements with the proprietor to work about five miles of the low valley which is supposed to have been the ancient river-bed, and from where there is a likelihood of their obtaining a very large amount of gold.

One of the best hydraulic plants that has ever been used in the colony has been erected here. No expense has been spared in making all the works of a substantial nature. Mr. C. E. Rawlings, the company's engineer and superintendent, informed me that the company had expended, up to the time of my visit, about £21,000. A description of this plant and the company's workings are as follows:—

Dam.—A dam is constructed on the Fruidburn, at a gorge at the east end of a large flat, in the form of a weir, and when full covers an area of about fifty acres. In ordinary weather, such as is generally found in the spring, autumn, and winter, the water in the Fruidburn is expected to keep up a supply of water in the dam to give about twenty sluice-heads. The dam is built of cement masonry on a solid rock-foundation, and is 17ft. high. The top portion is formed of double timber, and braced to 40lb. rails. There are two bays of timber, with a centre pillar. Each opening in the masonry is double-planked with totara timber, and bolted to the iron. The extreme length of the dam is 66ft., with a base of 14ft., and 8ft. wide on top; and it is calculated by Mr. Rawlings that it can be raised another 4ft. on the top if required.

Gate-openings.—There are three gate-openings, one on the bottom, 5ft. by 2ft., with an iron door, which can be used to empty the dam. The other two openings are into the flume, the lower one being on a level with the main level of the reservoir, so that nearly the whole of the water stored is available for the race. The third opening is situate immediately above the second, and will only be used in the event of more water being required than the second opening is capable of supplying. If at any time it is found necessary to bring in an additional supply from the Tallaburn, the upper opening will then be used. The overflow in flood-time goes over the top of the dam.

Main Flume.—The main, or weir, flume, which commences at the dam, is laid for 6 chains on the edge of a gorge on a dry-masonry wall. The flume is made of kauri timber, 4ft. wide and 2ft. deep, and tarred throughout, having a fall or gradient of about 3½in. to the chain. There are two by-washes in this flume for letting out the water when necessary.

Water-race.—At the end of the flume coming from the dam there is a solid-rock cutting, and, after crossing a small break where there is 36ft. of boxes 5ft. wide by 2ft. deep, it crosses the Fruidburn by a flume 144ft. long, of same dimensions as the previous boxes, with a fall of 2¾in. to the chain, the flume being 60ft. above level of the bottom of the creek. The race is then constructed for 98 chains in earth and rock cutting, with the exception of three short flumes, two of which are over gullies, having a length of 50ft. each, and one along a rocky ledge which is 140ft. long. These flumes are all 5ft. by 2ft. and have a fall of 2¾in. to the chain. The conduit in earth and rock cuttings is 5ft. wide by 3ft. deep, with a fall of 1in. in the chain.

At the end of the 98 chains of conduit there is a fall of 140ft. over solid rock, then 3 chains of ditching, afterwards a flume 40ft. high and 108ft. long over a creek, thence 50 chains of ditching, which brings the water to the penstock where the pipes are fixed. The carrying-capacity of the conduit when three-quarters full is said by the engineer to be thirty-three and one-third sluice-heads; but, judging from the carrying-capacity of the water-races constructed by the Government, and from experiments made as to their carrying-capacity by actually measuring the water in gauge-boxes, this race when running full would only carry about thirty sluice-heads. The company hold the right to twenty-eight sluice-heads from the Fruidburn and twelve sluice-heads from the Tallaburn; but other previous rights exist from the Tallaburn to the extent of ninety sluice-heads.

Penstock.—The penstock at the end of the water-race is 10ft. square, constructed of totara timber, and lined with pine. There are two bell-mouthed pipes fixed into this, which communicate with two mains, one 16½in. in diameter and the other 15in. These mains run side by side for 17 chains, when they join one 16½in. main in a three-way piece. The fall in the double length is 105ft. The fall in the single main is 600ft. in 27 chains. At this point there is a second three-way piece, when the water is conveyed in two lines of 15in. pipes for 46 chains, where the one crosses the Clutha River by suspension wire-cables, and the other is divided into two 11in. pipes, which have been for prospecting on the east side of the river. But it is contemplated to also take the second main across the river if more water is required there.

Taking Pipes across Clutha River.—There are masonry piers built at each side of the river, and trestles erected on the top of these to the height of 40ft., the timber used being ironbark and kauri. The masonry is built on a solid foundation and laid in cement. Over the top of the piers there are four wire-rope cables, two ropes in each cable, the span between the piers being 462ft. The cables on the east side of the river are anchored in solid rock; but on the west side of the river the ground is alluvial-drift ground. The mode of anchoring the cable here was to sink a heavy log for a considerable distance in the ground, having a platform on the top and covered over to a great depth with shingle. The total dip in the centre of the cables is 20ft., or about one-twenty-third of the span, and the pipe is suspended by suspension-rods from the cables on the same principle as the roadway of a suspension-bridge. The temperature affects the length of the cables every day, and this, together with the slight oscillation of the pipe, makes it difficult to keep the joints of the

pipe completely tight. The total length of pipes from the penstock to the claim on the west side of the river is 180 chains, and the total head of water in the bottom of the paddock is about 760ft.

Elevating-pipe.—The elevating-pipe is 15in. in diameter, with a heavy hæmatite cast-iron liner at the bottom 3in. in thickness: this reduces the inside diameter at the bottom to 9in. The water is led to the elevator-nozzle, which is 2½in. in diameter, by a 9in. pipe. The quantity of water the nozzle would discharge under a head of 760ft. would be about seven sluice-heads. This would exert a force equal to about 604 theoretical horse-power. The pipes are all made of steel, having lap-welded joints, and are from $\frac{3}{16}$in. to ¼in. in thickness. They are made in 18ft. lengths with a collar welded on each end, and at the back of thesecollars there are flanges made of angle-iron, which are slipped on to each pipe before the last collar on the end is welded on. These flanges come against the collar, and are bolted to the flanges on the adjoining pipe. With the collar welded on each end of the pipe it presents a surface of metal at the end of about 1in. in thickness, and the ends of the pipe are faced up in a turning-lathe. The end of the one pipe is butted against the adjoining one, having a thin insertion-ring between the ends, and they are held fast together with bolts through the flanges. This is what is termed the Kimberley joint, which seems to answer very well except at the bends, where there is a high pressure; but where these bends occur the pipe is liable to leak—that is, where the pipes are not laid in a straight line, but have a slight bend at the joint. The whole of the pipes were manufactured in England, and cost delivered f.o.b., including flanges and screw-bolts, as follows:—

Pipes 15in. in diameter, ¼in. thick, 8s. per lineal foot.
" " " $\frac{3}{16}$in. " 6s. 10d. per lineal foot.
" 11in. " $\frac{3}{16}$in. " 4s. 9d. " "

These are by far the best pipes that ever have been used for hydraulic purposes in the colony. The greatest pressure that they can be subjected to will not exceed 330lb. per square inch, while their bursting-pressure would be equal to at least 1,400lb. per square inch—that is, taking the tenacity of steel at 60,000lb. per square inch, and allowing the lap-welded joint to be only equal in strength to a double-riveted joint. This would give them a factor of safety equal to 4·25, while the most of the hydraulic pipes used by the miners have only about 2·5 and 3 as factors of safety.

Sluice-boxes.—The sluice-boxes are made 3ft. wide and 1ft. deep, of kauri timber 1½in. in thickness, the sides being lined on the inside with light iron. The ripples are made of 2in. angle-iron, placed crosswise in the box 1½in. apart, the ends being riveted to angle-iron sides. After the material has passed over about 150ft. in length of these ripples the bottom of the sluice is covered with cocoanut matting, having perforated plates placed on the top of strips of wood laid at each side of the box above the matting. This allows the fine sand and gold to pass through the perforations in the plates and on to the cocoanut matting, while the coarse gravel and stones are carried down on the top of the plates to where the tailings are deposited. The length of sluice-boxes from the paddock or elevating-pipe to the river where the tailings are deposited is about 330ft.

The company first commenced working on the east side of the river, before the pipes were taken across; but the ground here was very poor, only yielding about 1gr. of gold to the ton of wash-drift. They afterwards commenced opening out a paddock on the west side of the river, about the middle of July last, and they have been working here ever since. They happened to go down in a gut or old channel, the bottom of which is about 60ft. below the surface of the ground. This gut is about 38ft. wide, and has a smooth slightly-overhanging wall on one side, while on the other the rock rises up with a gradual slope. They have worked about 2 chains in length of this gut, and found in the bottom a great deal of fine mud, such as one would expect from the bottom of a deep water-hole, such as this gut has apparently been. The shingle in the upper layers is all clean and water-worn, the same as that now found in the bed of the river. After working in this deep channel for some time they found a narrow gut branching away to the south, and in it they found a rich deposit of auriferous wash, and also on the shallow ground at the sides, not more than 15ft. in depth. In about 6,000 cubic yards of this ground they got gold to the value of about £1,000. They were working on the top stuff at the time of my visit, using a 2in. nozzle, and washing the material down for a certain distance in a ground-sluice, and thence in a box-sluice to the well where the elevating-pipe is placed. Up to the time of my visit in the end of March last they had got about 500oz. of gold.

The whole of their workings are lighted at night with the electric light produced by a Gülcher dynamo, which is driven by a turbine water-wheel. A telephone is also connected with the manager's residence and with the house where the man resides who has charge of the dam. This enabels the water to be shut off at any time at the headworks, or more let on, as the case may be, without any waste of time. Judging from the appearance of the place where the present workings are carried on, the indications point out that they have found a channel where the river had at some previous period flowed, and, although thousands of years may have passed away since then, the same action, and probably on a more gigantic scale, has been carried on, sluicing away the fine sands and lighter materials, leaving the gold to be collected by the ingenuity of man.

Quantity of Material lifted.—From all the information obtainable from those in charge of the sluicing operations, they can lift about 40 tons of material per hour. This is elevated to a height of about 64ft., and, allowing that the head of water on the sluicing-nozzle is 700ft., then the quantity of water it discharges is equal to about 4·4 sluice-heads; and the quantity used for elevating is equal to seven sluice-heads. Therefore the quantity of material and water to be lifted to a height of 64ft. is equal to 44,243lb. per minute. This lifted to the height mentioned would require eighty-six-horse power to do the work. This would show that about 518 theoretical horse-power is absorbed in friction, which is six times the theoretical horse-power actually required to lift the material and water.

Island Block Extended Company.—This company has a claim of 45 acres at Welshman's Beach, and they have commenced to cut a water-race from the Menzionburn which, when completed, will

be six miles in length. They hold a right to twenty-five heads of water; but the dimensions of the ditch they are constructing is said to be only 3ft. wide in the bottom by 2ft. deep, having 10ft. fall to the mile. Allowing there is a batter of half to one on the sides, and the ditch full of water, it will only be capable of conveying about sixteen sluice-heads, and it is even questionable if it will carry this quantity—that is, if there are stones projecting on the sides, or if it has a very serpentine course with sharp bends. The company has not yet come to arrangements with the proprietors of the freehold through which a portion of this water-race has to be constructed, so the works were at the time of my visit suspended until some agreement with the owners of the freehold was arrived at. When this water-race is completed it will convey the water to a point about 800ft. above the level of the claim, and from this point the water will be taken in pipes.

Miller's Flat.—There is a large extent of drift-formation in Miller's Flat, which some day will probably be worked; but the most of this land, if not the whole of it, is freehold. It would, however, require strong companies to work it, on account of large expenditure in plant and bringing in water. Indeed, the most of the available streams are now held by those who have claims, and the water-rights out of some of those streams exceed the quantity of water flowing in them except in wet weather.

Hercules Company.—This company's workings are situate about a mile below Roxburgh, on the opposite side of the river. The ground had been worked for a number of years previous to this company acquiring the property, by the ordinary method of box-sluicing all the drift-gravel down to such a level as the river would permit fall for the sluice. Afterwards the ground was paddocked, and the material hauled up an inclined tramway and washed in the ordinary way in sluice-boxes, the ground being drained by a Californian pump driven by an overshot water-wheel; but this method of working did not give any great returns. It showed, however, that by a better system of working it could be made to pay good dividends. When the present company purchased the property they set to work and constructed a water-race two miles in length from the Teviot River, which conveys the water to a point on the side of the range about 450ft. above their workings. From the end of this race or conduit the water is conveyed to their claim in steel pipes 18in. in diameter, for a distance of about a mile, the whole of the pipes being manufactured on the ground. The manager, Mr. William Peters, informed me that some of these pipes had given considerable trouble, owing to the riveting being defective, as well as the joints.

They had three hydraulic elevators in their paddock at the time of my visit, two of which were used for elevating the drift-gravel, and one for lifting water only, the latter is used to drain the water out of the paddock in the event of it rising owing to a stoppage of the work. Owing to the long period of dry weather they had only sufficient water to work one elevator for raising drift-gravel, which had a jet-nozzle of $3\frac{1}{8}$in. in diameter, and a $2\frac{1}{2}$in. nozzle for bringing the material down to the well. These nozzles would discharge respectively about 8·7 and 5·5 sluice-heads, making the total quantity of water used with one elevator 14·2 sluice-heads. The elevators have a vertical lift of 44ft. and 50ft. respectively. The top portion of the ground having been sluiced off prior to this company taking possession has been a great advantage to the present proprietors, as they only have now an average depth of 36ft. to the main bottom of material to lift, and the richest portion of the wash-drift is nearest to the bottom. Sufficient ground has been stripped, by the original holders sluicing the bank away, as will take this company a long time to work out.

The present company commenced to work the hydraulic elevators in November last, only one elevator being used at a time, and up to the 12th March last the dimensions of the paddock worked would be about 6 chains long and 2 chains wide, having an average depth of about 36ft., which is equal to about 69,696 cubic yards, or 104,544 tons; and the quantity of gold got was about 1,300oz., which is nearly 6gr. of gold per ton. As the manager stated that they worked continuously during this period, it would mean that this quantity of material was lifted in a hundred and thirteen days of twenty-four hours, which would equal $38\frac{1}{2}$ tons per hour, or 1,271lb. per minute. Taking 14·2 sluice-heads of water and the weight of the solid material, the theoretical power necessary to lift this to a height of 50ft. would be eighty-three horse, while the theoretical power of 8·7 sluice-heads, with a head of 450ft., is equal to 445 horse. This would show that 362 theoretical horse-power was absorbed in friction. The gold-saving boxes are 3ft. wide. The bottoms have ripples on the upper end, covered with flat iron bars 2in. by $\frac{1}{2}$in.; and on the rest of the bottoms steel bars $1\frac{1}{4}$in. by $\frac{3}{8}$in., set crosswise on edge; and below these ripples cocoanut matting is placed. The manager stated that he preferred angle-iron ripples to the thin steel bars, and was getting some made. The bottom portion of the elevating-pipe is made of hæmatite iron 7in. in thickness. This portion of the elevator has given considerable trouble both here and at the Island Block Company's workings. The liners formerly used stand only for a very short time before they splinter and break, and never last until they are worn out. The continual jar of the stones on the sides directly above the nozzle very soon split the liners and broke pieces out of them, so as to render them useless. Mr. Peters has therefore adopted solid castings of the thickness mentioned, and he states that no trouble has yet been experienced with them. Judging from observation of the jar on the bottom of the elevating-pipes, the liners should be steel castings. Cast-iron, especially hard hæmatite iron, will not stand the continual jar of the stones striking the sides, whereas steel castings would last until worn through.

The bottom on which the gold is collected is composed of a soft decomposed granitoid rock, very easily cleaned up. It is soft enough to be cut up by the action of water from the nozzle, and therefore it only takes a very short time to clean the bottom when washing up. From the quantity of gold this company are getting, and the comparatively small outlay in the first instance—the whole of the works only costing about £6,000—the property is a valuable one, and the shareholders have already received in dividends half of the money called up on the shares.

Roxburgh Amalgamated Company.—This company acquired the claims of Waight and party and Anderson and party, who had been working the ground on the bank of the Clutha River oppo-

site Roxburgh for many years. In addition to these parties' claims they also took the ground on the flat between these claims and the foot of the range, so that they now hold a special claim of 160 acres. They have now commenced to construct a water-supply from the Teviot River, and a dam at the upper end of the gorge leading out of Dismal Swamp. Mr. C. Rawlings is superintending engineer for the company, and Mr. Rene Prouse is the engineer carrying on the works.

Dam.—The dam is to be constructed of a masonry wall 17ft. in height, with a large by-wash on one side, and is to have two iron pipes through the masonry at the bottom of the dam to draw off the water. These pipes are to be 24in. in diameter, and to be fitted with sluice-gates or stop-valves. The water stored in the dam is to be drawn off through these pipes and allowed to flow down the bed of the river, to be again picked up and led into a conduit, which will be about two miles in length. The area of water in the dam when full will be equal to 640 acres, with an average depth of at least 9ft. This will contain 1,568,160,000 gallons of water, which is equal to a supply of thirty sluice-heads for 96·8 days, flowing continuously. There will, however, be a considerable loss in evaporation during the summer months, when the water from this dam will be most required. The dimensions and area were given me by Mr. Prouse, who thought that the average depth would be 10ft., instead of 9ft. that the above calculation is based on. There is, however, a doubt in my mind whether even 9ft. is not too much to take as the average depth. The quantity of water covering an area of 640 acres, or one square mile, 1ft. in depth is equal to 322⅓ sluice-heads flowing continuously for twenty-four hours, or, the quantity of water covering an acre 1ft. in depth is equal to a little over one sluice-head flowing for twelve hours.

Water-race.—The water-race is to be 3ft. wide in the bottom and 2ft. deep, with a fall of 10in. to the chain, or 66ft. 8in. to the mile. It is to be presumed that the conduit is to be cut in rock, as no ditch constructed in ordinary gravel-drift would stand the velocity of the current of water this fall will produce. The slope on the sides was not given me, but, allowing that it is cut in solid rock, with vertical sides, a ditch of these dimensions and fall is capable of conveying thirty sluice-heads when full. The conduit will be 2 miles 10 chains in length, and will convey the water to a point about 700ft. above the level of the claim.

Penstock and Pipes—The penstock is to be made of kauri timber 1½in. in thickness, tongued-and-grooved, and to be 10ft. by 8ft. by 6ft., having 6in. by 8in. side-posts, and braced with 6in. by 4in., and held together with 1¼in. screw-bolts. The pipes leading out of the penstock are to be 22in. in diameter, made of sheet-iron $\frac{3}{16}$in. thick, having the longitudinal seams double-riveted, and the circular seams single-riveted. The lower pipes are to be 18in. in diameter, riveted in the same manner as the other. It is expected that the whole of the works will be completed so as to commence sluicing operations in July or August. At the time of my visit there were fifty-two men employed.

Adjoining the Roxburgh Amalgamated Company there are four private claims being worked; but, through the scarcity of water owing to the dry season, very few men are employed. These claims are said to give very good returns. The number of men generally employed in them is twenty-two. At the time of my visit only about twelve men were at work.

Commissioners' Flat Company.—This company has acquired 30 acres of ground on Commissioners' Flat, about three miles above Roxburgh, but on the opposite side of the river. They have commenced to cut a water-race from Shingle Creek, which when completed will be about six miles and a half in length. The water will be brought from the end of the race in pipes, and across the river by suspending the pipes from wire-rope cables on a similar principle to that adopted at the Island Block. The water will be brought in at an elevation of about 450ft. above the level of the claim. At the time of my visit twenty-three men were employed on the works.

Other Claims.—There are a number of private claims being worked here and there in the valley of the Clutha and on its banks which it would be impossible for me to enumerate, and equally impossible for me to visit at the time at my disposal; but it can be generally asserted that the most of those claims are payable for working where a supply of water is available. Indeed, there are very few flats and low terraces along the valley but will yet be worked. The more one sees the workings in this valley, and the indications which point to the course of the river being changed time after time, continually sluicing away the material brought into the valley by landslips from the mountains, and all the rivers and streams conveying auriferous drift into this large outlet, the more convinced one is of the untold treasures that lie buried there awaiting the devices of man to unfold them—treasures which will not be exhausted either in this or the succeeding generation.

Black's and Ida Valley.

There is scarcely any alluvial mining being carried on at Black's. It was expected that the tail-race which was taken up the flat a few years ago would open up fresh ground, but very little gold has been obtained by means of this tail-race, which cost £2,300, of which amount the Government gave a subsidy of £1,150. Before this work was undertaken it was asserted that the rich lead of gold that was worked at Black's in the early days went into this flat, but the quantity of water to contend with prevented it being followed; but these golden anticipations have not so far been realised. Mr. Green, who discovered a few years ago what was thought to be a rich deposit of gold in decomposed schist, and afterwards an auriferous lode of sandstone and quartz, has sold out of the latter to a Christchurch syndicate, and gone to seek fresh fields and pastures new. He has been the only one who has made any money out of these ventures.

The scheme referred to in my last report, to construct a water-race thirty-two miles in length, which was estimated by Mr. MacGeorge, the Vincent County Engineer, to cost £5,000, has fallen through. Before undertaking this venture some of the shareholders got Mr. Beal, mining engineer, of Dunedin, to report on this proposed work, and his estimate was £25,000, which was much nearer the cost than the former. Indeed, some of those whose reports appeared in the prospectus of this

company were actually ashamed to see their names connected with it. There is no doubt, if a good supply of water was brought on to this range at a high elevation, there is a deal of auriferous ground which would be found payable for working by hydraulic sluicing; but the proposed water-supply was only to have been about 178ft. above the level of the flat at Black's, and at that elevation the venture would not have been likely to prove remunerative.

At Ida Valley a syndicate consisting of local and Christchurch people took up a special claim of 50 acres, and have been prospecting for the Deep Lead, and have sunk three shafts; but, although they have got a little gold, they have not so far been successful in finding any rich deposits. No. 1 shaft was put down to a depth of about 90ft., and about sixty loads of auriferous wash-drift was obtained from it. Some of this has been operated on in a puddling-machine and sluice, and yielded about 1oz. of gold to the load; but a large quantity could not be obtained from No. 1 shaft. Another shaft was sunk to a depth of about 200ft., but when the drift was gone into they could not get in timber strong enough to stand the pressure and leave sufficient room for working. The box that was used for sinking through the drift was constructed with $\frac{3}{8}$in. boiler-plate and braced with angle-iron, but this was found to be too weak.

The No. 2 shaft is 6ft. by 2ft. 10in. in the clear, and timbered with 3in. planking; and when the drift was struck three thicknesses of this planking were used and the shaft centred; still, with all this the enormous pressure on the sides of the shaft made the timber belly out between the centres and the end. They then came up from the bottom about 16ft., and put in a drive 30ft. to the eastward, and sank a monkey-shaft in the drive, and got down to the same depth as the main shaft without finding any drift. No. 3 shaft was sunk between No. 1 and No. 2 shafts, but no auriferous wash-drift was found. There is a twelve-horse-power steam-engine on the ground, which was employed in pumping and winding, and a puddling-machine has also been erected to wash the drift. They have expended up to March last about £2,500, and, as the capital is nearly all called up, it is questionable if prospecting will be carried on much longer unless something more promising is struck.

This syndicate or company is formed on similar lines to those of some of the English companies who have mining properties in the colony. According to information supplied me, there are 9,000 shares in the company, out of which the local promoters received 6,000, leaving only 3,000 shares, which are held by Christchurch gentleman, and only on which capital could be called up. This principle of taking up ground and forming mining companies cannot be too strongly commented on, as it is simply ruinous to the ultimate success of the mining industry; and if the people residing in districts would discountenance mining ventures that were not started on an equitable basis they would confer a benefit on the mining community.

Tinker's.

This is the richest field for its size there is in the colony, and the area of the rich auriferous deposits is not yet defined, as the area of auriferous ground that can be worked is entirely dependent on the available water-supply on the field. There is apparently a run of the old quartz-gravel drift, or what is here known as the granite-wash, going along the foot of the range and extending to near Clyde in one direction and will no doubt yet be traced to Cambrian's, Vinegar Hill, St. Bathan's, Naseby, Mount Burster, and on to Maerewhenua. At Tinker's it seems to be confined to a comparatively narrow run, which lies at a considerable angle against the Maori Bottom, or Old Man Reef, on the side next the flat, and dips on the other at a corresponding angle underneath the schist rock in the main range. The bottom of this quartz wash-drift has never been reached. A shaft was put down near the boundary of the Mountain Race Company, the Undaunted Company, and Reid and party's claims to a depth of 240ft., and showed that the whole of this wash-drift contains sufficient gold to pay for working by hydraulic sluicing and hydraulic elevators. The Mountain Race Company has sluiced off to such a level as the tail-races will admit, except the portion underlying the schist rocks at the foot of the main range, in order to get the whole of the quartz wash-drift here. The schist rock overhanging the wash-drift, comes down in slides, and interferes with the sluicing operations considerably.

The shaft that has been put down has added considerably to the value of the following claims: the Mountain Race, Symes and Morgan's, John Ewing's, and Reid and party's. These claims have the run of quartz drift going through them, and the fact of knowing that this wash goes to a great depth has enhanced the value of each of those claims to the extent of the extra value of the ground there is in the deep run below the level on which the parties have been working.

To gain an idea of the value of mining property on this field, a small water-race, about two miles in length, which is constructed at a level of about 50ft. above the working, with the first right of seven sluice-heads of water out of Thomson's Creek, was sold by auction recently for £10,800. It formerly belonged to the Mountain Race Company and Undaunted Company, and as it was of little use to either company to divide the water it is capable of conveying, they agreed to put it up to auction, and the Undaunted Company purchased it at the price mentioned.

The Mountain Race Company have sluiced about 20 acres of ground partially away, and obtained out of this area about 17,000oz. of gold, which would represent a value of about £54,175, or £2,708 15s. per acre, and there is no telling how much more will be taken out of the deep run of ground below the present level they are working on.

The Undaunted Company hold very little of the deep run of quartz wash-drift, but they have a very rich claim—at the present time it is paying better than any claim on the field. They worked about 4 acres and got about 6,000oz. of gold, which would represent a value of £22,650, or £4,530 per acre, and they have obtained from their claim altogether about 12,000oz., or £45,300. The ground they are working is from 60ft. to 70ft. in depth, with a little gold through the gravel wash, but the greater portion of the gold is found near the false bottom they are working on.

The Matakinui Company's claim adjoins the Undaunted Company's ground. They have gone to considerable expense and brought water in from Drybread Creek, and have a very good supply of water; but their tail-race will not admit of their sluicing away all their tailings to the bottom. At the time of my visit they were running off the ground to a depth of about 30ft., and elevating for about 12ft. with a hydraulic elevator. The ground has so far not been nearly so good as that in the Mountain Race and Undaunted Company's claims, neither is their style of working nearly so good. They are using a large quantity of small pipes, which absorb a great deal of the head of water in friction, and there is in some portions of their ground a quantity of small stones and boulders which have to be picked out and stacked by manual labour. The tail-race has to be constructed on so flat a gradient that nothing but the fine gravel and sand can be sent away. An appliance similar to that used by the Fairmaid and Gladstone Company at Addison's Flat would answer for getting away the stones in this description of ground, or they could be picked up from a well with open bar scoops fixed on an elevating-belt, and stacked in the worked-out ground; but this company has already gone to great expense, and is obliged to resort to many makeshifts until they get sufficient gold from the ground to pay for improved appliances.

Reid and party are working in the quartz drift-wash, the whole of which is carried away in the tail-race and deposited on the tailings site that was purchased two years ago from Messrs. Laidlaw and Crawford. Their claim is known by the name of the Sugar Pot, and the average annual returns are about from 400oz. to 500oz. of gold.

John Ewing's claim adjoins the south-eastern boundary of the Mountain Race Company's claim. He has constructed a water-race from Thomson's Creek, which is about two miles and a half in length. This brings the water on to a spur at an elevation of about 450ft. above the ground he is going to work. As all the water-rights in this creek had been granted previous to his purchasing the ground, he had to pay £1,400 for the right of water from the creek which had been held by the Rise and Shine Company, who took the water on to the opposite side of the range; but this company's right to lift water out of the creek was at a much higher elevation than he required it. He therefore constructed a race at a much lower level, and lifts the quantity of water he is entitled to under the right he purchased; but, as there was some dispute as to his being entitled to shift the head of the race from the place where it was originally granted, and as the right he purchased was the second from this source, an arrangement was come to to gauge the quantity of water in the creek, which was done last summer, and the Warden is to determine what proportion of this he is entitled to.

He ordered 50 tons of steel plates from England, and has had the most of this manufactured into pipes by Messrs. Sparrow and Co., ironfounders, Dunedin. His main line of pipes from the end of the race is 18in. in diameter, with longitudinal seams double-riveted; and the branch pipes are 15in. in diameter, tapering down to 11in. There are also about 40 chains of pipes 13in. in diameter. The whole of these pipes are riveted with flat-headed rivets on the inside, and snap-heads outside. It has been the custom in manufacturing some of the pipes used for hydraulic plants, such as those manufactured by Mr. J. R. Perry for the Hercules Sluicing Company, near Roxburgh, to merely use rod-iron for rivets, and to have snap-heads both inside and outside; but as some of this company's pipes have failed at the riveted joints, Mr. Ewing had his constructed with manufactured rivets, and they certainly are the strongest riveted pipes in any large hydraulic plant in the colony at the present time. However, this was essential, as the plates are thin for the pressure they will have to bear—namely, about 195lb. to the square inch at the lower end—and when he commences to work hydraulic elevators some of them will be subjected to a greater pressure than this. Assuming that the 15in. pipes are made of No. 14 B.W.G. steel, and have to stand a pressure of 195lb. to the square inch, their bursting-pressure would be about 465lb. This would give them a factor of safety of 2·43; but if any of them are only No. 16 gauge their bursting-pressure would be about 364lb., which would give them a factor of safety of only about 1·86—that is, allowing the minimum tenacity of the steel to be 60,000lb. per square inch; but if the tenacity of the steel plates used was 72,000lb. per square inch, which is given by Molesworth for the lowest class of steel plates, No. 14 B.W.G. pipes of this diameter would have a factor of 2·8 of safety, and No. 16 gauge 2·3.

There is a new description of gold-saving box, constructed on a similar principle to that of Gutherie's tables, at the Fairmaid and Gladstone Company's claim, at Addison's Flat. It is 24ft. in width and 16ft. in length. It is divided into eight sections, each 3ft. in width, and the water and material is regulated on each section from a cross hopper-box at the head. A stream of clear water is also introduced on to this table. It has three separate vertical falls in the length: the upper one is 16in., and the two lower ones each 8in., having a well and splashboard at each drop or fall. This is a step in the right direction, as the gold in this ground is very fine, and unless the material passes over a wide surface a large percentage of it will be lost. Mr. Ewing expected the whole of the plant to be complete and ready for work in about fourteen days after my visit to this field. Before he is ready to commence sluicing operations the cost of this claim, with all the necessary hydraulic plant and appliances, will be about £9,000. Indeed, it would be difficult to find another man in the colony to undertake such a work single-handed; but it is only by carrying on mining with the most approved appliances that the ventures can be brought to a successful issue.

Symes and Morgan's claims adjoin Mr. Ewing's. They are also working in the quartz drift-wash, which gives them very good returns for their labour; but the small quantity of water they use makes very little impression on the high face of material they are sluicing away. One goes back here year after year and sees very little difference in the face where they are working.

There are altogether about fifty men employed in claims at Tinker's, and if the value of the gold obtained here were to be equally divided amongst them, they would have higher wages for the number employed than on any other goldfield in the colony.

St. Bathan's.

There are still a few miners about Cambrian's and Vinegar Hill, but the scarcity of water last year was a great drawback to them, as they could do but little work. Mr. J. Ewing's claim on Vinegar Hill is still being worked and giving excellent returns; but he could not give me even a close approximate idea how much gold he would have for the year's work, as he had not washed up, and was only commencing to clean up the bottom: but, judging from the area of the ground sluiced away and his former returns, he estimates that there ought to be at least 1,400oz. of gold.

It may be well to mention that Mr. Ewing made arrangements twelve months ago to have two of Robertson's patent atmospheric nozzles in his hydraulic elevators; but the ones supplied to him were of no service, and since then the patentee has been making improvements in them; but until such time as the new ones recently supplied have been thoroughly tested, nothing can be said of the merits of the patent. The principle on which these atmospheric nozzles are made would lead one to suppose they would be an improvement on the ordinary nozzle when the intake of the elevating-pipe is covered with water; but owing to the castings previously supplied being of so flimsy a nature, and to the defective way in which the nozzles were connected, the elevators did not produce the effect that was anticipated. Mr. Ewing works his Vinegar Hill claim day and night, and he has it lighted up at night with electric arc lamps, the electricity being supplied by a small dynamo, which is driven by a small Pelton water-wheel.

St. Bathan's Sludge-channel.—This sludge-channel or tail-race will yet take several years to complete, but it is constructed up to such a point that gold in the ground it is being constructed through pays for the cost of construction. The gold is very fine, and they constructed a wide table similar to that described at Mr. Ewing's claim at Tinker's, and covered the bottom with cocoanut matting, and in three months' work they got 80oz. of gold out of the material that was formerly running to waste. This clearly shows that wherever the gold is of a light scaly nature great care has to be taken to save it; and it is only by getting the auriferous material spread thinly over a large surface, with only sufficient water to keep the tables clear, that a fair percentage of this class of gold can be saved.

There is a little work being done in some of the claims near the Township of St. Bathan's, but there had been very little water to carry on sluicing operations for a long time prior to my visit.

Muddy Creek.—The Scandinavian and M. and E. Companies have been steadily at work, but the scarcity of water has prevented them from getting much gold last season: they had not sufficient water in the sludge-channel to keep it clear—they merely banked up the sides of the channel with scrub, and allowed the bed to fill up with tailings. The Scandinavian Company had a considerable break in their head-race last year, which delayed their sluicing operations for some time. This company is said to have a very good claim, and the expense of working it is not great. They got 150oz. of gold for last year's work.

Blackstone Hill.

There are few miners here, and the scarcity of water last year made the returns from the claims very small. Mr. R. Johnstone has a water-race, which is taken from a branch of the Manuherikia River, which in ordinary weather gives a good supply of water. This race is taken on to the top of Blackstone Hill, where its proprietor has a claim which is said to contain very good ground; but, as it is of a considerable depth, and the material when exposed to the atmosphere gets into a soft, pulpy condition, the sides of the cutting in which he was working slip in, which necessitates a large area of ground to be washed away on the surface before the auriferous wash-drift can be taken from the bed-rock, as that is where most of the gold lies. There is auriferous ground here and there all down this range to Ophir, which would pay well for working if a supply of water could be taken at a sufficient elevation to command it. And the only supply that could be got is that held by Mr. Johnstone.

Naseby.

The effects of the dry season have been felt severely in this part of the district. The ground, in general, is not rich, and the primitive method of working it makes the average earnings of the miners very small. There are no large claims nor extensive workings on this field. A great many make-shifts are resorted to in working some of the claims, which indicates that they are not profitable ventures. The ground on the side of the Hogburn Creek is getting pretty well worked out, and also the ground in Home Gully; but beyond Home Gully, towards the Kyeburn Diggings, there are apparently several wash-drift terraces and flats that will pay for working with a good water-supply. The whole of the ground in the district is generally of a shallow nature, so that large areas can be quickly washed away if plenty of water were available.

On my visit to this district a deputation of the miners, business people, and the County and Borough Councillors waited upon the Under-Secretary of Lands and Mines and myself, urging that we should represent to the Government the urgent necessity of constructing the reservoir at the Eweburn in connection with the Government water-race at Mount Ida, as it was part and parcel of the original scheme, and the work could not be expected to pay before it was completed. The place where the reservoir is proposed to be constructed is a good site for conserving water. It is proposed to put an embankment in a narrow gorge having rock on both sides; but, although the rock shows out on the northern side of the Eweburn, it is questionable if there is not a loose-gravel gut going through a low saddle directly behind the place where the rock crops out, and, if so, there would be a considerable expense to get a good foundation for the core of the embankment. The estimated cost of construction of this reservoir is from £10,000 to £12,000; but it requires a more minute survey of the site, and prospecting-shafts to be sunk in the bed of the gully, and also on the apparently low gravel terrace, to prove at what depth a solid foundation can be got; and,

further, that prospecting should be done to see where good clay could be obtained for the construction of the puddle wall in the embankment. On these elements the cost of construction will in a great measure depend.

The embankment proposed to be constructed is 70ft. in height above the level of the surface of the ground in the bed of the Eweburn, and according to the plan supplied by the County Engineer this embankment will back the water for a distance of 45 chains up the gully when the reservoir is full, having an average breadth on the surface of the water of about 11½ chains, and being estimated to hold when full 57,789,000 cubic feet of water, which would be equal to a supply of thirty sluice-heads of water for eight hours per day for a period of sixty-six days. The site being about six miles up the race-line from Naseby, the supply of water from the reservoir would be limited to the extent of the carrying-capacity of the water-race; therefore it might be said to be the means of providing a supply of thirty sluice-heads of water for a period of three months during the summer—that is, taking the quantity of water in the race and the extra supply from the reservoir. It is estimated that the construction of this work will increase the receipts from the sales of water to the extent of £830 per annum. Assuming that the cost of the work was £12,000, it would take thirty-four years to pay back the capital invested, with 4 per cent. interest; or, even if it only cost £10,000, it would take over twenty-three years to return the capital, with interest: which does not make the construction of this reservoir an encouraging venture to embark in,

There is a large extent of auriferous country in this district, and the same run of old quartz-gravel wash-drift as found at St. Bathan's must pass through on to Mount Burster—and this has been satisfactorily proved by a prospecting-shaft that was sunk some years ago up in the valley of the Hogburn Creek, about half a mile above Naseby. This shaft was put down to a depth of a little over 200ft., and got into the quartz drift-wash, in which there was gold, and about 16 chains above this, nearer the foot of the range, the Old Man Reef, which is overlying this drift-wash, and the schist rock join, which indicates that there is a deep run of ground, or channel, which is full of this description of wash-drift, and that it will be found to abut on to the schist rocks nearer the range. If this run of ground were properly prospected, it is possible that a good lead of auriferous wash-drift will be found to extend from Mount Burster to near Clyde, and if so the Mount Ida Water-race may become yet a valuable property, as the water may be utilised as a motive-power to drive mining machinery.

At Mount Burster there have been two claims on which sluicing operations have been carried on when water was available. Messrs. Guffie and Endor's claim still continues to give good returns, and is likely to do so for a generation to come. The great trouble here is to get water, which is stored in dams on the top of the range, from catch-water races when the snow is melting, and in wet weather; but, as this is about 4,000ft. above sea-level, work can only be carried on for about six months of the year.

Hamilton's, Hyde, and Macrae's.

There are a few fair claims about Hamilton's, but the ground near Hyde is principally abandoned; still, there are large areas of auriferous ground at both these places that would pay for working if there was a large supply of water at a high elevation; but this would be difficult to obtain, and the construction of a water-race would be a long and costly undertaking; indeed, it is questionable if a large supply of water could be got. At Macrae's Flat there is scarcely any one at work. The best of the shallow ground here was worked in the early days, and a large quantity of gold obtained. The gold was traced down into deep and wet ground, which has never been prospected. Recently Messrs. Guffie and party have taken some of the ground here with the intention of working it by dredging: and probably this will be as cheap a method of working it as any, as very little water could be obtained for hydraulic sluicing, and a tail-race, to be of any use to work this deep ground, would be costly to construct.

Skipper's and Shotover.

There is a large area of auriferous country in this district that would pay to work by hydraulic sluicing if a plentiful supply of water was available. Such a supply could only be obtained out of the Shotover River, and in order to get the water at a high elevation it would have to be lifted out of the branches, and it is questionable if a large supply could be obtained from the river at this point during midsummer and midwinter months. The supply in the winter months would not signify so much, as no water could be carried in a conduit-pipe or flume during the cold frosty weather. The face of the ranges along which such a water-supply would have to be brought is in many places very precipitous, and in other places the sidlings are nothing but slips from the main range, full of breaks, gorges, and deep ravines; so that to get a large supply of water at a high elevation in this part of the district would be a very costly venture, and one that very few private individuals could afford to undertake. The whole of the drift terraces and slips from the range are more or less auriferous, and the most of them would pay for working if water could be brought to bear to systematically sluice them away.

Davis and Moody's Claim.—This claim is held by Messrs. Davis, Moody, and Company, of Melbourne, who are represented here by Mr. J. Miller. They are constructing a water-race from Skipper's Creek, above the branches, to Skipper's Point, where their claim is situate, adjoining Mr. Aspinal's claim. The head-race commences about a mile and three-quarters down Skipper's Creek from the Phœnix Company's crushing-battery, and is carried in an open cutting on the north side of the creek, principally constructed in the solid rock, 2ft. 6in. wide in the bottom, having a width at the top of 3ft. 6in., and a depth of about 3ft., with a fall of 8ft. per mile. Assuming that this ditch had a depth of 3ft. of water flowing in it, then its carrying-capacity would be about eighteen sluice-heads. There is about four miles and a half of ditching; then the water is carried across Skipper's Creek in a siphon, which is 1ft. 10¼in. in diameter, constructed of Nos. 12, 14, and 16 B.W.G iron:

it is made in 18ft. lengths, with angle-iron flanges at each end. The greatest pressure on the siphon is equal to a head of water 250ft. high, or about 68½lb. per square inch. This siphon is 900ft. in length, with 7ft. of fall, or a hydraulic gradient of about 1 in 129, which will be capable of conveying about eighteen sluice-heads of water. Where breaks and gullies occur in the line of ditching the pipes have the same fall as the head-race, and where these occur the pipes are 3ft. in diameter, and have about the same carrying-capacity as the long siphon across Skipper's Creek, and the ditch if carrying to its fullest capacity.

The pipes are all manufactured on the ground, the seams being all single-riveted, and the workmanship is very creditable to the manager. Mr. Miller expects to have everything completed about the beginning of next year, but the head-race will soon be completed to a point where the water will be used in sluicing away slips on the south side of Skipper's Creek, where rich patches of auriferous material were worked in the early days of the field. The cost of the work done by this private company at the time of my visit in March last was £7,000, and the manager estimated that before the whole of the pipes are constructed and all the hydraulic plant on the claim the expenditure will amount to about £12,000. All the works so far constructed are of a substantial character and well laid out. When once the water is brought in and this claim properly opened out, the property is likely to prove a valuable one. Although the claim held by this company is not large, there is a great depth of wash-drift, which will take a long time to wash away.

Aspinal's Claim.—This adjoins Davis and Moody's claim, and is situate on the south side of the junction of Skipper's Creek with the Shotover River. Some years ago Mr. Aspinal informed me that since he had been working in this claim he had taken out gold to the value of £30,000. Last year, however, the weather was remarkably dry; and, as he is entirely depending on drainage-water to fill his reservoir, he was not able to carry on any sluicing.

Davis Brothers' Claim.—This claim is situate on Stony Creek Terrace. The ground they are working is about 300ft. deep, all of which is washed away with water coming through hydraulic nozzles. The quantity of water available varies greatly according to the state of the weather, but they would have from six to eight heads. This is used through two hydraulic nozzles, one of which is under a head of 250ft., and the other under 150ft. of water. The material is all washed down into one sluice-box, which tails into the Shotover River. They have recently constructed an undercurrent-box 14ft. in width, which is the means of a good deal of fine gold being obtained. They have not room to construct many of these undercurrent-boxes, which soon pay for the cost of construction. The loss of gold from this claim when sluicing operations were first commenced was something considerable. About two years ago, when I was in this district, it was reported to me that after every fresh in the river a good patch of gold would be got under the drop from the tail-boxes, and there is no doubt but that these men are yet losing a considerable amount of gold, as their sluice is constructed too narrow for the amount of drift-gravel that is carried away with the water. It is said these men got last year about 360oz. of gold in sixteen weeks. They have gone to a great deal of expense in constructing a head-race from Stony Creek and opening out their claim. There are a good many large stones amongst the wash-drift, and in order to lift these readily they have a crane in the paddock which is capable of lifting 10 tons.

R. Johnston's Claim.—This claim is situate on Pleasant Terrace. The ground is from 30ft. to 40ft. in depth, but it is worked in a very primitive manner, with only about three lengths of sluice-boxes to save the gold. And no attempt is made to use the available head of water; it is brought over the face in a canvas hose. Still, although worked in a primitive manner, it is reputed to be a claim that pays good wages for working.

Upper Shotover.—There are a few parties scattered here and there all the way up the Shotover from Skipper's to the Branches, some of whom do fairly well when water is available from the small creeks coming out of the range; but scarcely any one did particularly well last year, owing to the long-continued spell of dry weather. There are several terraces up the river that would pay well for working with a large supply of water, and even with the limited quantity there is available some of them do very well. It was said that Messrs. Monk and McInnes got about 120oz. last year. Their ground is about 120ft. deep, and they have only about half a sluice-head of water.

Messrs. Gamble and Huisted have a claim on the sand-hills, and if they were to continue working here for the next thirty years they would not wash away a large area of ground. These men have about 1,000ft. of small iron piping, but their supply of water is very intermittent. It is said, however, that they average about £5 each per week when water is available.

Messrs. Collins and Enright are said to have a good claim near Maori Point; but they work it in a primitive manner. The depth of ground is about 120ft., and they are content with the quantity of material that washes away with the water falling over the face.

There is, no doubt, a large amount of alluvial auriferous material in the terraces and sides of the ranges on each side of the Shotover River which will some day be worked and made remunerative investments; but it will require a large capital to get a good water-supply before this takes place.

Arrow.

A large quantity of gold was obtained from this portion of the district in the early days; but there are only a few men now employed in alluvial workings. Some of these have small water-races, and make a good livelihood in washing the terraces, and some are still washing away in the bed of the river. Mr. Scoles and party started a hydraulic elevator in the bed of the river about a couple of miles above Arrowtown, and turned the river by tunnelling through a narrow ridge; but the place where the river-bed was laid bare by the turning of the stream was found to

have been worked to the bed-rock in the early days of the field, when there was not nearly so large a depth of shingle in the river-bed as there is at the present time, and they did not find sufficient gold to pay for working it a second time.

Messrs. Moody, Davis, and Company, a Melbourne firm, the same gentlemen who are constructing an extensive hydraulic plant to work Londonderry Terrace, in the valley of the Shotover, have commenced a gigantic work in the gorge of the Arrow River, about four miles up from the township. It is at a point in the river-bed where at one time a large slip of rocks came down from the side of the range and formed a complete dam in the river, which has been for ages filled up. Very rich patches of gold have been found in this river-bed wherever the bed-rock could be reached; but from this point to a considerable distance above its junction with Soho Creek—or what is locally known as Roaring Billy—could never be bottomed for water. A miner held this ground for a number of years, shepherding it, and occasionally doing a little work, and tried at one time to drive a tunnel through a slip on the north-eastern side; but it was merely a small prospecting-tunnel, with small timber, and it collapsed. And when Mr. Miller, Messrs. Davis, Moody, and Company's manager, came to examine the place he made arrangements with this miner to purchase any right he had acquired to the ground.

A tunnel is now being driven through solid rock on the opposite side of the river from the slip where the prospecting-tunnel was commenced, 10ft. wide and 7ft. high, constructed on such a gradient that the tunnel will not only take the whole water in the river but also the bottom of the tunnel will be paved to act as a sluice for saving the gold. The tunnel at the time of my visit in March last was constructed for a distance of 420ft., and was costing £2 15s. per foot for driving. There was still about 200ft. further to construct before getting through the rock to the point where the sluicing operations will commence, so that this tunnel when completed will be about 620ft. in length, and at the upper end it will be 120ft. below the surface of the present river-bed. The lower end of the tunnel is about from 10ft. to 12ft. above the bed of the river, and the bed has considerable fall for a good distance below this, so that there will be a good get-away for tailings.

As soon as the tunnel is completed Mr. Miller intends to construct a jump-up to the surface, and to secure the upper end of the tunnel with iron sluice-gates, so that in the event of a flood occurring he can shut the gate and turn the flood-water down the original bed, and only work the ground when the whole water in the river can be sent through this tunnel; and by having the gorge completely dry he will be able to blast the large rocks that now form the falls, and lower the bed gradually, when probably a good deal of gold may be found here; but where they expect to find the richest auriferous deposits is in a wide basin which now forms the river-bed above the point where the tunnel terminates to above the road-crossing, which is some distance up the river from the junction of Soho Creek.

The estimated cost of completing the whole of the works at this place, and getting the claim in working-order, is somewhere about £8,000. The tunnel is constructed through very hard rock, which will never require any timber; but the head-works at the upper end will be very costly to construct, and difficulties will probably be met with that cannot altogether be foreseen, but the manager thinks that the estimated amount will cover all contingencies.

Mr. Miller deserves great credit for the systematic manner in which he is carrying on all the works for his employers. He seems to be able to cope with all the difficulties met with, and if the present ventures prove successful ones it will be the means of getting plenty of outside capital to work the alluvial auriferous deposits in Otago on a large scale. A few days before my visit his employers were so thoroughly satisfied with their many ventures here that they instructed him to take more ground on the terraces near Macetown, and bring in a large supply of water from the Arrow River. This will entail about from eight miles to nine miles of a head-race, which is proposed to be constructed capable of conveying fifty sluice-heads of water, and the estimated cost of construction is £20,000. There will be a great many breaks and gullies to be siphoned over with wrought-iron pipes in this distance; and where the water will be taken across Macetown Creek there will be 40 chains of piping, some of which in the bed of the valley will have to stand a pressure of 220lb. per square inch.

Arrow Flat.—It is thought by many of the residents here that the Arrow River at one time flowed towards the Shotover River when it left the gorge, or, at least, that it went for some distance in this direction. There is a flat running south-westward from the mouth of the gorge, where several people have tried to prospect, but none have yet been successful. The great influx of water after getting down some 30ft. has baffled all attempts. Some time ago a shaft was sunk, and a small steam-engine used to work pumping appliances; but the pumps were too small to keep down the water, and nothing has been done lately towards getting better appliances to prospect this place.

Cardrona.

This creek has been worked from its rise to the Cardrona township, a distance of about ten miles, and large deposits of gold have been found in its bed. The gold was also traced for some distance into the flat below the township; but the ground got deep, and there was too much water to contend with to carry on prospecting. The lead of the auriferous run of ground was lost, and never has again been discovered in the flat. The Government gave a subsidy of £1 for £1 to the extent of £400 towards prospecting this flat, and a mining association was formed, which commenced prospecting operations about six miles below the township, at a narrow place in the valley, where the bed-rock could be seen at both sides. They constructed a tail-race, and tried to sink a paddock by working a California pump with a small water-wheel; but this was not sufficiently powerful to drain the water to enable the ground to be bottomed. They afterwards extended the tail-race with the view of getting to the bed-rock and then by driving across the valley they could tell whether the lead continued to go down the flat; but they were never able to get the bottom.

A considerable number of miners have been employed on this field since it was opened in 1863. After the creek was worked out gold was found in the terraces and on the sides of the creek; but these places were getting very poor for working, and the miners turned their attention to the Criffel Diggings for a time. About two years ago some very rich auriferous ground was discovered on a low terrace not far from the township, and three water-races were constructed, which have a carrying-capacity in the aggregate of about eighteen sluice-heads of water. Some of the claims on this terrace paid remarkably well for working, notwithstanding the dry season and scarcity of water. Although the ground is tolerably hard to break down, there is not a good hydraulic plant on the field.

Goldsborough and Party.—This party are working on the Maori, and sometimes on a sandstone bottom. The ground is very shallow in places, but the best run of gold is in a narrow gut of ground, some of which is 30ft. in depth. One of this party informed me that they got about 200oz. of gold for the season's work. There are three men employed in the claim, and they were stopped for fourteen weeks during the winter months, when they could not work for frost.

Toney and Party.—There are four men employed in this claim. They got 600oz. of gold from November, 1888, to the beginning of the present year, a period of fourteen months; and during the seven weeks prior to my visit they had been making about £30 per man per week.

Robertson Brothers are said to have a very good claim. They have a great depth of wash-drift, and several layers amongst it contains gold; but the best of the auriferous layers is on the bottom, where it is from 4ft. to 5ft. thick. Some specimens of cemented wash-drift from this claim were exhibited at the late Dunedin Exhibition, which showed that very rich patches of auriferous material are found in this claim, and the gold is of a coarse character. There are three men employed in this claim.

Diamond and party are said to have a payable claim. One of this party informed me that it pays about £7 per week per man for the time they are working. There are three men employed.

Jones and party of five men, Nichol and party of four men, Austin and another, Bowmont and another, and Monday and party of four men, are all said to have payable claims for working, while there are two or three claims that are prospecting and getting a little gold. There will be from fifty to sixty men employed in claims close to the upper and lower township, and a few working in the terraces higher up the river, as well as some in a branch creek about five miles below the township.

The ground is all worked here by sluicing, and, although there are some instances where 100ft. of pressure could be had on the hydraulic nozzles, this pressure is not utilised: the water is allowed to flow down to above the working-face, and is then taken up in a canvas hose, with about from 30ft. to 40ft. head on the nozzle, which is not sufficient to break up the ground. The gold-bearing wash-drift does not seem to be confined to a particular run, but is more distributed in patches here and there. The Maori or Old Man bottom is very near the surface in places, with scarcely any wash-drift, and in other places there is 40ft. and 50ft.; and generally when the latter occurs gold is found. It is thought by some that this run of auriferous wash-drift will be traced on to the Criffel Range—which probably it may be, but the character of the gold found here is quite different from that got on the top of Mount Criffel. The latter more resembles the gold found in the branch creek about five miles below the Cardrona township, and is nearly of the same value. There is, however, ample opportunity to discover fresh auriferous-drift deposits in this portion of the district, as there is a large area of country where very little prospecting has ever been done. The approximate quantity of gold obtained last year at Cardrona was 5,000oz., representing a value of £18,750.

Criffel.

There has been very little doing at Criffel this season, as there has been no water. Halliday and party, the prospectors, are said to have purchased Craig and party's water-race, and they now hold all the available water-rights on this field. The water, however, can only be utilised for four or five months during the summer at the most, and the ground has to be rich to pay wages for the time the men are idle. The run of auriferous wash-drift found on the top of this range cannot be traced for any great distance. The wash-drift is also of two different characters—one description of it is formed similar to that found in the low terraces near Cardrona, while the other is an old quartz-gravel wash, similar to that found in the vicinity of St. Bathan's and Mount Burster, having large trees lying amongst it, with branches complete, all silicified. The gold found in this quartz drift also seems to be more ground up than that found in the other wash-drift. It is only here and there where this old quartz-drift deposit occurs: it seems to come from the direction of Mount Pisa, but the top of the range has been greatly worn down since this deposit has been made, and only a few places remain to mark the course of an ancient current which must have carried this material for a considerable distance. The approximate quantity of gold obtained last season was 600oz., representing a value of £2,025.

Cromwell.

There are still a few parties working on the banks and low terraces on the sides of the Clutha and Kawarau Rivers, and also up the Lindis River, and some of the claims are said to give fair returns for working; but the quantity of available water from the small creeks coming from the sides of the ranges is generally very limited, and very few good sites can be got for constructing large dams to store a supply for working the terraces. The place where the largest number of miners are at work is Bannockburn, in Pipeclay Gully. The construction of a sludge-channel in this gully, which the Government subsidised to the extent of £773 19s., has been the means of a large area of ground being worked which otherwise could not have been touched. The ground is not rich, but by being able to wash it away in a face it pays wages for working. When the sludge-channel was first

constructed the upper end had a grade of 1 in 21, or about 3ft. 2in. to the chain; while the lower portion was constructed on a gradient of 1 in 18., or 3ft. 8in. to the chain. After working for some time it was found that the upper portion had too little fall to run away the stuff with the quantity of water available, and it was altered by raising the sides of the channel to have the same gradient as at the lower end.

Messrs. Ray and party of four men, working in Pipeclay Gully, have about 40ft. of a face that they are sluicing away—and in some places the ground is 70ft. deep—but the most of the gold is found near the bottom. This party uses ten sluice-heads of water, and their claim pays them fair wages for working. The other principal claims at the head of the gully are: Menzie and party of three men, Park and party of three, Renshaw two, Roy two, Dickey and party three, Bruce and Hogan two, Menzie two, and Ray and Aitken two. Messrs. Ball and Patterson are constructing a new channel at about 12ft. lower level than the present channel, and running up parallel with it about one chain distant, their ground being too deep to be worked from the present one. In Smith's Gully there are very few men at work. A commencement was made some years ago to take a sludge-channel up this gully; but they commenced on too high a level, and after spending a considerable sum of money, which the Government subsidised to the extent of £251 1s., the work was abandoned; and there is not sufficient fall to work the bed of this gully without a deep tail-race, neither is there sufficient water on the field to admit of it being worked by hydraulic elevators.

During last year the Carrick Water-race, which is the principal water-supply on this field, was sold for £900. This shows that water-races commanding ground in this locality are not profitable investments. The Government gave a subsidy towards the construction of this water-race several years ago to the extent of £9,249 13s. 1d. The present proprietors, Messrs. Jolly and Co., of Cromwell, since acquiring this property have been widening and repairing the race, so as to give it a larger carrying-capacity. It is constructed at a high elevation, and the supply of water is to a great extent regulated by the rainfall. The miners in Pipeclay Gully informed me that they were idle last year for three months during winter through frost, and two months in summer for want of water; this means that they were able to work only seven months during the year. The ground, therefore, has to be tolerably good to give them wages.

On the Kawarau River there are several men working here and there along its banks. At the time of my visit the river was very low, and several were washing the sand and gravel from amongst the boulders in its bed with a small cradle such as was used in the earliest days of gold-mining in the colony; and some of these were doing very well. The bed of the river wherever shingle-beaches are to be seen is all taken up in dredging claims.

Orepuki.

This district still maintains about the same number of miners it has maintained for several years past—about 120. The most of the parties are old residents and have small water-races of their own, but at the time of my visit the supply of water was very limited. Every one was complaining for want of rain. There are very few large parties; most of the claims are worked by two men, with a small supply of water, some of them not having more than about one-third of a Government sluice-head. The best of the claims in the district cannot be said to be extremely rich. Donovan and Barry's claim is said to be amongst the best on the field. They have worked up the bed of a small gully for about 230ft., when a good lead of gold was found, and from this gully the lead turned at almost right angles, as if running in the direction of the school reserve. They have worked this lead of gold, which is about 40ft. in width, to within 40ft. of the north-eastern side of the boundary of the reserve. This claim, however, cannot be said to be very rich. The shareholders informed me that for eight weeks' work two men got 25oz. of gold. The last washing-up was in the beginning of October, and they expect to get 30oz. when they wash up before Christmas. The face they are working in is about 35ft. high, being principally sand, with slight clay-bands through, as well as bands of shale; but the principal gold is found on a soft sandstone bottom.

Amongst the claims that are said to be the best on the field are Rashut and Sons', Tillie and Anderson's, and Fitzgerald's claim. The two former claims are on the face of the terrace falling into Taunoa Flat, which is drained by the Prospectors Gully. The depth of the ground here is from 15ft. to 30ft. The best of the ground has been worked in the early days, but small island blocks have been left which were at that time deemed too poor. These are being worked now, and are considered very good ground. The largest party or company of men working on the field is that of the Big Race Company, who have about eight men employed. They have constructed a water-race from the Waimea Creek for a distance of about nine miles, which conveys about four Government heads of water, and with this water they are working four claims. This party also constructed a tailings-channel from the sea-beach for a long distance up the side and bed of Stony Creek, into which the whole of the sludge and water from the claims passes. This channel is cleaned up once in twelve months, and is said to be a considerable source of profit to the shareholders, giving them about 100oz. of gold per annum. Formerly each man that tailed into this channel had to pay 2s. 6d. per week for the privilege; but very few, if any, pay for this privilege at present.

In some places the gold is found on a decomposed-granite bottom, and in other places on a sand bottom; but the gold and wash-drift show clearly that the land has been considerably lower at one time, as the whole of the deposit is ocean-drift. It is also probable that after the elevation of the land it has been again depressed, and that other leads or layers of gold-bearing drift will be found below the sea-level.

In some of the claims the gold is found on the top of a bed of kerosene-shale. This is the case near the place where the Orepuki Coal and Shale Company have lately been working, on an outcrop about three-quarters of a mile nearer the range than where the shaft was sunk some years ago. There is a seam of coal at this place 5ft. in thickness, overlying which is a bed of shale 3ft. thick,

and on the top of this shale gold is found. From recent tests made from the shale from this company's mine it is said to contain fifty gallons of oil per ton; but it is questionable if this would pay for the expense of working for oil at the present time, as the company would have to depend on a local market, which would be limited—that is, for crude oil.

It would be hard to estimate how long it will take to work out this field. The small amount of available water will necessarily take a long time to wash the ground away, and there are some prospects of other layers on the flat near the sea-beach being found below the bottom that has been worked. The average wages of the miners last year on this field would be small, but there is a mining reserve or commonage here, of which the equal is not in the colony for growing grass, and most of the miners are able to have a few cattle. The soil is of a very rich character, and with very little labour vegetables can be grown, so that it does not cost a great deal to keep a family.

The ocean-beach from Orepuki to the Waiau River, a distance of six miles, has all been taken up for dredging, and a number of applications have been made for the bed of the Waiau River. Gold has been from time to time found in this river in different places for a distance of sixty miles up from its mouth, and it is of quite a different quality from that found at Orepuki. Three years ago a rich patch of gold was obtained at the mouth of the river, and along with the gold there was a good deal of platinum. When Mr. Devonshire was working his claim at the mouth he gave me about 3oz. of platinum which he had taken out along with the gold. The gold itself is of considerable less value than that found in the district further northwards, being worth only £3 9s. per ounce, while that from Orepuki brings £3 16s. 6d. per ounce.

Round Hill.

There has been a large amount of work done on this field, and it supports a considerable population—about three hundred Chinese and twenty-five Europeans—all of which are making fair wages. Some of the claims on this field have produced large quantities of gold, but last year the supply of water was very intermittent, and the quantity used was so small that the ground must be very good to pay sufficient to provide a livelihood for those working it. On my former visit to this district there were some Chinamen working what is termed the New Moon Claim, which paid £10 and £12 per man for working, and on my recent visit this claim was still being worked and giving on an average £4 per week per man. Adjoining this claim Chong Ti and party of eight men are working whenever they can get water, and are averaging £4 per week per man.

It may be of some interest to state that the New Moon party worked out a great portion of their claim, finding the gold on a layer of shale and lignite. They are now working the ground underlying this bed of shale, and have about 7ft. of wash-drift lying partially on a soft sandstone and partially-decomposed-granite bottom. The wash-drift in Chong Ti and party's claim is about 16ft. in thickness, composed of sandy cemented wash, full of syenitic boulders and small water-worn stones, such as are found on the sea-beach. The gold resembles that at Orepuki, being fine and scaly, and has no doubt been ground up amongst the sand and stones by the action of the waves.

This is a district where there is yet a large area of ground to work, and a likelihood of a lead being yet traced from here to Orepuki; but the quantity of water that is or ever can be brought on to this field is very limited, unless at an enormous expense, far beyond the means of private individuals engaged in mining. A new water-race has lately been constructed by C. Potts and Chinese, for a distance of sixteen miles, at a cost of about £3,000; but this race only carries about four sluice-heads of water. Berndtsen's race has also been extended for four miles and a half, but the additional supply is very little.

Several attempts have been made to sink shafts in the bed of the Ourawera Valley, without success. Two companies have erected steam-engines and elevators to lift the material; but the quantity of sludge on the surface of the ground is so great that the machinery hitherto erected has not been sufficiently powerful to cope with the difficulties there are to overcome. A large claim has been taken up, and the holders of it have placed it in the hands of Miss Cornwall to float a company on the London market; but at the time of my visit they could not tell whether she had floated the company or not.

It is proposed to work the whole of this valley by sinking a paddock at the ocean-beach, and placing powerful dredging machinery in this paddock to lift the whole of the sludge and tailings that come down, at the same time to cut a channel from this paddock with sufficient fall to carry all the material to the dredging machinery. It is estimated there is fully 3,000,000 cubic yards of tailings and sludge covering the surface of this valley which would pay to sluice away with proper appliances, and the old residents state the ground in the bed of the valley is in many places very rich in gold. A scheme to work this ground was propounded by Mr. Beal, mining engineer, of Dunedin, whereby he was to construct a large flume or sluice-box on the surface, having a tramway on each side, on which there were to be placed several travelling Priestman dredges to lift the sludge and all material into the sluice. From a description of the plan of the proposed operation given me by the promoters, Mr. Beal's scheme is scarcely feasible, and certainly could not be brought to a successful issue. Whatever scheme be adopted to work the bed of this valley, it will entail a large expenditure in the first instance. The large quantity of buried timber and roots that lies on the original surface would make it difficult to dredge; but, as the wash-drift and mullock does not contain a large percentage of stones, a powerful dredge on the Welman principle might be used to lift the water and material from a paddock if precautions were taken to provide for the water being conveyed past the paddock in time of floods.

Coal Island, Preservation Inlet.

A good deal of prospecting has from time to time been carried on on the south-west side of the Waiau River, in Fiord County, and, although a little gold has been found, it was

considered too little to pay for extracting. In the beginning of this year gold was found on Coal Island, at the mouth of Preservation Inlet, and in April last there were about sixty-eight men on the ground, distributed as follows: In No. 1 Creek, 14 men in 5 claims; in No. 2 Creek, 41 men in 11 claims; and in No. 3 Creek, 8 men in 2 claims. There were also three men prospecting in No. 4 Creek, and two men prospecting on a spur between Nos. 2 and 3 Creeks. The whole of the men on the field are said to be getting sufficient gold to pay for working the ground. The best claims are in No. 2 Creek. The wash-drift here is said to yield on an average 3gr. of gold to the tin dish, and as much as 6dwt. to the dishful of dirt has been obtained. The gold is tolerably coarse. McNamara and Curran got a 4½oz. nugget in their claim in No. 2 Creek; Morgan and party a 2½oz. piece, and several others have found 1oz. nuggets in their claims. The other creeks are not so rich as No. 2, but still the men seem satisfied with the prospects they are obtaining.

The depth of wash-drift in the creek varies from 1ft. to 14ft. in depth, with from 1ft. to 5ft. of peaty soil on the top. In the creek-beds there are large granite boulders, some of which are over 2 tons in weight, requiring blasting before they can be removed. The whole of the ground is covered with timber, but there is very little scrub and undergrowth. The timber is of very little value except for firewood and for mining purposes. This island contains an area of about 2,800 acres, and the highest points are given as 850ft. above sea-level, and the nearest point to the mainland is about 25 chains at lowwater. It is about sixty miles to the south-west from Orepuki, and about ten miles from the Puysegur Point lighthouse. Up to the end of April last there had been about 400oz. of gold obtained.

The foregoing account of this field is taken from a report of Constable Green, who visited the island on the 11th of April last, and he also reports that at the end of April twenty-four men had left the field. The fact of getting nuggetty gold in this part of the colony will tend to have prospecting carried on with more vigour, and possibly rich auriferous deposits will yet be discovered between this and the Waiau River; but, this part of the country being destitute of roads or tracks, it is almost impossible for men to get far into the country to prospect, as they cannot get provisions unless carrying them on their backs; and any one carrying a large swag in this part of the country will make good headway through the bush if they travel six miles a day. The surface of the ground is of a soft peaty nature, that, even if the timber were cut down, it would not be passable for pack-horses; and when miners have to prospect a country of this description, it means that they must be possessed of money and also be of a strong robust constitution. It is a part of the country where the construction of an inland track might lead to auriferous discoveries being made that would recompense the colony for the expense.

The greatest difficulty at Coal Island at the present time is getting a constant supply of provisions; but when it is known that it contains a certain population this will soon be remedied. The island is steep and precipitous in places, and the soft peaty nature of the soil makes the carrying of tools and provisions from the landing-place to their claims a laborious task. Indeed, unless men are getting well paid for their labour they will not stop. When a number of miners are engaged on a limited area, such as this island, care should be taken by the Warden that the water-rights, which must also be limited, are not acquired by a few individuals, as this would esult in driving away a great many, and the ground falling into a few hands.

DREDGING.

A very large area of ground is now held in dredging claims, but very little work has yet been done in any of these claims, with the exception of a few. Many of these claims have been held for over two years without the slightest work being done in them. Indeed, it is questionable if many of the present holders intend working their claims: they are merely holding on to the ground as long as possible, with the view of being able to sell their claims to those who will work them. The principle of working the ground by dredging is now sufficiently established to prove that ground to a depth of 20ft. or 25ft. can be very economically worked with dredges; and, such being the case, those that hold large areas of ground in special claims should either be compelled to work the ground or else their grant should be cancelled, in order to stop a system of levying blackmail on those who actually place their capital in dredging ventures, and being the means of checking an industry which is ultimately likely to develop into large proportions.

Almost the whole of the ocean-beaches on the west coast of the Middle Island have been taken up in special claims for dredging, as well as the beds of some of the rivers; and in Otago the beds of the Molyneux, Kawarau, Shotover, Dart, Nevis, Manuherikia, Mataura, and Waiau Rivers, and many other beds of streams, have been taken up for the purpose of working the ground by dredging operations. There is no doubt there are plenty of claims taken up that will not pay for working; but, on the other hand, there will also be a large number which will give good returns. Therefore intending investors in dredging ventures should be careful before commencing to construct a dredge to see that the ground they are buying into has been properly prospected.

On the west coast of the Middle Island Messrs. Kincaid and McQueen, ironfounders, Dunedin, constructed a dredge on the Ocean Beach Lagoon, about two miles and a half south of Ngakawau, for a company; but this has been a thoroughly mismanaged concern from first to last, and it is now standing idle. The dredge was originally built to be worked by water-power—namely, by having a turbine water-wheel on the dredge—and the water was brought from a creek in wrought-iron pipes to supply water to drive the machinery; but when the water was turned on to start the machinery the pipes were found to be faulty in construction, and not to be able to stand the pressure they were subjected to. A steam-engine and boiler was then substituted in lieu of the water-motor; but, although the dredging-buckets and gearing worked well, the appliances they had for washing the material

and saving the gold were found to be of no service. The washing appliances were altered, and another start made; but they could not get sufficient gold in the material lifted to pay for working the dredge. But it is very possible the true solution is that they were lifting a large quantity of material and washing it overboard again without saving very much of the gold the drift contained. The capacity of this dredge was said to be about 100 tons per hour; but the washing appliance is not suitable for one-quarter of this material passing through.

Greymouth.—The only dredge that has yet been made to pay for working is Mr. Joseph Taylor's, on the Back Lead, north of the Grey River. It is a combination of a pump and a Priestman's grab. The former takes the sand and small shingle, and the latter the coarse shingle and boulders. This dredge has been working for about eighteen months, and is said to be giving good returns.

At the Saltwater Creek, Paeroa, Messrs. S. Brown and Company, of Wellington, erected a dredge with a Cataract pump for lifting the sand and shingle; but, although this pump was highly spoken of as an efficient dredge by people in America, the experience of working it here has been that this pump is only suitable for lifting shingle of about a maximum size of 3in., and it therefore proved entirely unsuitable for dredging the bed of the Saltwater Creek. Recently a ladder and buckets have been substituted for lifting the material, and the Cataract pump used only for lifting water for sluicing. Mr. Brown could not inform me of the quantity of material lifted by this dredge, nor the quantity of water lifted for sluicing purposes; but he states that it takes steam at a pressure of 130lb. per square inch to keep the engine working at 130 revolutions per minute, the stroke being 16in., and the diameter of the high-pressure cylinder 7½in., the low-pressure cylinder having a corresponding proportion to the other in relation to the differences of the pressure of the steam. If this data is reliable, then, supposing the steam to be cut off at three-eighths of the stroke, the terminal pressure in the small cylinder would be equal to $\frac{130}{\frac{8}{3}}$ or 48·87lb., and the mean pressure throughout the stroke would be 96·68lb. per square inch, taking the travel of the piston at 343ft. per minute, which is taken from the foregoing data. Then the theoretical power developed—that is, allowing the low-pressure engine to be of the same power as the other—would be $\frac{343 \times 96{\cdot}68 \times 44{\cdot}17}{33{,}000} \times 2 = 88{\cdot}7$ horse; but, as the quantity of material and water lifted is not known, the loss absorbed in friction cannot be ascertained.

At the Saltwater Beach, south of the Waitaha River, Mr. Welman erected one of his dredges for a company here; but, although it has been now working for some time, nothing can be learned respecting its suitability for dredging the material found here, or as to the quantity of gold obtained. With regard to the latter, it may be taken that not much gold is being got; but it would be satisfactory to learn whether this is due to the gold not being amongst the drift, or to the dredging appliances being imperfect.

At the Three-mile Beach, south of Okarito, Mr. Brooke-Smith, on behalf of the New Zealand Beaches Company, has got a large dredge constructed, and will shortly be in full work. The dredge is of the Welman pattern; but the dredging-pipes are larger than have hitherto been used, their diameter being 13in., and the washing-surface of the tables is about 800 square feet. At the Five-mile Beach, which is about two miles further south than the Three-mile, preparations are being made to erect a dredge. This is one of the beaches selected by Mr. Brooke-Smith when he took up the first dredging claims on the west coast beaches. It was on this beach that he placed a small prospecting-dredge, and found the ground payable for working if good appliances were used; but the dredge that he got out from England at that time to work this ground was a perfect toy, and therefore could not be made to pay for working. This ground now belongs to a Christchurch company, who propose to bring water from the Alpine Lake, at a distance of about two miles and a quarter, in pipes, and utilise the water as a motive-power to work a dynamo for generating electricity to drive the dredging appliances. The estimated cost of the whole of the works is about £16,000. From my knowledge of the ground on the Five-mile Beach, I feel confident that this beach will pay well for working with efficient dredging appliances; but it is questionable if the interest on the extra outlay required to bring in water from the Alpine Lake to the place where it is required on the beach to work the dynamo, would not more than pay for the extra expense of steam-power, and if such can be shown then steam-power is preferable.

At Gillespie's Beach a company is getting one of the Von Schmidt's dredges constructed by Messrs. Anderson Bros., of Christchurch which will soon be completed. There are good prospects to be got on this beach, and it seems one where dredging operations should be made remunerative. As soon as the dredges get distributed along the coast-line, and the claims are proved payable for working, the number of dredges will increase rapidly.

The Waiau River south of Orepuki has all been taken up in dredging claims, and good prospects for dredging appliances can be got on the ocean-beach near Orepuki; but a floating dredge could not be got to work on the richest beaches, as the sea-waves in stormy weather wash back against the high terraces.

On Waipori Flat a large dredge has been constructed, and has commenced working. After a commencement had been made it was found that the revolving cylinders for separating the stones from the fine material were not large enough to wash the clayey gravel sufficiently. This has recently been remedied, and it is expected that the dredging operations here will be made to give good returns for working. Recently they got 260oz. of gold for five days' work.

The flat is being worked by a steel bucket-and-ladder dredge 92ft. long and 18ft. 6in. beam, and capable of dredging 75 cubic yards per hour from a depth of 20ft. below the surface of the water, and drawing 30in. There are two twelve-horse-power nominal surface condensing-engines, one working the buckets and winches, the other a centrifugal pump 4ft. 6in. in diameter, with 12in. suction and discharge, lifting 3,000 gallons of water per minute a height of 14ft. The material lifted is discharged into a revolving cylinder constructed of 3in. by 1½in. bars $\frac{3}{16}$in. apart, 4ft. in diameter,

making ten revolutions per minute. The screenings, passing through the slots, are carried by water and distributed into the tables, which are 24ft. in width and 12ft. long, covered with a matting. The larger gravel and stones pass out of the cylinder into a shoot 3ft. wide and 40ft. long, fitted with venetian ripples and perforated plates, and finally pass over the stern into the ground already worked by the dredge. The fuel used is Westport coal, costing £2 15s. per ton delivered, and the quantity used for three shifts of eight hours each is 1½ tons; but it is proposed to use firewood in lieu of coal, at a cost of £2 per cord, and it is expected that a saving of £2 per day will be effected. The depth of material operated on is about 12ft. from the surface to the false bottom, and it consists principally of fine silt and quartz-gravel, with some larger stones on the bottom about 3in. in diameter. The material is well adapted for dredging, and the part being now worked is old workings, producing an average of 31oz. of gold for 120 hours' work, the largest return got for this period being 36oz. and the smallest 26oz. The dredge was built by Kincaid, McQueen, and Co. (Limited), costing about £3,300, and is doing good work, lifting somewhere about 1,000 tons per day.

On the Clutha dredges have been used for nearly twenty years, and some of these have proved very remunerative ventures to their proprietors. From what is now known respecting the wash-drift in the bed of the river, there are very few places that will not pay to work with properly-constructed dredges. Several of the dredges now at work cannot get as much gold as they could some years ago, on account of the quantity of tailings that is accumulating in the river-bed. There are many places where the bed of the river is raised at least 8ft. from the level that it had in the early days of gold-mining in this valley. Many of the dredges are worked by a current-wheel; but it is found that these only work well in the current of the river, and cannot be used with advantage in working near the beaches or eddies, where the richest portions of the wash-drift are generally found. Messrs. McQueen and Company's steam-dredge, which was shifted down from 2 miles above Alexandra to opposite the mouth of Coal Creek, has been paying remarkably well. The gold is very fine, and the washing-surface on this dredge is very limited for the quantity of material put through, and no doubt a large percentage of the gold is again washed back into the river. Still, with all this, the working of this dredge proved last year a remunerative venture. The Welman dredge, which was erected and afterwards lay submerged in the Manuherikia River for a long time, has been lifted, but it is too small to be of any utility in dredging such rivers as the Clutha.

Waipapa.

A number of special claims have been taken up on the ocean-beach between Waipapa Creek and the lighthouse, comprising all the available ground that is deemed suitable for working by means of dredges. There is as yet only one dredge at work, but arrangements have been made to place another dredge on the beach near Lake Brunton. The other claimholders are merely holding the ground with the view of floating a company to work it. The successful manner in which the Waipapa Company's dredge does the work, and the amount of gold that it has been the means of obtaining even out of old worked ground, have caused such excitement in this district that even the cautious Scotch farmers, in many instances, have been induced to risk a little money in mining ventures. Indeed, many are under the impression that a new El Dorado has been opened, and that, with improved dredging machinery, the most of the ocean-beaches and beds of rivers will be made to give profitable returns for working.

Waipapa Dredge.—This dredge has been now at work for about twelve months on the ocean-beach at the mouth of the Waipapa Creek. When it first started it had a great many difficulties to contend with, not only in alterations of the machinery and appliances, but also in working through ground which had been worked by individual miners years ago, and where numerous scrub embankments had been made to prevent the waves from filling up the paddocks as they were taken out. There is no trace of these old paddocks or scrub embankments on the surface of the beach, so that no one could tell what there was to contend with until the dredge commenced working.

The hull or punt on which the dredging machinery is erected is 50ft. long and 15ft. in width, and on each side of this punt there are three pontoons, the four end ones being 4ft. and the centre one 6ft. wide. These pontoons are placed alongside the main punt on each side, end on end, and are held together by longitudinal beams lengthwise, and to the main punt by heavy cross-beams, which go across the deck, extending from 7ft. to 8ft. on each side. This admits of these beams being bolted to the longitudinal beams which hold the pontoons together, so as to form a platform to erect staging to carry the washing-tables. There are also two pontoons at the stern of the dredge, fastened by beams to the main punt, to carry the staging for the end of the washing-tables and tail-boxes, which deliver all the water and waste material on to the ocean-beach, the tailings being prevented from banking up to any great extent by the action of the waves.

The dredging is done with one of Welman's patent pumps, which in many respects is similar to a centrifugal pump, only the runner is differently constructed, the vanes, or blades, being merely solid cast-iron junks, instead of being thin and greatly curved on the inside. The runner employed at the Waipapa dredge is 2ft. 3in. in diameter and about 8in. wide between the flanges, with four solid vanes greatly curved on the back, but almost straight on the other face. On one side the flange is solid, having slight ribs on the outside to strengthen it, while on the other side there is a circular opening, about 15in. diameter, to allow all the water and material to pass through the runner. This runner is keyed on to a shaft, which is about 2in. in diameter, and has a cast-iron casing over it of about 1½in. in thickness, and revolves at the rate of 430 revolutions per minute. This forms the Welman pump. The difference in its action from the ordinary centrifugal pump is that it receives all the water and material from the side instead of from the bottom, and the discharge-pipe is taken from the bottom of the casing instead of from the top, as in the case of the centrifugal pump.

The pump is placed on the main punt, and from it there is a horizontal pipe with an elbow to join on to the casing, and fit on a projecting flange on the runner. This horizontal pipe, after

passing to the front end of the punt, is fitted with a universal joint, so that the pipe outside the punt can be lowered, raised, or moved from one side to the other. On the end of the outside pipe there is an elbow turning downwards, and having a bell-mouthed sleeve over the end. The suction- and delivery-pipes are 12in. in diameter; but in order to prevent stones jamming in the pipe there is a ring fixed inside the bottom end of the suction-pipe, which reduces its diameter to 10in., therefore any stone which comes through this ring can easily pass through the pipe, but there is still a danger of its jamming in the runner. Indeed, it appears to me that the greatest defect in the Welman pumps is that the openings in the runners are not large enough; but it is certainly a very good pump for lifting the class of material they have to deal with at Waipapa. There may be occasionally a large stone, but the great bulk of the stuff, or about 95 per cent., is composed of sand and fine shingle. During my visit there was no stone lifted larger than about 5in. at its greater diameter. Indeed, the arrangements made for separating and getting the stones and shingle clear of the dredge would not answer if there was a large percentage of stones and coarse shingle amongst the material.

The material is lifted 15ft. above water-level, and discharged into a long hopper-chute, which is about 36ft. long, going right across the dredge at right-angles to its length, having a fall from the centre on each side of about 1 in 12. This hopper is covered with punched iron plates, about 10 B.W.G., having holes $\frac{3}{8}$in. diameter. Under this hopper there is a box with a fall from the centre each way for some distance, and from the outer ends towards the place where it meets the fall from the centre, thus forming the appearance of the letter V well flattened out. The fine material passes out of this box on to a distributing-board or table which is 12ft. wide and 6ft. long, and from this table the water and material pass on to the tables for saving the gold. These tables are 2ft. wide and 30ft. long, six of them being on each side of the dredge, so that there is 720 square feet of surface in the gold-saving boxes or tables. The tables are longitudinal with the dredge, having a fall of about $\frac{3}{4}$in. to the foot, and being covered with plush for about 18ft. to 20ft. in length from the discharging-hopper towards the stern, but on the bottom end there is neither plush, blankets, nor ripples for saving the gold, so that the whole of the gold is collected on not more than 480 square feet of surface. From the end of the longitudinal tables the water and material pass into a sluice-box running at right-angles to the tables, which delivers all the water and waste material on to the ocean-beach, where it is afterwards distributed by the action of the waves. The stones and shingle that come on the top of the perforated plates in the hopper are raked down by a man stationed there for that purpose, and discharged at each side of the dredge; but, as previously stated, there is very little coarse material amongst the stuff that is lifted.

The dredging-pipe is lifted and lowered by a steam-winch, the derrick being placed directly in the front end of the punt and swinging round on a pivot, so that the pipe can be made to describe an arc of about 160 degrees: by this means a cut or paddock can be excavated from about 45ft. to 50ft. wide. After taking up one cut the dredge is shifted back again and another cut commenced. In order to have always clear water for washing, the water from the Waipapa Creek is turned into the excavated paddocks. Had there not been means of getting a supply of clear water they would have had to use the same water over and over again, when eventually it would have become thick and muddy. There is a vacuum-gauge attached to a pipe leading from the top of the universal joint of the dredging-pipe, and this gauge shows the man that guides the dredging-pipe how it is working. If everything is going on smoothly the vacuum-gauge registers 5lb. pressure per square inch, but if a stone gets into the bottom end of the pipe it immediately rises considerably above this, or if a stone gets jammed near the runner the vacuum-gauge falls below the 5lb. By this means the man conducting the dredging operations can at once tell what is the matter, and remedy it accordingly. On inquiries as to the lifting-capacity of this dredge, the man in charge informed me that it lifted about 35 tons of solid material per hour. It was supposed by Mr. Welman, when he constructed it for the company, to have a lifting-capacity of 80 tons per hour, but it does not lift half this quantity. Judging from the quantity of water in the tail-boxes, the quantity of water lifted with the material is equal to about six sluice-heads.

The Welman pump, or dredger, is driven by a double-cylinder horizontal under-type steam-engine, placed under a semi-portable boiler, the cylinder being 10in. in diameter, and the stroke of the engine 16in., making 125 revolutions per minute. With the view of ascertaining the power absorbed in friction in this style of dredge, it will be interesting to those engaged in dredging operations to show that a great surplus of power is required beyond that necessary to lift the solid material and water. The engineer informed me that the initial pressure of steam required to work at the proper speed was 80lb. per square inch; but the steam had to be kept up to from 90lb. to 100lb. on the boiler. Assuming that 80lb. was the least pressure that would keep the engines working at the proper speed to do the work, and also that the steam was cut off at three-eighths of the stroke, then the mean pressure in the cylinder would be 59·6lb. per square inch. This makes the theoretical power of the engine to be equal to 94·4 horse. The quantity of solid material lifted being 35 tons per hour from a depth of 35ft.—that is, 15ft. above the surface of the water and 20ft. under the surface—and allowing nothing for the less weight of the solid material in the water, then the 35 tons per hour is equal to lifting 1,307lb. per minute to a height of 35ft., or 45,745lb. 1ft. high per minute. The water, being only lifted 15ft., is equal to 22,500lb. being lifted to a height of 15ft., or 337,500lb. 1ft. high per minute. Therefore the total weight lifted is equal to 383,245lb. 1ft. high per minute, and the theoretical power necessary to lift this weight would be equal to 11·6 horse. This shows that 82·8 theoretical horse-power is necessary to overcome friction, being about 713 per cent. of the power necessary to lift the actual weight. The power absorbed in friction in dredging operations seems appalling, but a considerable power must be required to disintegrate the solid material.

In order that any one may examine these calculations to test their accuracy: The mean pressure of steam in the cylinder equals the terminal pressure multiplied by the hyperbolic

logarithm, *plus* 1, of the ratio of expansion, and the terminal pressure = the initial pressure of the steam entering the cylinders divided by the ratio of expansion: thus,—

Initial pressure = 80lb. per square inch.

Ratio of expansion with steam cut off at three-eighths stroke = 2·66.

Then $\frac{80}{2 \cdot 66}$ = 30lb. terminal pressure.

Hyperbolic logarithm of 2·66 = ·9783260, and 1 added to this is 1·9783260 × 30 = 59·6lb. mean pressure in cylinders.

Area of each cylinder = 78·54 square inches: this, multiplied by the travel of the piston and number of revolutions per minute, divided by 33,000, equals the theoretical horse-power.

$$\frac{78 \cdot 54 \times 2 \times 59 \cdot 6 \times 333}{33{,}000} = 94 \cdot 4 \text{ horse-power;}$$

and $\frac{383 \cdot 245}{33{,}000}$ = 11·6 horse-power; also, 94·4 − 11·6 = 82·8 horse-power, the latter being the horse-power absorbed in friction.

There is also a small engine used for working a pump to lift the water for streaming down the blanketings or washings from the plush. The cloths are washed twice in the twenty-four hours, and when there is a collection of sand from these washings it is streamed down an inclined table covered with plush, and afterwards amalgamated. The amount of gold obtained by this dredge, the man in charge informed me, was about 100oz. of amalgam per week, which, taking it at one-third, would be about 33oz. of gold, which is worth £3 15s. 6d. per ounce.

There are twelve men employed, including the manager, and they consume about eighteen cords of rata firewood per week. Setting down the working-expenses, including wear-and-tear, at £70, this would leave a good margin of profit to the shareholders—£55 per week. Assuming that the average quantity of material lifted is 35 tons per hour, this is equal to 5,000 tons per week; and taking the yield of gold at 33oz., this is equal to about 3gr. of gold per ton. If the data supplied me as regards the quantity lifted and the yield of gold is correct, dredging operations on the ocean-beaches will become a large industry and a remunerative one; but it must be borne in mind that there will be plenty of blanks as well as prizes, and people embarking in this industry will do well to prospect the ground thoroughly before going into expensive machinery.

The Welman dredge is well suited to lift the class of material there is at Waipapa, but with runners such as used at present it would not be suitable for lifting large stones. There is another of these dredges being constructed near Lake Brunton, with a runner of from 3ft. 6in. to 4ft. in diameter, and it will have a larger pipe than the one employed at Waipapa. This is expected to get over the difficulty in lifting large stones, as there will be considerably more room in the runner, and it will not require to be driven at such a high speed.

Notwithstanding the success which has attended the Waipapa Dredging Company in being able to work the ground profitably, there still remain considerable improvements to be made in their machinery and washing appliances before they are able to save a large percentage of the gold from the beach-sand and drift. Assuming that the quantity of sand and gravel lifted amounts to 5,000 tons per week, and the yield of gold to 33oz., this is an average of 3·17gr. of gold per ton, and the working-expenses are equal to 1·99gr. per ton; but the real question at issue is, are they saving a fair percentage of the gold raised amongst the material? and on this point there is no doubt in my mind they are losing a large percentage of the gold. It is well known that all the gold on the ocean-beaches is of a fine, scaly nature, and liable to be carried away by a strong current of water if the material is rushed quickly through the boxes. In order to save a large percentage of the gold the tables must only be covered with a thin film of the material, having only as much water as is necessary to keep them clear. The washing-surfaces of the tables are too little for the amount of material that goes over them; the tables should have a much larger transverse area. The width of the tables for saving this character of gold is a far more important factor than the great length, as wide tables allow the water and sand to be spread out in a very thin film, which causes all the particles to roll on the plush or blankets instead of being floated away with the water. It is, no doubt, a great advantage to be able to lift a large quantity of material—as the labour is almost the same whether the quantity be 20 tons per hour or 100 tons—so long as the washing appliances are capable of dealing with the lifted material satisfactorily; but it is waste of power attempting to lift large quantities of material to run it over the stern of the dredges, only getting a small percentage of the gold out of it.

The Welman dredge is suitable for lifting the class of material found on the ocean-beach at Waipapa, where it is mostly sand and fine shingle; but this class of dredge, unless greatly improved, would not work in the river-beds successfully, where there are large quantities of stones. The principle of discharging the shingle and stones at each side of the dredge is entirely unsuitable for working shingly river-beds, as the material in many of these river-beds contains from 60 to 70 per cent. of stones and shingle, and this quantity of material discharging at each side would cause the dredge to be jammed so that it could not be shifted about.

There is ample room for large improvements in the washing appliances used on dredges, and also in getting clear of the stones and shingle, for these must be separated from the material before allowing it to pass over tables which are covered with plush or blankets. Some of the gentlemen connected with the Sew Hoy Company, Shotover River, met me while in Dunedin in regard to recommending some appliance to discharge the stones at the stern of their dredge, and stated that the dredged material contained about 70 per cent. stones. Where a large quantity of stones and coarse shingle is met with it will have to be disposed of by mechanical means, as the power required to lift the material to a sufficient height above the water in order to allow a chute to be constructed on a sufficient grade to make the stones and shingle slide on the hopper plate over the stern of the dredge would not be compensated by the disposal of the stones in this manner; besides,

the extra height of the framing above the deck of the punt would tend to render the punt carrying the dredging appliances top-heavy.

The stones and shingle could be discharged automatically over the stern of the dredge by means of travelling slices being fixed on a flexible steel-wire rope-belt, or they could be discharged through a pipe by a hydraulic jet of water. The latter plan could be easily adopted on any dredge, and the whole of the coarse material by this means could be deposited a few feet beyond the stern; or, the most effective way would be to separate the stones and shingle by means of a perforated revolving cylinder, which will be fully described in my remarks on the Sew Hoy Company's dredge. In regard to the construction of washing appliances, it becomes a question of whether it is more economical to build a large punt along with pontoons to carry the whole of the washing appliances, or to construct the washing-tables on the shore, and deliver the dredged material on to them through a pipe from the dredge. There are objections in both cases. In the first case it is difficult to erect a large surface of washing appliances on a floating punt which carries the dredging machinery, and to have the tables free from vibration and always perfectly level transversely, which is one of the most important elements in saving the gold; and in the second case the pipes between the dredge and the tables, if they were stationary on the shore, would have to be lengthened or shortened very often, unless the tables were made on a travelling-frame. The washing appliances erected by the Fairmaid Company, Addison's Flat, are the best appliances to save the beach-gold that have yet been used in the colony. A model was exhibited in the Exhibition, Dunedin.

Dredge, Mataura.—This dredge is placed on the Mataura River, about three miles and a half above the township of Fortrose, by a company of local gentlemen. They leased the bucket-dredge from the Invercargill Harbour Board, and have fitted it up with washing-tables on a somewhat similar principle to those used by the Waipapa company. The ladder of the dredge limits the depth of dredging to 15ft. There is a centrifugal pump in connection with the dredge, which forces the water into the hopper where the buckets empty, and this sends the dredged material into a similar hopper to that used at Waipapa. The tables are five in number, 2ft. wide and 21ft. long, set to a pitch of 1 in 12. That means that there is 210 square feet of washing-surface. The centrifugal pump is too small to lift the quantity of water required to keep the dredge working full power—it can only lift about five buckets per minute, or 30 tons of material per hour; but even with this quantity the surface of the washing-tables is not sufficient. The operations are more of a prospecting character. A little gold has been got, but not enough up to the time of my visit to pay working-expenses.

It is difficult to make such alterations in a dredge of this description, which was built expressly for deepening the harbour and delivering all the material through a pipe on to the shore, as to get sufficient washing appliances for gold-saving. The hopper is close to the stern, which is the natural place to deposit all the waste material, and it is here where the washing appliances have to be constructed. In this instance beams are bolted to the hull of the dredge and project 12ft. over the stern. These carry the washing-tables; but if the company find sufficient gold to pay for working they will no doubt make such alterations in the present dredge, or get one specially constructed, so that more material can be lifted, and have room to erect a much larger surface of washing-tables.

Sew Hoy Company.—This company have three special claims in the bed of the Shotover River, extending from the mouth of the gorge at Arthur's Point to the lower end of the gorge below the Big Beach. At the present time this company has only one dredge at work at the Big Beach, but they have three more dredges in course of construction; one of these is to be completed in June, one in July, and one in August. These new dredges are being manufactured by Messrs. Anderson Brothers, in Christchurch; they are to be much larger than the present one, and made to dredge to a depth of 24ft. below the surface of the water, whereas the present one only dredges to a depth of 14ft.

The dredge now used commenced constant working in July, 1889, and from that date up to the 1st of March last had been dredging 3,883 hours, lifting on an average 50 tons of material per hour, which is equal to 194,150 tons; and the quantity of gold got for this period was 1,127oz., representing a value of £4,226. This makes the average yield of gold per ton of material lifted 2·78gr., or, the average value of the stuff dredged was about 5¼d. per ton. Notwithstanding this low yield, the profit on the working has amounted to about £2,600.

Dredging Appliances.—The dredge is one on the centre-bucket principle. There are fifty-nine buckets on the ladder, each bucket having a capacity of 2¼ cubic feet, and from nine to twelve buckets are discharged per minute. Allowing that the buckets are not quite full in average working, but that they bring up 2 cubic feet each time, and that ten buckets are discharged per minute, then the average quantity of material lifted is 20 cubic feet per minute, or 44 cubic yards per hour. There are, however, unavoidable occasional stoppages which would slightly reduce this average, but the quantity lifted may be set down at 50 tons per hour. The material is lifted 15ft. above water-level, and falls from the buckets on to a short inclined grizzly, made of flat iron bars 3in. by ¾in., and spaced 1¼in. apart. The head of the sluice-box goes under this grizzly. It is 3ft. wide and 48ft. long, set on an inclination of about 1 in 8, and from the end of the sluice-box there is a return sluice-box below, set on a gradient of 1 in 12. The upper sluice-box and also the return one is made of plate iron, and is first covered in the bottom with calico, on the top of which there is cocoanut matting. On the upper sluice-box there are first 12ft. of iron ripples, then for the next 12ft. slips of wood 1in. deep are laid on the top of the cocoanut matting at each side of the sluice, on the top of which are laid perforated iron plates, having holes of $\frac{3}{16}$in. diameter. Below this, again, is another 12ft. of iron ripples, and the 12ft. at the end is covered with perforated plates. All the large stones are picked out at the head of the sluice by the men attending the boxes, and the medium stones and coarse gravel pass over the end of the sluice and are deposited behind the dredge. The end of the upper sluice projects for a considerable distance beyond the stern. The fine material which passes through the last set of perforated

plates falls into the return sluice-box, which is covered with perforated iron plates, having holes of ⅛in. in diameter, laid on the top of the slips of wood above the matting as previously described. The material from this lower or return sluice passes into a small tank, and is deposited directly at the stern of the dredge. By this means the coarse material is stacked up behind the dredge about 3ft. above the surface of the water; but the fine material from the return sluice cannot be deposited above the surface of the water. The water for washing is raised by a centrifugal pump 13in. in diameter, running at a speed of 500 revolutions per minute, about four sluice-heads of water being used. This is lifted 15ft. above the surface of the water where the dredge is floating.

The whole of the machinery is worked by a compound steam-engine, the high-pressure cylinder being 10in. in diameter and the low-pressure one was given me as 22in. in diameter; but it is questionable if there is not some mistake as to the diameter of the latter cylinder, as it appears to be of large dimensions in comparison with the diameter of the high-pressure one, and it is probable that 19in. or 20in. diameter will be nearer the actual dimensions. The engines work at 120 revolutions per minute, with 16in. stroke, and the engineer informed me that it required at least 60lb. pressure of steam to work the engine at the proper speed, and that when the steam went below this pressure the speed could not be maintained. This data enables a comparison to be made between the theoretical horse-power employed and the theoretical horse-power required to lift the material and water for washing purposes.

In making a comparison between this dredge and the Welman dredge at Waipapa, as to the amount of horse-power absorbed in friction, it will be necessary to assume that the steam in the cylinders is cut off at a certain portion of the stroke, say three-eighths. Then, on this assumption, the theoretical horse-power employed to work the Sew Hoy Company's dredge would be as follows: Speed of piston, 320ft. per minute; mean pressure of steam in high-pressure cylinder, with 60lb. pressure, and cut off at three-eighths stroke, 44·5lb. per square inch. Taking the low-pressure cylinder to develop the same power as the high-pressure one, then the theoretical power employed is equal to 67·7 horse. While the power required to lift 50 tons of gravel per hour from a depth of 29ft., and four sluice-heads of water to a height of 15ft., is equal to lifting 54,130lb. of gravel and 225,000lb. of water 1ft. high per minute, the power required to do this is equal to 8·5 horse. It will be seen, therefore, that 59·2-horse power is absorbed in friction, which is equal to about 700 per cent., while the Welman dredge absorbed 713 per cent. in friction. This is, however, on the assumption that steam is cut off in both the engines of these companies at three-eighths of the stroke, and that the low-pressure cylinders develop the same power as the high-pressure ones.

Considerable attention has been directed to the lifting-capacity of these dredges, but very little to the saving of the gold. At Sew Hoy's dredge all the machinery works extremely well—indeed, it may be said to move along like clockwork; but they are lifting auriferous drifts, purporting to be saving the gold, when at least about one-quarter, if not a third of it, is deposited again at the stern of the dredge amongst the tailings: it is simply impossible to save the fine gold that is in the drift-wash in these river-beds by rushing the material through a narrow box with a large stream of water. After the material is lifted, all the large stones and coarse gravel require to be separated from the fine sand before a large percentage of the fine gold can be saved. The fine sand containing the gold should be spread over a very large surface, only using sufficient water to keep the surface of the plush, blankets, or cocoanut matting—whichever is used—clear. Every particle or grain requires to roll down on the surface of the material used to collect the gold, and not simply to be held in suspension and carried away with a large volume of water.

The material in the bed of the Shotover River contains a large percentage of stones and coarse gravel, and appliances will have to be used to separate this from the finer material before it passes on to the gold-saving tables. Provision has also to be made so that the dredged material can be stacked up at the stern of the dredge for a good height above the surface of the water in which the dredge floats. This may necessitate the material being raised to a greater height above the water, and absorb a little additional power; but the object gained would justify this end. All the stones and gravel must be deposited a certain distance beyond the stern of the dredge, and kept clear so as not to interfere with moving the dredge sidewise and endwise.

In order to get clear of all the stones and coarse gravel, and separate them from the fine sand, a revolving perforated cylinder, having the holes about ¾in. in diameter, would be a simple way to effect separation: The cylinder to be, say, 10ft. long, set on a slight inclination towards the discharge end, having just sufficient to make the cylinder clear itself and thoroughly wash the stones. The stones and coarse gravel, on leaving the cylinder, to fall into an iron chute with smooth bottom, being set at such an inclination that a stream of water entering at the head of the chute would force the stones and gravel over the stern of the dredge. The fine material coming through the perforations of the cylinder to fall into sluice-boxes placed longitudinally with the dredge at each side of the chute for conveying the stones and gravel over the stern. These sluice-boxes to be similar to the ones now used, and to project over the stern of the dredge about 14ft.; the top end of the boxes could be fitted with iron ripples, but the lower end to have perforated plates laid on top of side strips of wood above the matting for a length of, say, 25ft. The holes in the plates to be ½in. in diameter. All particles above this size would pass over the end of the sluice, while the fine material would fall into a cross distributing-box, say 30ft. in length; and about 18in. in width. From this distributing-box tables to be placed from the end of the main sluices, returning back to the stern of the dredge, having a total width of 30ft., and being at least 12ft. in length; to have longitudinal divisions about 3ft. apart, so as to form ten boxes 3ft. in width and 12ft. in length. These tables to have three drops and splash-boards, the bottom of each drop having the shape of the letter U. This would form a well in which quicksilver could be used if desired. The bottom of the tables to be covered with plush, blankets, or coir matting, and provision made to keep the matting down, and also to remove the matting at intervals to wash it in a tank. The distributing-box to have openings on to each division of the table, so that when the matting is removed to be washed a gate can be

shut down, and the material turned on to the nine remaining divisions. The tables to be set at such an inclination that the material passes over the surface of the matting in a very thin film, and the surface is always kept clear of sand settling. As soon as sand settles on the matting and to heap up in the slightest degree gold is carried off.

By adopting wide tables at the end of the main sluices all the coarse material is separated, and nothing but the fine sand remains to pass over the tables. The openings in the distributing-box have to be regulated so that the fine material will be uniformly distributed over the whole surface, and only sufficient water used to keep the surface of the matting or plush clear. It is an easy matter to get machinery to lift a large quantity of material, but corresponding washing appliances have to be provided. This seems to be the great want in the Sew Hoy's Company's dredge; and, although there is a large washing-surface on the Welman dredge at Waipapa, the tables are badly constructed, and too much water is used for washing purposes; and also, better arrangements have to be provided for a uniform flow over the whole surface of the tables.

Wakatipu and Kawarau Big Beach Companies.—These companies are each having a dredge constructed and put together at the side of the Kawarau River, a short distance below the outlet from Lake Wakatipu. The hull of each of these dredges is 18ft. long, and has about 18ft. of beam. The height of the top tumbler is 20ft. above water-level. This is to admit of a revolving perforated cylinder being fixed to separate the stones and coarse gravel from the fine sand. The dredges have each two sluice-boxes about 3ft. in width, one on each side of the dredge; but the washing appliances in both these will be found to be defective, as a large percentage of the fine gold will not be saved. They require a much larger surface to distribute the fine sand after separation from the stones and coarse gravel. The revolving perforated cylinder is, however, a great improvement on the plan adopted by the Sew Hoy Company to get clear of the stones. Both of these are centre-bucket dredges, and the ladder is of sufficient length to admit of working to a depth of from 24ft. to 26ft. below water-level; but on examining these dredges, and taking into consideration the top weight and the height that the appliances are fixed above the deck, it would seem that they will require pontoons constructed on each side to give them stability when working, and provide a greater width to construct tables for washing.

Dredging Generally.—The whole of the bed of the Shotover River and a great portion of the Kawarau River and banks are taken up in dredging claims, and there are also some dredging claims taken up in the Dart, Nevis, Waiau, and other rivers and streams in Otago; and there is but little doubt that a great number of claims will pay for working by this method. At the same time, in some of the gorges in these rivers that are taken up in claims it will be difficult to keep dredges moored in time of floods, and unless some special provisions are made to have moorings made fast to the sides of the gorges, either by strong eye-bolts let into the rock or by other means, to stand the force of the current and keep the dredges clear of the sides and off the projecting rocks, a number of them will be washed away or destroyed.

It is a question at the present time as to the best description of dredge to use. There are portions of the river-beds in which there are large rocks and boulders and a great many stones. In stony wash-drift the bucket-dredge is more suitable than the Welman or suction dredge. At the same time the latter dredge is the best for lifting the gold off a rocky bottom. The bucket-dredge will lift larger stones than the Welman, the size being only curtailed by the capacity of the buckets; but where the gold lies on a hard rough rocky bottom very little of it can be lifted. That being the case, it would seem that a combination dredge would be found in many instances to be the best—that is, to use the buckets for lifting all the coarser material, and when the bottom is reached, or where there is fine gravel and sand, the suction-pipe to be used. There is no doubt it would lift more gold off a rough rocky bottom than the buckets could possibly do, and it will be found in many instances that the most of the gold, or, at least, the richest portion of the wash-drift, lies directly on the bed-rock. Taking, therefore, into consideration the rough stony character of the wash-drift in some of the river-beds, and that the gold will be found in largest deposits near the bed-rock, it will be seen that neither class of dredge at present constructed will work the ground satisfactorily. The Welman dredge is not suitable for lifting large stones, and the bucket-dredge has an equal defect in not being able to lift the gold off the bed-rock where it is of a hard nature; but, if dredges were constructed so that one or the other principle could be adopted more gold could be obtained than by either of the present systems.

The beds of the Shotover, Kawarau, and Clutha Rivers have been found to contain by far the richest deposits of auriferous wash-drift there is in the colony, and the reason of this is that these rivers flow through a highly auriferous and mountainous country. Slips from the sides of the mountains are continually taking place, and these are washed away by the water being confined within narrow gorges; all the lighter particles and materials of less density are carried away on the bosoms of the streams, and swept out to the ocean, while the metallic substances and materials of greater density are deposited in the beds of these rivers and in the beaches. These rivers therefore form, as it were, gigantic ground-sluices, while their rough rocky bottoms act as ripples, which contain heavy deposits of gold, and properly-constructed dredging appliances will be the means of many of the buried treasures in these river-beds being collected.

ANTIMONY-MINING.

Antimony-ore has been found in lodes and bunches in many parts of the colony—namely, at Waipori, Carrick Range, Hindon, Barewood, and other places in Otago; Collingwood; Reefton; and at Endeavour Inlet, Queen Charlotte Sound; also, it is found in small deposits in the Thames and Coromandel districts, and in the Puhipuhi Mining District. There is a good deal of antimony-

ore in the vicinity of the Kaimanakau Creek; but there have been no workings of any extent, with the exception of those at the Endeavour Inlet.

Endeavour Inlet Antimony Company.—Stibnite lodes have been worked at the Endeavour Inlet for many years. A small company, principally formed of Wellington gentlemen, worked a lode here for several years, and spent some £25,000 on the mine and plant. They erected small dressing-works and smelting-furnaces, and turned out very good star antimony; but the price of this metal got so low that it was not remunerative for working with the appliances they had. They therefore sold the property to an English company, who have been carrying on operations for about three years, and have done a large amount of work in the mine.

The range where the stibnite was first discovered is 1,660ft. above sea-level. A tunnel was driven through the range at 175ft. below the crown, and a good lode, well defined, was met with. This tunnel is 900ft. long, and the ore from this level has been all stoped out, and a winze was sunk from the bottom of the tunnel to a depth of 80ft., which carried good ore for the whole of the distance. Another adit-level has been constructed for 1,400ft, about 95ft. below the tunnel; but they had not succeeded, at the time of my visit, in finding the lode that was worked in the upper level. At the time that this was being constructed they found large blocks of antimony-ore in a slip, and brought on water to the ground from a small creek, and sluiced away portion of the slip; and this led to the discovery of another lode about 694ft. above sea-level.

An adit-level—what is known as No. 3—was constructed at 1,170ft. above sea-level, and in this level a lode of stibnite was found. The adit is 1,200ft. in length, and the lode has been stoped out for 800ft., and to an average height of 150ft.; but this seems to be a different lode from that found on the upper level, and it cannot be picked up in No. 2 level; there is merely a trace of where the lode should be. It is well known that all stibnite lodes are very bunchy, cutting out here and there and making again; and very likely this lode will yet be found in No. 2 by putting up an uprise on the vein, which shows the trace of a lode. The lode found and worked out on No. 3 level averaged about 14in. in width, but this level is now abandoned.

No. 4 level is constructed for a distance of 1,400ft., and the lode stoped out for 550ft. to a height of 90ft. Another level is constructed for 180ft. about 160ft. below No. 4, but the lode here is broken and greatly mixed with mullock, and in other places it seems to pinch out. The principal workings are on No. 6 level. Here they have constructed an adit for 230ft., partially through a slip and partially in the country rock, and have driven for 430ft. on the main lode, which varies in thickness from 6in. to 5ft. and lies very flat, having a vertical dip of about 1ft. in 2ft. horizontal. This lode runs in a northerly and southerly direction and dips to the eastward. Only one stope has been taken out on the main lode at this level. About 75ft. further to the eastward there is a leader of mullock, and bunches here and there of high-class ore; also, about 50ft. further eastward than this leader, there is another of similar character. This leader has been stoped out for 75ft. in length, and to an average height of 20ft. The ore from these leaders is sorted, and any quartz broken off, and the ore is then shipped to England without further dressing. The last returns showed that the ore sent Home in this manner contained 47 per cent. of antimony. About five tons was similarly sorted from the main lode and forwarded to England, but the returns showed that it only contained 23 per cent. of metal. Therefore, all the ore, with the exception of that from the leaders, is dressed with the machinery at the works. There is another level, 200ft. below No. 6, constructed in rock for 400ft., and which will have to go another 200ft. before they expect to strike the lode. In reference to the leader furthest to the eastward from the main lode, a hard belt of sandstone comes in on the north end, which cuts it entirely out. The No. 6 adit-level being started in a slip, the recent wet weather has caused a slip to occur, and canted the timber for some distance in from the mouth, and rendered it unsafe. They have commenced to construct another adit to cut off the broken ground, but it will make the level such a serpentine course that it would be far more advantageous to carry it into the hill for a distance of about 250ft. until it cuts the lode. The strata through which the adits are constructed contain a good deal of lime, and swell considerably by exposure to air, which makes the ground very heavy on the timber. The No. 6 adit is, in addition to this, badly timbered; the sets are too far apart, and the timber is not strong enough.

The company has done a great deal of work, and have spent a considerable amount on prospecting. The manager was absent at the time of my visit, but the acting-manager informed me they sent about 30 tons of dressed ore Home monthly, varying from 47 per cent. to 63 per cent. of antimony. Taking all the adit-levels that have been constructed in the mine, they are equal to a distance of about a mile and a quarter, while the amount of stoping that has been done would equal about 2,200ft. along the lode by 96ft. high. The ore is taken from the different levels on a level tramway along the sidling of the range to an inclined tramway which runs straight down the range, and is emptied into a paddock at the bottom, when it is again put into trucks and taken by a horse-tramway to the dressing-works.

Dressing-works.—The dressing-plant consists of one of Blake's rock-breakers, one of Marsden's ore-crushers, one Leucop's centrifugal patent pulverisers, one three-plunger jig, one four-plunger jig, and four jigs constructed by the manager, Mr. Warne. When the ore is dumped on the floor of the dressing-shed it is first put into the rock-breaker, which reduces it to a maximum size of about $\frac{1}{2}$in. in diameter; and from this it goes into the three-plunger jig, which has a perforated-plate sieve with about 4in. of ragging. After leaving this jig the ore is dried over a circular oven, and afterwards put through the Blake-Marsden crusher, which reduces it to a maximum size of about $\frac{1}{16}$in. in diameter. The ore on leaving the crusher falls into a bin, is lifted with elevators, and passes through a circular revolving screen, which has likewise a jolting motion. The ore that does not pass through the screen goes back to the ore-crusher, and the fine material is carried by a small stream of water into another revolving screen with a finer mesh than the first one. The coarse particles that do not pass through the second screen go into one of the Warren jigs and are put through twice, while the fine stuff passes into another Warren jig and goes through once. The

light material is carried away over the top of the ragging and run to waste, while the particles of the greater density go through the ragging into the box below, which is emptied at intervals into a tank, and from there shovelled back on to the floor to go through the finishing four-plunger jig; and is then fit for bagging to send to England. The finest of the ore by this means contains about 63 per cent. of antimony.

Since my former visit a new dam and head-race has been constructed, which gives a head of water at the works equal to 140ft. The water is taken down from the head-race in a wrought-iron pipe 14in. in diameter to the Pelton hurdy-gurdy wheel which drives the whole of the machinery. Since they have erected the Marsden crusher they have discontinued the use of the Leucop centrifugal patent pulveriser, which was very costly to maintain, the wear-and-tear being very great. It may also be of some interest to mention that the Marsden crusher has a capacity of 6 tons in eight hours, and requires about six-horse power to work it, whereas, according to the catalogue, it is represented to crush 10cwt. per hour fine enough to pass through a screen with 2,500 holes to the square inch, and only requires four-horse power to work it. According to this, some one might be disposed to get a machine of this description to crush quartz, but it would not be likely to prove economical for this work.

This company are stacking their tailings, which will all pay to crush up and treat again with a proper plant, whereby the slimes can be saved. At the present time a great deal of valuable slimes are carried away with the water, and pass down the creek beyond recovery. A plant similar to that erected at the Mount Bischoff Mine in Tasmania is required to dress the ore. The present plant is very incomplete, and the company is losing a large amount of valuable ore, which can be saved with very little more expense in working than they have at the present time. The dressed ore is said to be worth from £25 to £28 per ton in England; and, with a good dressing-plant, this mine should be made to pay good dividends to the shareholders.

The smelting-works which were erected and in operation at the time of my last visit are pulled down and smelting abandoned, but another description of a furnace has been built, with the intention of making crude antimony. This furnace must have cost a large sum to build, and proved an utter failure when it was tried. Neither the cast-iron nor the fireclay retorts would stand the action of the antimony when in a molten state. There were thirty-five men employed at the mine and works at the time of my visit, but the acting-manager informed me that they have had double this number employed.

Since writing the above one of the directors of the company informed me that they have struck the lode in the lower level, and that it is about 8ft. in thickness, carrying about 30 per cent. antimony. The leaders that they are working on the No. 6 level are likely to be found on the lower level in a more solid mass, and also more uniform in thickness.

Stewart Island.

Tinfields.

The great excitement about the discovery of tin in Stewart Island has subsided, and some are beginning to realise the stern reality that all is not gold which glitters. When tin was first discovered here claims were taken up in every direction, and some of those were applied for by persons who had never seen the ground, but were quite satisfied to mark them off from a plan showing the position of the claims which had previously been applied for, and the result is that a large extent of country is pegged out and surveyed as mineral leases. Similar steps are taken to secure ground on all new rushes; so that the rush for ground in the Pegasus district has been no exception to the general rule.

The base, as it were, for commencing to mark off claims is the Remarkable Mountains, which are from 1,300ft. to 1,500ft. above sea-level. Running along the ridge of those mountains a dyke of rock can be traced for a long distance— indeed, in some places the rock stands up above the surface in two walls, the material that was formerly in between those walls having been partially eroded away. Along the ridge of the Remarkables there is a small lode to be seen here and there containing wolfrom, tungsten of iron, and cassiterite—oxide of tin—mixed amongst quartz. This lode is from 9in. to 15in. in thickness, having in places a band of gneissic schist rock on each side of the quartz, which in its turn is enclosed between walls of hard gneiss and syenite rock. As far as could be seen from the small amount of work done on the surface of the ground, the lode has the appearance of being in blocks here and there more than that of a continuous lode; the walls in no place are clearly defined, but the lode-stuff merges into the surrounding rock. There are small quantities of tin in the stone, but in no place is the lode of sufficient size and richness to pay for working—that is, as far as yet ascertained.

The tin found in the alluvial wash-drift is widely distributed: a few grains of oxide of tin may be found anywhere, wherever there is wash-drift, but in most instances the granite or syenite rocks come up to the surface, or, at least, have no covering of wash-drift about them. The ground is covered with from 6in. to 2ft. of mossy peat, and underneath the peat there is sometimes a little wash-drift on top of the rock, but in general the peat comes to within a few inches of the bed-rock; so that there is little chance of any large deposit of tin being found in the alluvial drifts in this district. There are some places near the gullies where there is 14ft. of alluvial wash, but where this occurs there does not appear to be sufficient tin distributed through the ground to pay for its extraction.

There had been up to the time of my visit 144 claims surveyed. The average acreage of each claim—with the exception of the prospectors' claims, sections Nos. 6 to 14, which are all of a smaller area—would be about 50 acres, or, to take the total area held in mining claims, is, in round figures, about 7,000 acres; and the number of men at work on the ground at the time of my

visit was about twenty. Mr. McPherson, of Invercargill, accompanied me over the field, as well as Mr. Rusha, and took me to all the various workings.

After inspecting the line laid off by Mr. G. G. Simpson for a track, we visited Professor Black's claim on Healey's Creek, about two miles and a half from Pegasus Harbour, in which there were five men at work sluicing for tin, and lower down the creek there were two men opening out a new face. There was about 2ft. 6in. of wash-drift at the place where sluicing operations were carried on, but there appeared to be deeper ground further ahead. The manager, Mr. Neaven, informed me the depth of wash-drift in places was from 7ft. to 8ft. It is only a narrow strip in the bed of the gully; the granite rock rises up to near the surface on each side of the creek. There is from 15in. to 2ft. of mossy peat soil on top of the wash-drift, the wash-drift itself being full of syenite boulders, which have to be stacked behind on the worked-out ground, many of them requiring to be broken up before they can be handled. A dam has been constructed in the bed of Healey's Creek, and at the time of my visit there was about one sluice-head of water used to work the ground. The manager informed me he had about 80ft. of head on his nozzle, but judging from the force of water out of the nozzle there could not have been more than 20ft. of pressure—indeed, the force of water was totally inadequate to work the ground to any advantage; neither was there a sufficient supply available.

The manager showed me several prospects by washing in a tin dish, but none of these were of a payable character. One dishful was taken from the sluice, but when washed out it did not contain more than ½oz. of tin-ore; and other dishfuls taken from the face gave only a few specks of tin. Professor Black deserves credit for the plucky manner he has gone to work in employing labour to prospect the field, but if the prospects in the ground are not better than in the place where they tried at the time of my visit there is not the slightest chance of the money expended in labour ever being recouped from the sale of tin-ore extracted from the ground. Taking the depth of wash-drift at not less than 2ft. 6in., with the large number of boulders through it, and the limited supply of water available, nothing less than 1oz. of tin-ore to the tin-dishful of stuff would pay for working. This only means 4lb. of tin-ore per cubic yard of material, representing a value of about 1s. 8d.

Tucker's Claim.—After leaving Professor Black's claim, we passed a place where there had been some work done, but apparently deserted—indeed, there did not seem to be any wash-drift—and then came on to Tucker's claim, where my companions informed me we would see good prospects and a great depth of wash-drift, but here we were doomed to disappointment as far as the good prospects were concerned. There appears to be a gutter of wash-drift alongside a small creek, which is about 10ft. in thickness, consisting of cemented gravel, which is too hard to be brought down and broke up by the force of water from a nozzle at the pressure or head of water available. The material would require to be loosened with picks and broken up before the tin-ore in the wash-drift would be liberated. Several tin-dishfuls of stuff were tried from this face, taking the material from different places, but in no case was a payable prospect of tin obtained. There does not appear to be a large extent of deep wash-drift in this claim; but it is difficult to tell this here, as the whole of the ground is covered for a certain depth with mossy peat and dense bush. The only indications of the depth of the wash are seen in the small creeks, where some prospecting has been done. In general, there appears to be only narrow runs of wash-drift here and there; the mossy peat, as a general rule, goes down to the granite, or, at least, within a few inches of it. There is a little gold amongst the wash-drift in Tucker's claim, and probably there will be pockets here and there where good prospects of gold and tin can be obtained, which might pay individual miners to work the ground, but there is not a sufficient extent of wash-drift or water available to work the ground to ever pay a large company to carry on tin-mining operations. The field is only suitable for working miners, who may manage to make small wages by following up the narrow runs or leads.

Smith and Hunter's Claim.—This is known as the High-level Tin-mining Company. They have constructed a small dam, and opened out a paddock at the side of McFadyin's Creek, in which three men were at work. It was known that we were to visit this claim in the afternoon, and everything was in readiness to show the claim to the best advantage. A tin-dishful of tin-ore mixed with a little gold was standing as an exhibit of the richness of the ground. This dishful had no doubt been obtained from the head of the tail-race after streaming down. The depth of wash, as far as ascertained in this claim, varied from 3in. to 6ft., the latter depth only occurring in one shaft. The prospects by tin dish are considerably better than in any other claim on the field; and it is possible that there may be runs of wash-drift here which will contain sufficient gold along with the tin-ore to pay for working. The ground is covered with heavy timber, and a considerable depth of mossy peat, with only a very thin layer of wash-drift in many places; and, moreover, there is not a large supply of water available, so that extensive sluicing operations could not be carried on. This requires the ground to be exceedingly rich to pay companies for working it.

Smith and Black's Tunnel.—This claim is situated on southern end of the Remarkables, about 1,300ft. above sea-level, and three miles from Port Pegasus. The lode crops out on the summit of the range, taking a horse-shoe bend in this claim. The lode is not clearly defined, but merges in and out of the surrounding rock. It is about from 8in. to 1ft. in breadth, and contains wolfram and oxide of tin, the latter being only finely distributed. An adit has been constructed for 280ft. at about 55ft. below the cap of the lode, but this adit is constructed so as to run almost with the direction of the lode instead of cutting it at right angles, owing to the bend in the lode, which was not observed by those laying out the direction of the adit, although it can be clearly traced on the surface. The lode is not payable for working on the surface, and the means taken to prospect it in this claim are not commendable. Whatever money has been expended may be considered thrown away.

Henderson's Claim.—This is a claim on the lode that follows along the ridge of the Remarkables. An adit has been constructed at about 190ft. under the level of the cap for a distance of 250ft., but no lode of a payable character has been struck. There is a considerable stream of water

in this adit-level, and at the end, where the workings stopped, a stream of falling water can be heard a short distance further ahead. This indicates that the end of the adit is either near some lode or cross-course, and the adit should be constructed a few feet further ahead to test this.

Nelson's Claim.—This claim is on the lode cropping out on the summit of the Remarkables, on the northern end of Henderson's claim. There has been no work done with the exception of sinking a few feet on the cap, where the lode is about 9in. in thickness. There is nothing to be seen on the outcrops of the lode on the Remarkables that would lead one to infer that a good payable tin-lode will be found. At the same time, there is a much better chance of success attending a large company in prospecting for a lode than by expending money to work the alluvial ground, inasmuch that the bed-rock is too near the surface, and destitute of any covering of wash-drift in most of the places.

Waddel's Claim.—This claim is on the eastern side of the Remarkables, about 600ft. above sea-level. There has been a considerable amount of work done, and faces opened out which show in places 6ft. of wash-drift, but the prospects obtained by washing with the tin dish were not encouraging; none of the dishes washed in my presence contained sufficient tin to pay for working. There is a head-race constructed from Henderson and Waddel's Creeks, but the supply of water is very limited. There would have to be plenty of wash-drift, and also tolerably rich, before it would pay any company to carry on tin-mining operations.

Gilroy's Claim.—This was stated by my companions—Messrs. McPherson and Rusha—to be the richest claim on the field, and where from 3oz. to 10oz. of tin, along with a good prospect of gold, could be washed out in a tin-dishful of stuff. There was only a few inches of wash-drift on top of the bed-rock; but, although about twenty dishfuls were washed from different places, there was no prospect obtained from any dish that would weigh more than 4dwt. of tin, or give more than a colour of gold.

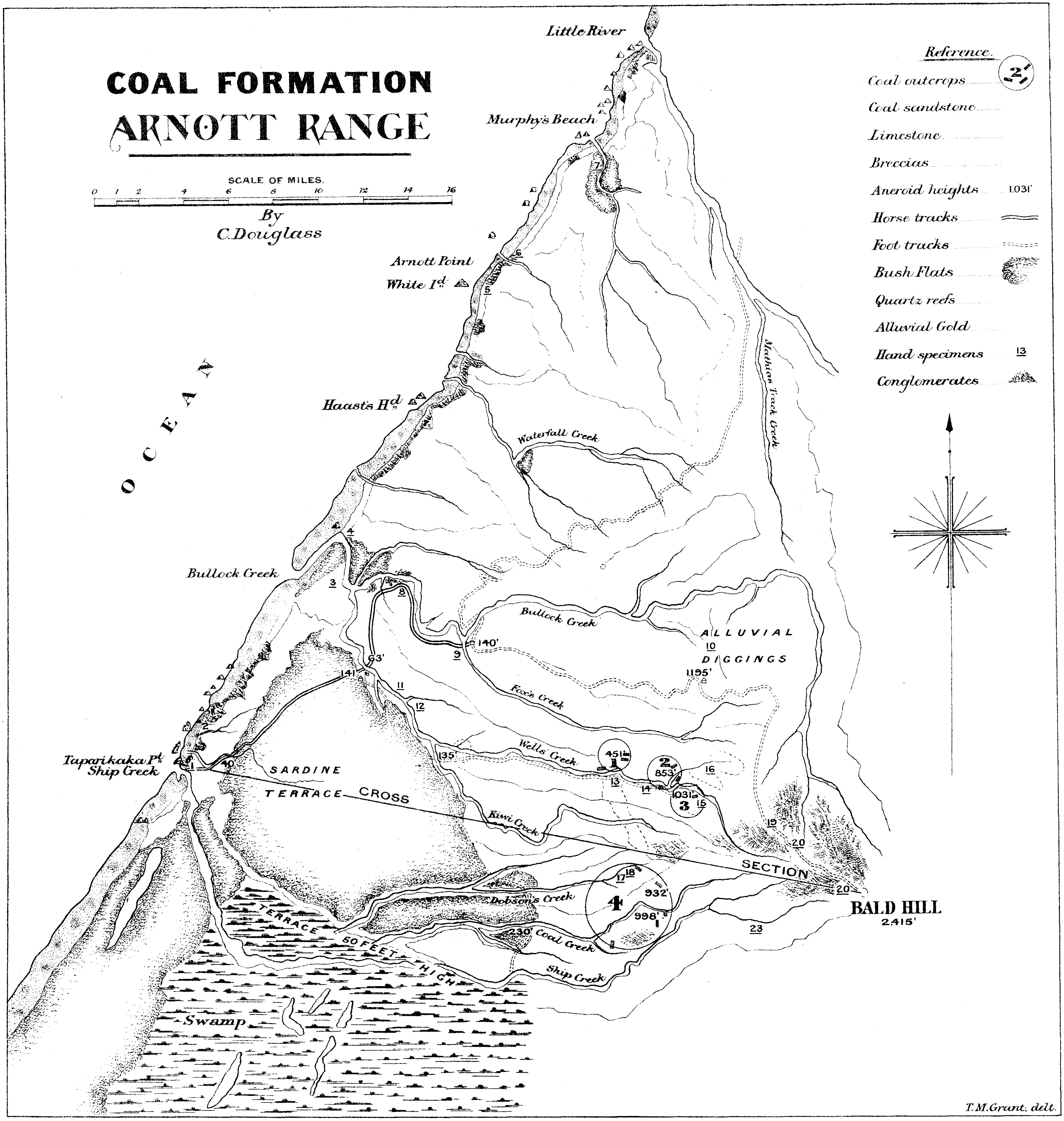
Prospectors' Claim.—This is the only claim on field where any working has been done that was not prospected with the tin dish in my presence. The proprietors of this claim are constructing a head-race either from McFadyin's or McArthur's Creeks, where a good supply of water can be obtained; and where the race terminates there will be a head of about 30ft. The proprietors do not, however, avail themselves of this head; in the meantime, they propose leading the water over the face and ground-sluicing the stuff. There is very little wash-drift in many places, and, except the ground is exceptionally rich, it can never pay any but working-miners to have anything to do with it.

To summarise the prospects of this field, the discovery of tin in the alluvial drifts wherever there is any wash, as well as a little gold, will be the means of affording employment to a few individual miners; but, as far as large deposits of tin being found in the alluvial drifts is concerned, the general character of the country does not hold out great inducement for these being discovered. A little tin is found almost anywhere, but it is widely distributed, and, in general, in narrow runs. Taking the available water on the field, even where there is a good depth of wash-drift, it would never give employment to a large population. Over a large area the bare granite rocks are exposed on the surface, and where they are covered with mossy peat the country is covered with timber and dense vegetation. After getting up to an elevation of some 700ft. above sea-level there are large areas covered with rata and akeake scrub, twisted about in every direction, so as to become almost impenetrable. Indeed, it is surprising the amount of ground that has been marked off in claims, seeing the difficulties of getting through the bush, where at first there were no tracks, and where everything has to be carried on men's backs, wading in many places knee-deep in mud. On the top of the Remarkables there is no timber or scrub, and walking about is comparatively easy, and one can get a good view of the southern portion of the Island. At the time of my visit to the field there were, in all, about twenty men at work.

EXPLORATIONS, SOUTH WESTLAND.

Ever since gold was first discovered on the West Coast it has been anticipated by many that rich deposits of gold may be found in the southern portion of Westland, and now and again prospecting parties set out with equipments to pass the summer months amongst the mountains, in the hopes of finding either auriferous lodes or deposits of auriferous wash-drift. A little gold has been found in places, but no large deposits have been found inland south of Okarito, although some of the ocean-beaches south of this have contained the richest deposits of gold on any of the ocean-beaches on the West Coast, especially the Five-mile Beach. The gold on this beach apparently, at one time, came down the Waiho River; gold has also been traced up that river, but never any large deposits found. The country south of this is high and very broken, having immense gorges, deep ravines, large rivers which in many instances are not fordable, and precipitous mountains, making the work of carrying on prospecting one of the most laborious in the colony, and, moreover, requires men with strong constitutions to stand the hardships they have to endure. The greatest explorer of the southern portion of Westland is Mr. Charles Douglass, who has been prospecting all through the Southern Alps during the last twenty years, and has not so far been able to find anything that would give immediate returns. During his recent exploration in the Mount Cook district and Arnott's Range he made a sketch-map of the district showing where he found quartz reefs which he thinks are worthy of being prospected, but at the high elevation they are at they would require to be extremely rich to pay for working. He has sent in copies of his sketch-maps (hereto annexed) which are very interesting, and Mr. Douglass, being an observant man, has noted as he went along the change of country he passed through.

Mr. Douglass states that there are several belts of country which contain quartz reefs, and these all run almost parallel to each other, in a north-east and south-west direction. One of these belts extends from the Okarito Lagoons, crossing the Totara and Waiho Rivers to the Copland Range.


COAL FORMATION
ARNOTT RANGE
SCALE OF MILES.
0 1 2 4 6 8 10 12 14 16
By
C. Douglass
Reference.
Coal outcrops
Coal sandstone
Limestone
Breccias
Aneroid heights 1.031'
Horse tracks
Foot tracks
Bush Flats
Quartz reefs
Alluvial Gold
Hand specimens 13
Conglomerates
Little River
Murphy's Beach
Arnott Point
White Id.
Haast's Hd.
OCEAN
Bullock Creek
Waterfall Creek
Mathias Track Creek
Bullock Creek
ALLUVIAL DIGGINGS
140'
63'
141'
1195'
Fox's Creek
Wells Creek
451'
853'
1031'
135
Taparikaka Pt.
Ship Creek
SARDINE TERRACE CROSS SECTION
Kiwi Creek
Dobson's Creek
932'
998'
230' Coal Creek
Ship Creek
TERRACE 50 FEET HIGH
BALD HILL
2.415'
Swamp
T. M. Grant. delt.

Photolithographed at the General Survey Office, Wellington N.Z. July 1890.

GEOLOGICAL MAP OF
COOKS RIVER DISTRICT

SCALE.
2' 1½ 1 ½ 0 2' 4 6 MILES

REFERENCE.

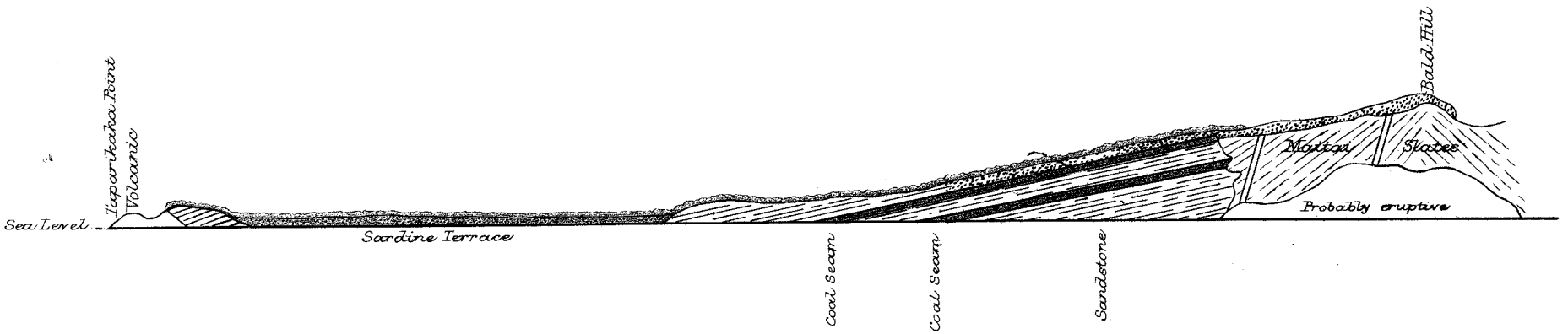
- Torlesse Slates
- Gneiss
- Schist
- Morainic Drift
- Coal Sandstones
- Hot Springs
- Saddles
- Bush Flats
- Grass ,,
- Horse Tracks
- Bells of Chlorite Schists
- Quartz Reefs
- Cultivation
- Civilization
- Alluvial Gold
- Estimated Heights ..... 500'

R. Waikupakupa
Moonlight Beach
Stony Creek
Long Beach
Galway Beach
Gillespies Point
Gillespies Beach
Cape Bluff
Malcolm's Knob
Isaacs' Beach
OLD MAN ROCK
Hunt's Beach
Cook's River
Stillwater River
Karangarua R.
Fox River
Hot Spring
CROSS SECTION
NEVE
4000'
400'
250'
FOX GLACIER
Mt. Hardinger
Mt. Tasman
Green's Peak or Mt. Hector
MT. COOK
Craig's Pk. 5500'
BALFOUR GLACIER
9000'
Balfour River
2000'
LA PEROUSE GLACIER
La Perouse
Probable Pass
Hot Springs
Castle Rock
Cooks River
Mt. Copeland
Mt. Sefton
Mt. Lyttle
Copeland River
3000'
3500'
1500'
HIGH CLIFFS
DOUGLAS GLACIER
Pointed Pk:
Mt. Isabel
Dwarf Pk:
McKERROW GLACIER
Hot Springs
Douglas River
4500'
4750'
4700'
5000'
5050'
3500'
600'
Karangarua R.
Landsborough R.

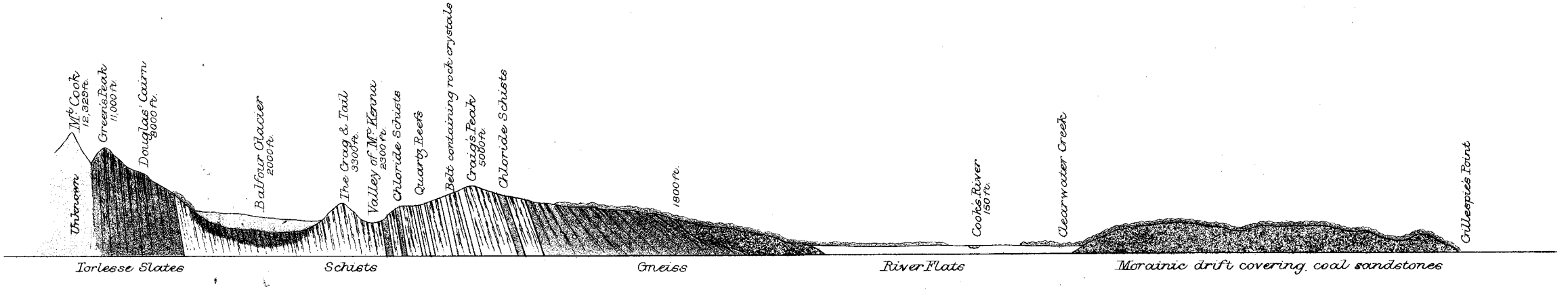
Photolithographed at the General Survey Office, Wellington N.Z. June 1890.

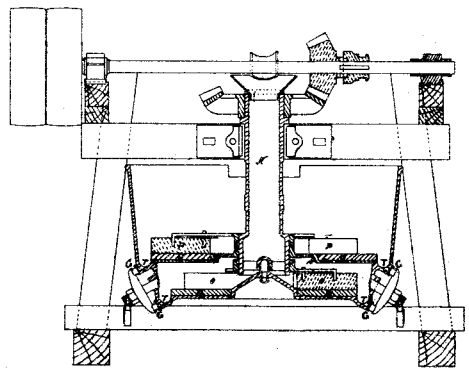
By C. Douglass

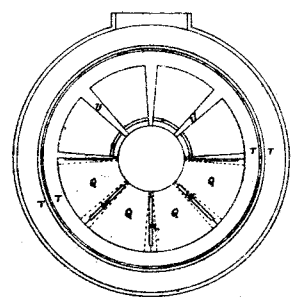
Cross Section
Taparikaka Point to Bald Hill.

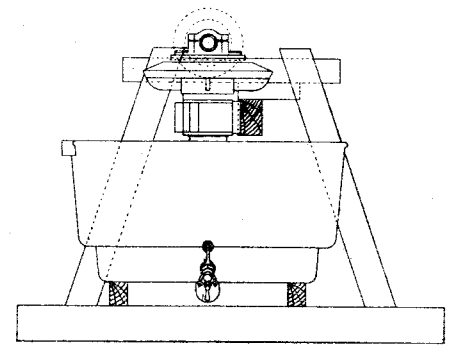


Cross Section
Gillespie's Point to Mt. Cook.









Mc QUEEN'S PATENT GRINDING AND AMALGAMATING MACHINE.

This belt he characterizes as the parent of the Waiho and Cook's River gold. To give his own words with reference to this belt: "I hung about the hills for months trying to get a chance to prospect it, but had to give it up. The season was an exceptionally bad one, and the snow never came off the spur between Balfour and Fox's Glaciers. Had I been able to find my way along the shoulder of Mount Tasman, where the Torlesse and mica-schists join, I am almost certain I should have found something good, as fine gold-quartz and quartz specimens are found in the *débris* on the Balfour Glacier. The reefs shown on the map and cross-sections are well defined, but I could see no gold, or even iron-pyrites, in them. The rock-crystals so plentiful up the Balfour Glacier are found high up Craig's Peak, in cracks and crevices of the rock. The crystals are generally very small, but I found one about 2ft. long and 6in. in diameter. With the exception of one lode of iron tolerably rich, I found no trace whatever of any metal either in the creeks or spurs.

"The second belt commences at the Waikohai Bluff, and extends in a south-west direction, crossing the Paringa watershed. I found one small leader of golden quartz; four galena reefs; dykes containing antimony, with an appreciable show of gold; some large reefs containing arsenical pyrites, but no gold; some large lodes of iron; and a coal-seam 5ft. in thickness, in prospecting the Paringa River and tributaries. The gold found was only in a small leader, and I could not trace it to anything; in fact, the leader is far away from the reefs, up the river, and appears to have no connection with them. The galena, about which so much was talked years ago, is, as far as I know, a delusion. Rumours were circulated that the galena lodes were 3ft., 6ft., and even 12ft. thick. . . . I know dozens of the so-called reefs—a thick belt of feldspathic quartz, with galena forming, as it were, a soft casing a few inches thick, but no trace of any other metal in the quartz.

"The third belt commences at Bruce Bay, extending parallel with the former. This belt contains the usual galena reefs, a magnetite lode on Mariner's Peak, and fine quartz reefs cropping out close to the granite in the Black River. I also found a small specimen of native silver in the Blue River, but could never find it *in situ*.

"The fourth belt commences at the ocean, a little southward of the mouth of the Paringa River. This belt contains the copper-ore found on Thomas Range, and various outcrops of quartz reefs on the spurs between Paringa and Blue Rivers. I followed this belt south, but as it enters the gneiss on the island side of the Thomas Range it is barren. The schists commence up the Okura, and the line ought to cross Mount Victor, but that mountain and the surrounding country is so cut up with gorges and towering precipices that I could not explore it.

"The fifth belt commences a little to the northward of Arnott Point, and I believe to be the same as the Shotover Belt. Where the Shotover rocks cross the divide they are separated from the Arawata schist, which is the same formation, by the chlorate schist of Mount Aspiring, and of Castor and Pollux."

There is a great deal to be learned yet about the southern portion of Westland. Very few have ever been through this part of the colony; and there is no one who has a greater knowledge of it than Mr. Douglass. His information respecting it will therefore be of considerable interest to those who are still looking forward to the discovery of mineral lodes and deposits of auriferous drifts being found in this part of the colony.

McQUEEN'S PATENT PULVERISING AND AMALGAMATING MACHINE.

A very ingenious machine has been patented by Mr. McQueen, of Kincaid and McQueen, iron-founders, Dunedin. My attention was directed to this machine at the recent Mining Conference held at Dunedin, a sketch-plan of which is annexed hereto.

The machine is a circular cast-iron pan about 4ft. in diameter, with drags for grinding somewhat similar to those used in the Wheeler pan, only this pan has a false bottom or storey, whereby a double grinding-bottom and two sets of drags are used. Mr. McQueen states that it requires two of these machines to each battery of five heads of stamps. The pulverised material, on coming from the stamp-mortar, flows over copper-plated tables coated with quicksilver, and thence passes into the hollow vertical shaft of this machine, and comes out into the bottom of the pan on a level with the bottom set of drags, O O, and after being pulverised by them it passes under the upper drags, P P, the material flowing upwards through the holes in the plate S. The false bottom, Q Q, is made of hard hæmatite white metal, and kept in position by the ledges R R. Quicksilver wells are shown round the circumference at T T, and the silver wells, U U, are placed radically in the bottom of the pan, the latter wells being overlapped by the false bottoms. The openings, V V, above such well are to allow the pulverised material to come freely in contact with the silver. The openings G G are for drawing off the quicksilver and amalgam. When the machine is working, or stopped at any other time than when cleaning up, the openings G G are effectually closed and locked.

One of the features about this machine is that the quicksilver is not submitted to a grinding action, but the material merely forced down on the surface of the silver. There is no doubt that this is a good grinding-machine, but it is questionable if it will save a larger percentage of gold than the Wheeler, or Watson and Denny pans, or even the combination pan. They are all constructed on a similar principle, the detail parts of each being somewhat different. It has been pointed out by chemists and metallurgists and many others that it is almost impossible to get a large percentage of gold from the ore out of the pulverised material in a stamp-mortar. Some of the gold gets hammered in the mortar, and when in such a condition it will not amalgamate with quicksilver; but if the material be again pulverised by any grinding process the hammered particles of gold get ground up, and then become amalgamable. Therefore this description of machine which Mr. McQueen has patented is a good machine for operating on the pulverised material after leaving the stamp-mortar It is stated that it requires two flasks of quicksilver when charging it for use.

STEAM-PUMP FOR HYDRAULIC PURPOSES.

Attention has been directed in several of the newspapers to a steam-engine and pump constructed by Messrs. Merryweather and Sons to be used for hydraulicking. The department communicated with the manufacturers, through the Agent-General, to get particulars as to the weight and cost of this steam-pump, &c., and the quantity of water it will throw. The following information has come to hand :—

The engine-boiler and pump is mounted on wheels, similar to a portable engine for working a thrashing-machine; the total weight is about 6 tons, but if a boiler was required for burning firewood it would have to be slightly larger than the one usually supplied, and in that case it would add a little more to the weight. The engine-cylinders and two pumps are all in one casting, which is bolted to the frame of the carriage. In applying the engine for hydraulicking a suction-hose is attached to one side of the pump, whilst there are two outlets at each side to which are connected delivery hose-pipes, 2¾in. in diameter. The four delivery hose-pipes may be used separately, with nozzles on each for projecting four streams of water on to a face of ground; or two lines of hose may be connected with a breeching-piece; or the four lines of hose may be attached to the monitor, and a jet of water through a nozzle 2½in. diameter may be projected to a distance of upwards of 200ft., with a water-pressure of 100lb. per square inch on the pump. The whole of the plant can be taken asunder if required for transit across a rough country; so that no piece is heavier than about 1 ton.

The manufacturers state that their steam-pump is capable of throwing 1,400 gallons of water per minute—which is equal to nearly 3¾ sluice-heads—to a height of 200ft.; but while stating this they recommend, instead of running one engine at a very high speed, to have two engines working at half-speed. The price of one engine to deliver 1,400 gallons of water per minute as described is £1,300, and if two engines had to be employed the cost would be £2,600. The admission on the part of the manufacturers that one engine is not suitable for the work, notwithstanding the pamphlets published by them to the contrary shows how careful one has to be in ordering any new machine which purports to do a certain amount of work, and after getting it is found to fall short of what it was represented to do. However, Messrs. Merryweather and Sons are candid enough to state that the maximum limit of the quantity of water delivered by this pump is 1,400 gallons of water per minute, but that they would not expect to run an engine at such a speed continuously. The fittings and articles delivered with each engine are as follows :—

50ft. of suction-hose : twenty 40ft. lengths of delivery-hose, with metal swivel couplings; four copper branch-pipes and twelve gun-metal nozzles; two collecting breechings for taking two lengths of hose into one nozzle; six 20ft. lengths of delivery-hose for connecting breeching with branch-pipes; one monitor fitted on wheels with swivelling jet and hand-lever; one set of spare fittings for boiler.

The second size pumping-engine cost £1,020, and the maximum quantity of water that this will deliver to a height of 200ft. is that which a 2in. jet will deliver, which would be about 2·3 sluice-heads, but more than half this quantity could be calculated on working continuously.

PROGRESS OF METALLURGICAL SCIENCE.

The subject of the treatment of ores is attracting attention in all the mining centres in the world, and none more so than in America, which is by far the largest gold- and silver-producing country, and where a large quantity of refractory ores are found. Indeed, it is to this part of the world we must look to for modern appliances to make low-grade ores pay for working. In the older countries, such as Germany, where there are extensive metallurgical works erected, the price of labour is much less than in the colonies, and lower-grade ore can be made to pay; but on the Pacific Slope the wages of the workmen, both in the mines and about these works, correspond with the price of labour in the Australian Colonies—if anything, it is a trifle higher—therefore any ore that can be made to pay for working there, the same grade of ore should be made to pay for working here. The American mining men are, as a rule, great inventors of labour-saving appliances, and it is only by this means that many of the lodes can be worked. A very interesting paper was recently read by Mr. Richard Pearce, who has been for many years connected with the Boston and Colorado works, at Denver, at a meeting of the American Institute of Mining Engineers, which contains a great deal of information on the subject of the treatment of auriferous and argentiferous ores, and may be useful to many of the millmen in this colony. The following is an extract :—

"Some few of the gentlemen present will remember the crude condition of metallurgical practice as it was conducted in Colorado only twenty-five years ago. My own personal experience covers a period of eighteen years, and during this comparatively short time I have seen the most astonishing changes in the conduct of metallurgical works. In all probability the marked progress which this country has exhibited could hardly be reached anywhere else, and this result has been achieved mainly by the activity and enterprise so characteristic of the men of the West.

"The first little successful attempt at smelting, made at Black Hawk, in 1867, by ex-Senator N. P. Hill, represented by the Boston and Colorado Smelting Company, proved a great boon to the miners, who were almost overpowered with the difficulties of ore-reduction. His works were erected at a time when mining was threatened with collapse, and they afforded a ready market for ores which failed to yield their gold by the old-fashioned stamp-mill process. The whole operation of smelting as conducted at that time was a very simple one, and in these days would be regarded as a process involving very little metallurgical skill, rewarded by what would appear to be very large profits. But when we consider the difficulties which even the most experienced metallurgist had to contend with—such as the scarcity and inferior quality of building and refractory materials, the high price of labour and fuel, and the heavy freight-charges which the product had to bear in its transportation to Swansea, Wales—we are not surprised that the rates for treatment which prevailed were so high.

"The system adopted by the Boston and Colorado Smelting Company at that time, and so successfully conducted by Professor Beeger, the father of smelting in the West, consisted in the concentration of the gold, silver, and copper into a rich matte by two operations—viz., roasting, and smelting in reverberatory furnaces. The degree of concentration was about 8 or 10 tons into 1. The further treatment of the matte for the extraction of the silver and gold was given in Swansea, Wales.

"These facts are not merely points of technical reminiscence; they could scarcely be overlooked by any historian of Colorado, for the stimulating effects of this little establishment at Black Hawk had a marked influence on the subsequent development and importance of this great State.

"It will be necessary in the course of this address to refer again in a general way to this process as it is now conducted at the works at Argo, which were established in 1878.

"For a period of ten years, from 1870 to 1880, other metallurgical systems were represented in Colorado, in the shape of amalgamation-works or mills of a different type from the gold-mills of Gilpin County. These were established in the silver districts of Georgetown and Caribou, and one or two other localities, and were, on the whole, fairly successful. At the present time, however, owing to the low cost of smelting, there is not a single silver-amalgamation mill in successful operation in this State.

"The treatment of gold- and silver-ores by smelting with lead was practised to some extent in the early days of mining in Colorado; but, owing to the scarcity of the latter metal, lead-smelting can hardly be said to have been successful. When visiting Georgetown in 1871 the Brown Mining and Smelting Company, one of the old pioneer mining companies of Clear Creek County, had been obliged to import from Chicago, in the form of pig-lead, and at a cost for freight alone of $130 per ton, the lead required for the reduction of silver-ores; and in the summer of 1874 the old Swansea Works, near Denver, used granulated lead for the reduction of silver-ores in reverberatory furnaces of very small capacity. Various attempts were made in different parts of the State to smelt ores by the lead system, but I think I am correct in saying that scarcely one of these establishments was conducted with any financial success.

"The year 1877 was marked by the great discoveries in Leadville; and in the following year lead-smelting began in earnest. At the outset everything was necessarily very crude, and the first attempts at smelting were conducted without much regard to scientific principles. The rich carbonate of lead, however, proved to be easy of reduction, and sufficient local skill was found to conduct the business with profit. As a result of keen competition, improved methods were soon adopted. Under the skilful guidance of such men as Grant, Eilers, Fohr, Uleyer, Haher, and others the business soon settled down to a practice based on sound principles; and to-day we have monuments of the skill and enterprise of these gentlemen in Denver, Pueblo, and Leadville which, I think, will compare favourably with any other lead-smelting establishments in the world.

"The superior skill which has been brought to bear on smelting is the result of a more intelligent comprehension of the scientific principles involved; and a great deal of valuable knowledge has been gained from the experience of a few years of practical work. Changes have been made in the form and size of the furnaces; the proper composition of the slag has been determined, and a great many devices and improvements have been adopted to keep pace with the vigorous competition which has existed in Colorado since the era when lead-smelting began. To this, mainly, we may ascribe the superior advantages which Colorado offers as a market for ores. These advantages are felt in a great many districts outside of the State, for a large proportion of the ore smelted comes into the Colorado market from other States and territories.

"The following table, prepared from data collected by a friend, will show the commercial advantages which the miner has experienced by the progressive development of the smelting industry. For the sake of comparison, ores have been selected which have no special value as fluxes or as aids to smelting, and I will consider them merely in relation to their intrinsic value, and endeavour to show the returns which the miner gets now as compared with the figures of eighteen years ago—in other words, the net percentage value of an ore to the miner to-day is compared with the value for successive periods from 1871. The value of the silver has been figured from $1·29 per ounce in 1871 down to 93 cents in 1889; and for the years prior to the resumption of specie-payment, the premium on gold is taken into consideration. The slight falling off in 1874 and 1875 was due to the depression following the financial panic in the fall of 1873. For a time silver-ores were rather a drug on the market, and prices consequently fell off.

Table showing the Percentage of the Total Value of Ores paid to Miners each Year during a Period of Eighteen Years.

	Black Hawk.			Argo.		
Year.	Contents in Silver per Ton.	Percentage paid to Miner.		Year.	Contents in Silver per Ton.	Percentage paid to Miner.
	Oz.				Oz.	
1871	100	65		1879	100	70
1872	100	65		1880	100	74
1873	100	65·5		1881	100	74
1874	100	53·6		1882	100	76
1875	100	60		1883	100	76·5
1876	100	67·2		1884	100	81
1877	100	64·3		1885	100	77
1878	100	65		1886	100	80
				1887	100	80
				1888	100	82
				1889	100	84

"The difference between the maximum and minimum is 30·4 per cent. Having avoided making any figures to show the changes in value of gold-ores from year to year, but without going into details. To make a Gilpin County gold-ore which would net the miner 53 per cent. of its value in 1870 would now yield him 80 per cent., a difference of 27 per cent.; and on a somewhat lower grade of ore the difference is 33 per cent.

"For what are commonly called tailings (or concentrated pyrites from the stamp-mills) the net percentage value to the mines in 1874 was 24 per cent.; at the present time it would amount to 76 per cent., a difference in favour of the miner of 52 per cent.

"A pyritous ore from the Robinson Mine in 1882, assaying 50oz. of silver per ton, would net the miner at Argo 55·4 per cent. of its value; at the present time the same ore would net 78 per cent. of its value. The increase in value of these particular ores is mainly due to their value as fluxes, containing, as they do, a large percentage of iron and very little silica.

"The difference in the value of Leadville ores, extending over a period of ten years, is even more marked than the changes here shown in regard to silver-ores in the older mining districts. The changes in Leadville have been largely effected by the demand for lead and certain basic material necessary for successful smelting. The different ores commanded varying prices, depending on their composition; and the fortunate mine-owner who possesses an ore which fits all the requirements of the smelter receives a premium, while his unlucky neighbour whose ores are of a different character suffers heavy discounts.

"In 1875 silver was worth about $1·40 per ounce in currency. Its present value is something over 92 cents., or 34·28 per cent. less than in 1875. Taking the output of the Colorado mines alone for 1888 in round numbers at 18,000,000oz., this reduction in price amounts to the sum of $8,600,000, which is considerably beyond the total value of the gold and silver product of the State before the development of the Leadville mines.

"It will be seen from these figures that if it were not for the great efforts which have been made from time to time to cheapen the cost of smelting, silver-mining here would have received its death-blow long ere this. The decline in silver has brought the net value of the ore to the miner down to almost the same as it was thirteen years ago, but the cost of mining has been largely reduced by improved facilities for transportation, by cheaper labour, and by cheaper materials, enabling him to sell at a profit ores that formerly were worthless. These same elements have, of course, helped the smelter to a still greater degree, and there is yet room for further improvement.

"The quantity of ore smelted by the smelting-works in Colorado for the year 1888 was: Total ore smelted, 596,594 tons (this includes 72,147 tons from other States and territories, leaving a total tonnage of ores produced in Colorado of 524,447, or 88 per cent.). In the year 1877 the total smelting capacity of Colorado probably did not exceed 20,000 tons, or about 15½ per cent. of the amount treated last year.

"The present capacity of lead blast-furnaces of modern construction is from 60 to 65 tons of material per day, exclusive of fuel. This represents, on an average, from 40 to 50 tons of ore per day. As you will all have opportunities of seeing the operation of smelting in blast-furnaces, and judging for yourselves of the magnitude and importance of this branch, attention need not be drawn, at this time, to the nature of the improvement referred to, however briefly, to make a comparison of the conditions in the two systems of smelting—namely, in a blast-furnace and in a reverberatory furnace. Although the latter is not adapted to the treatment of lead-ores, yet it would appear to have some merits when used for smelting ores containing copper in lieu of lead, as a base for collecting the precious metals. For convenience, I have tabulated the peculiar conditions of the two systems:—

——	Blast-furnace System.	Reverberatory System.
Atmosphere	Reducing	Oxidizing.
Fuel	Coke, charcoal	Coal, wood.
Degree of concentration ...	Low, 6 or 7 in 1	High, 20 in 1 before separation of silver.
Per cent. of base metal required to collect the precious metals...	15 per cent. of lead ...	3 per cent. of copper.
Lime as flux	Necessary	Unnecessary.
Calcining pyritiferous ores ...	Should be complete ...	Not necessarily complete.

"The old-fashioned reverberatory furnace in use ten years ago, with a capacity of 10 tons per day, and a ratio of fuel of ore of 1 to 1¼, would stand no chance whatever in competition with the present style of blast-furnace. But certain changes in the construction of the reverberatory within the last two years have increased the capacity to about 25 to 27 tons per day, with a ratio of fuel to ore of 1 to 3. This, perhaps, is the highest record reached by reverberatory smelting, except some work said to have been accomplished in Montana by introducing red-hot ore into the furnace direct from the roasting-cylinders.

"The system adopted by the Boston and Colorado Smelting Company has certain features, which are, perhaps, somewhat novel. Although copper is used in lieu of lead as a means of collecting the silver and gold contained in the ores, it can hardly be said to represent copper-smelting, for this metal plays only a small part as regards the value of the output. Although the general principles of the process would entitle it to be called the 'Swansea system,' the changes and improvements which have from time to time been introduced show some features distinctly American.

"The old works of the Boston and Colorado Smelting Company, at Black Hawk, which were so well described by Dr. Eggleston in 1875, have disappeared, and the method in use at Argo to-day has been so far changed as to be scarcely recognisable as the old Boston and Colorado process, except so far as the general principles involved. Nothing has been published relating to these works since Dr. Eggleston's papers appeared. The present capacity of the plant is 200 tons of ore per day. These include a great variety of copper-, silver-, and gold-ores from Colorado, as well as from other Western States and territories. About 12¾ per cent. of the ores treated come from districts outside of the States. These include Montana, Utah, Nevada, California, Arizona, New Mexico, and Old Mexico. In composition the ores differ very widely, made up as they are of an infinite variety of minerals. A few typical examples are silver-and-gold-bearing pyritous ores from different districts of Colorado; barytic silver-ores from Aspen; silicious silver-and-gold ores from Colorado; pyritous and arsenical concentrates from Colorado and Nevada; arsenical copper-ores from Utah; copper-mattes from Montana, and from the lead-smelting establishments of Colorado. The general average contents of the ore as smelted from day to day are: Silver 40oz. to 60oz. and gold ½oz. to 1oz. per ton, and 2 to 3 per cent. of copper. About 90 per cent. of the ore treated contains no copper, the other 10 per cent. furnishing the copper to make up the general average to about 2 to 3 per cent. Fifty per cent., or 100 tons, of the ore has to be roasted per day. This operation is conducted partly in furnaces and partly in kilns, and in neither is it carried on to a finish, as sulphur is always allowed to remain to the extent of from 5 to 7 per cent. The remaining 100 tons are smelted without any preliminary roasting.

"It is not necessary to describe the changes which occur in roasting. All this has been done by other members of the institute, and I refer particularly to the excellent little work on copper-smelting by A. M. Howe. However, notice very briefly a point connected with the elimination of arsenic in this stage of the process. Having found by experience that it is not an easy matter to get rid of arsenic from an ordinary arsenical copper-ore by roasting, and in order to test efficiency of coal added in the latter stage of roasting for the elimination of arsenic, as recommended in certain works on copper-smelting, the following experiments have been made:—Experiment No. 1, on an ore consisting of chalcopyrite, bornite, and enargite, and containing 3·26 per cent. of arsenic, gave, on roasting to a "dead-roast," a product which contained 2·5 per cent. of arsenic; loss, 23·31 per cent. Experiment No. 2: On the same ore. Sample roasted dead and, whilst still hot, mixed with 10 per cent. of fine coal. Roasting continued until coal was consumed. The roasted ore was found to contain 2·19 per cent. of arsenic; loss, 32·82 per cent. Experiment No. 3: The same ore mixed with 10 per cent. of fine coal, and the whole well roasted. Product contained 2·36 per cent of arsenic; loss, 27·60 per cent. Experiment No. 4: Sample of ore was well roasted and then mixed with 30 per cent. of coal. It was then submitted to a strong heat in a covered vessel to exclude air, and finally it was roasted with the admission of air until the coal was consumed. The roasted ore was found to contain 2·36 per cent. of arsenic; loss, 27·60 per cent. The mean of these results shows a difference in favour of coal of only 6·02 per cent.

"All the above experiments were made in a muffle of finely-pulverised ore, and the conditions were as perfect as it is possible to obtain. The sample, taken from the same ore, which had been roasted for twenty-four hours in a large calciner gave 1.59 per cent. of arsenic; loss, 51·22 per cent. This result is no more than might be expected, for, as has been clearly pointed out before, the conditions which are most perfect for oxidation are not the best in practice for the elimination of arsenic from copper-ores. The fact is explained fully by H. M. Howe and others. The result of my experiments, as given above, would indicate that the reducing action of coal or any other carbonaceous matter on arseniate of copper is not so active as is generally supposed. Indeed, it is a question whether there is any action of importance, or whether reduction can take place except at the melting point of arseniate of copper which is beyond the temperature necessary for roasting. It is, of course, possible that arseniate of copper is reduced to arsenide of copper at a roasting temperature in contact with coal without producing any sensible loss of arsenic.

"Returning to the description of the process at Argo. The roasted ore is mixed with others, principally siliceous, and the mixture is so arranged that when smelted it shall yield a slag containing as near as possible 40 per cent. of silica and a first matte (ore metal) which assays 40 per cent. of copper, 400oz. of silver, and 6oz. of gold per ton. The capacity of each furnace is about 25 tons of ore per day, the total burden being 27 tons, on account of rich slags which are added from other operations.

The degree of concentration in this smelting is about 13 to 1. The composition of the slags, so far as the bases are concerned, is subject to many changes. The silica ranges from about 38 to 42 per cent., and no lime or flux is used other than what may be obtained in the ores. The following are examples of typical slags:—

——	I.	II.	III.	IV.	V.	VI.	VII.
Silica	40·96	39·80	41·62	37·42	39·42	36·52	41·73
Protoxide of iron ...	28·30	29·40	28·26	33·80	31·41	30·68	33·08*
Aluminia	2·96	4·35	4·84	3·63	...	1·29	...
Oxide of manganese ...	7·16	5·53	5·03	3·72	4·53	4·46	3·96
Oxide of zinc	9·10	11·03	7·87	11·47	13·46	20·08	9·72
Lime	7·08	7·60	5·59	5·01	5·52	3·57	6·02
Magnesia	0·76	0·94	0·58	Trace	...	...	1·34
Copper	0·39	0·62	Trace	0·42	0·40	...	...
Lead	0·42	0·24	3·31	3·78	...	...	...

*Including aluminia.

"III and IV are slags from smelting ores containing lead. VI. Slag produced from ores containing much zinc. The ratio of the oxygen in the base to that in the silica is 1 to 1·5, and the slag would be classed as a sesqui-silicate. Since these slags all show distinct magnetic properties, we may assume that a portion of the iron exists in the form of magnetic oxide. The oxidizing conditions of the laboratory of the furnace will account for this peculiarity in the slags, as at the end of the operation the reducing action of the sulphur and sulphurous acid ceases, to a certain degree, to be active. The slags were all produced some five years ago, but they represent nearly the composition of the slags made at this time, except that the latter contain barium as an additional base since Aspen ores have come into market.

"The matte which is produced in this first operation of smelting consists mainly of copper, iron, and sulphur; but when, as is sometimes the case, lead is present in the ore, a portion of this metal replaces the iron in the matte. This frequently occurred in former years, before care was taken in the assortment of the ores. An example of this copper-lead matte is given in the following analysis:—

	First Matte (Ore Metal).	Probable Composition of First Matte.	
	Per Cent.		Per Cent.
Copper	32·03	Cu_2S	39·85
Lead...	26·60	PbS	30·47
Iron	9·50	Fe_2S_3	17·51
Zinc	4·29	ZnS	6·36
Silver	1·92	Ag_2S	2·18
Gold...	0·05	Au	0·05
Sulphur	21·70	.....	3·58
Insoluble residue and traces of other metals	3·58		
	99·67		100·000

"This is merely given to show to what extent lead may enter into the composition of the matte without seriously interfering with the subsequent treatment. It may be of interest to note the results of some assays from two samples of matte from one large tap, representing about 7 tons. When broken, the mass showed a section of about 12in., the upper part of which varied considerably from the lower. The upper portion was of a very close texture, and the lower crystalline and vesicular.

	Copper.	Lead.	Silver.	Gold.
	Per Cent.	Per Cent.	Per Ton.	Per Oz.
The upper portion contained	38·6	18·9	543	8·4
The lower portion contained	31	37·1	760	18

"The ratios between the quantities of lead, silver, and gold in the two portions are approximately as follows:—

	Lead.	Silver.	Gold.
Upper portion	1	1	1
Lower portion	2	1·4	2

"One great objection to the existence of lead in large quantities in such matte is that a compound of lead, copper, iron, and sulphur is formed, still richer in lead than the original matte, which, from its extreme fusibility, finds its way into the heart of the furnace. It is often found in lustrous crystalline plates, having somewhat the structure of spiegeleisen, and corresponding in composition very closely to the following formula: 5 (Cu_2S) + 4 (PbS) + Fe_2S_3.

"An analysis of this substance gave:—

	Per cent.
Copper	32·60
Lead	40·52
Iron	5·02
Silver	2·56
Sulphur	19·97
Total	100·40

"It may be stated here that this first matte always contains a certain amount of lead, but the quantity rarely exceeds 10 per cent. Passing on to the next stage in the process, which includes the roasting and concentration of the ore metal or first matte to 'white metal' containing 60 per cent. of copper. The charge in this operation of smelting consists of a mixture of two-thirds of roasted metal and one-third raw metal, together with rich siliceous silver-ore in quantities sufficient to prevent corrosion of the furnace by the iron present in the matte.

"The concentration-furnace in which this operation is performed stands some 3ft. above the level of the ore-furnace, in order that the rich slag from the former may, when skimmed, flow directly into the ore-furnace, where it is cleaned and reduced to the condition of ordinary ore-furnace slag. This effects a very great saving in the re-smelting of these rich slags. The white metal from this concentration-smelting contains, on an average, from 700oz. to 800oz. of silver and 10oz. of gold per ton, and 60 per cent. of copper. Each ton of this matte represents from 20 to 21 tons of ore. This white metal is now ready for the extraction of the silver, which comprises the following operations: Rough roasting, fine grinding, fine roasting for sulphate of silver, leaching and the precipitation of the silver, refining and melting of the cement silver. The metal, crushed so as to pass through a screen of six meshes to the linear inch, is roasted for twenty-four hours. The bulk of the sulphur is driven off in this operation, and oxides of copper are formed, the mass still containing sufficient sulphur for the subsequent roasting for sulphate of silver. After cooling, the roasted material is ground fine in a Chilian mill, and passed through a sixty-mesh screen. It is then ready for the fine roasting and conversion of the silver into a sulphate.

Roasting for Sulphate of Silver.—This operation, based on the principles first pointed out and carried into practice by the eminent Ziervogel, is perhaps one of the most interesting and most beautiful of all the metallurgical processes ever discovered. The chemical changes involved in the operation, so far as they are understood, have been described again and again, and I will only briefly refer here to the principal stages in the roasting process. It must be understood that the process is a delicate one, and requires to be watched with great care in order to arrive at good results. The whole operation extends over a period of about five hours from the time the charge is placed in the furnace until its withdrawal. The first stage is conducted at a low temperature, and lasts about one hour and a half. A finely-ground material begins to glow from the oxidation of any copper desulphide and copper dioxide that may be present. Second stage: Slightly increased temperature for one hour and a half, material increases in volume, and assumes a porous spongy appearance from the formation of cupric sulphate. Third stage: Temperature further increased for one hour, or until sample, treated with water, shows the silver to be what is termed 'out,' which means that it has been changed into a sulphate. The presence at this stage of a quantity of dioxide would, during the operation of leaching with water, reduce the sulphate of silver to metallic silver, the latter showing itself in beautiful spangles. Fourth stage: Charge is vigorously stirred and turned over to present fresh surfaces for oxidation, the temperature being kept as in the third stage. This stage is purely for the purpose of completely oxidizing any cuprous oxide, so that no reducing action shall occur when the material is leached.

"The presence of foreign elements in the matte very materially influences the results in this operation. Arsenic, antimony, and bismuth form insoluble compounds with silver. Bismuth is found to be mostly injurious, and gives more trouble than all the other metals together. An insoluble sulphate of bismuth and silver is probably formed, which increases the richness of the residues in silver. In the absence of large quantities of these metals, or with what might be considered fair average matte, the residues will contain, after leaching, about 40oz. of silver per ton; but, as these residues are subjected to a further treatment, the question of a few ounces of silver more or less makes very little difference in the final result, as will be explained.

"The leaching of the roasted matte is effected in tubs, and nothing but hot water is required. The solution is charged with sulphate of silver, and is allowed to flow over copper plates for the precipitation of the silver. This process of precipitation requires little attention. The solution enters tank No. 1, charged with silver, and leaves tank No. 2, charged with copper, and containing no trace of silver. This copper solution, in its turn, flows over old scrap-iron for the precipitation of the copper.

"In the precipitation of the silver a certain amount of copper is found mixed with the silver in the form of cuprous oxide and of small scales and scraps of metallic copper, and a process of refining is necessary previous to melting. This copper is removed by prolonged boiling with water containing a small quantity of sulphuric acid, into which air is injected by means of a small jet of steam. Sulphate of copper is formed, which is carefully washed out of the silver. The silver is then dried and melted into bars of an average firmness of 999.

"The residues, after the extraction of silver, contain about 40oz. of silver and 10oz. of gold per ton, and 55 per cent. of copper in the form of cupric oxide. They also contain associated metals, such as lead and bismuth as sulphates, and iron as ferric oxide.

"*Treatment of the Residues.*—The residues are mixed with the necessary quantity of pyritous ores containing gold or low-grade silver-bearing pyrites, rich in sulphur, and with silicious gold-ores, and are smelted direct for matte of 65 per cent. copper. This matte contains about 10oz. to 15oz. of gold per ton, and 80oz. of silver. The slag from this operation is thrown away. It contains about the same proportion of iron and silica as the ore-slag.

"*Treatment of Matte for rich Copper-gold Alloy.*—This process involves two operations, which may be described under the following heads: A combined roasting and smelting, and a refining of crude alloy. The aim of this process is to concentrate the gold contained in the matte into a rich gold-silver-copper alloy, containing also the bulk of the impurities existing in the matte. This process resembles the old Swansea process for making 'best selected copper,' a description of which will be found in any of the standard works on copper-smelting. As practised at Argo, it is as follows:—

"Twelve tons of matte, or residue metal, are placed in slabs on the hearth of a large reverberatory furnace. The openings of the furnace are closed, except two large ports, which are situated near the bridge, and are used for the supply of air for oxidation. The heat is gradually increased for a period of about seven hours, or until the whole mass assumes a semi-pasty condition. The ports are then closed, and the heat is still further increased until a point is reached when the whole charge is in a perfectly molten condition. In the last stage of the melting a reaction takes place

between the oxide and the sulphide, and a certain amount of metallic copper is liberated, this metallic copper containing nearly all the gold, together with any foreign metals present in the matte, such as lead, arsenic, antimony, bismuth, &c. The charge is tapped into sand moulds, in the first few of which, nearest the taphole, there will be found, after cooling, under the enriched matte, plates of the above-mentioned impure copper, commonly known as metallic bottoms. The proportion of these bottoms to the whole tap of matte, called pimple-metal, is about 1 to 15. The following analysis will give some idea of the composition of this crude alloy: Copper, 60·04 per cent.; lead, 33·61; arsenic, 0·44; bismuth, 0·40; iron, 0·08; zinc, 0·15; gold, 0·54; silver, 1·35; sulphur, 1·68: total, 98·29 per cent.

"It must be understood that this analysis shows the composition of one specimen of such alloy only. The composition varies, of course, with the nature and quality of the impurities present in the residue metal. These impurities, without a doubt, increase the solvent action of the copper on the gold. In other words, a copper-matte containing little or none of the impurities mentioned will not yield its gold so readily to the copper. The whole operation of roasting and smelting occupies about twelve hours. The crude bottoms contain 100oz. to 200oz. of gold to the ton, and about 300oz. of silver. The compound that bismuth forms with gold, when present in this crude alloy, has been referred to in the paper on 'Certain interesting crystalline alloys." The matte pimple-metal, if the operation has been properly done, contains (not to exceed) 0·2oz. of gold per ton (assays frequently show less than 0·1 of gold), 90oz. of silver, and 77 per cent. of copper. The roasted slag from this operation is smelted in the ore-furnaces.

"*Treatment of the Crude Alloy.*—The treatment of this alloy, and the separation of gold from copper is a part of the process which, for certain business considerations, I am not at liberty to describe.

Treatment of the Pimple-metal of finished Matte.—The finished matte, containing 77 per cent. of copper and 90oz. of silver per ton, is crushed, roasted, ground fine, and again roasted, to form sulphate of silver; in fact, it is treated precisely in the same manner as the rich silver-matte described in the Ziervogel process: the only difference is, that the treatment is conducted in a separate set of furnaces, as the matte contains no gold. The residue, after leaching, consists almost wholly of oxide of copper, with an amount of silver not exceeding 10oz. per ton. The oxide of copper is dried, packed in barrels, and sold to the manufacturers of sulphate of copper, or reduced to black copper by melting with fine slack coal in a reverberatory furnace. This copper is refined in Massachussets and disposed of in the Eastern market in the form of ingot copper.

"At this point let me refer for a moment to some important improvements which have been recently introduced in Montana in the treatment of copper-ores. The old, slow, and costly method of roasting in calciners is being replaced with great success by very capacious revolving cylinders. In a country where fuel and labour are dear a change of this nature is an immense advantage when large quantities of ore have to be roasted before smelting. Transferring the hot ore direct to the furnace, instead of allowing it to cool before charging, is also a very important gain, as it greatly increases the capacity of the furnace.

"While Colorado may be said to lead in its successful development of the lead industry, Montana has come to the front and has made a great advance in the treatment of copper-ores. One can form some idea of the magnitude of the copper-smelting enterprises in the neighbourhood of Butte when I state that the works of the Anaconda Company alone are sufficient to smelt 500 tons of ore per day, yielding about 100 tons of copper in the form of matte. And this would have been largely increased had it not been for the disastrous fire which, last March, destroyed some extensive additions. The Anaconda Works, which were first built some four years ago, were moulded after the Welsh pattern, with all the old-fashioned methods peculiar to the system which has been so long in vogue in South Wales. It was soon discovered that, with expensive labour and high-price fuel, some radical change must be made. The works were consequently entirely remodelled, in a style which, from their magnitude and the ingenuity shown in handling the materials, may be considered purely American. Montana may also be credited with the only application of the French system for bessemerizing copper mattes in America, and from the long period it has been in use it is presumed that success has been assured.

"THE MACARTHUR-FORREST PROCESS FOR THE TREATMENT OF REFRACTORY GOLD-ORES.

In the *Engineering and Mining Journal* of New York, the following description of the Macarthur-Forrest process is given:—

"This process depends upon the great chemical affinity of cyanogen for gold and silver, and the ease with which these metals form soluble double cyanides with the alkali metals. Of the common metals, gold has the greatest affinity for cyanogen, and their relative affinities are as follows: First, gold; second, silver; third, copper; fourth, zinc; lead, iron, arsenic, antimony, &c., very small.

"In this paper it is not proposed to discuss the chemical forms in which gold exists in these so-called gold-ores; suffice it to say that so great is the affinity of gold for cyanogen that any one has yet failed to meet with any ore which did not, on shaking up with even dilute solutions of cyanides, yield up its contents of gold almost entirely to the cyanide solution and become dissolved as the double cyanide of gold and the alkali used.

"The cyanides of the alkali and earthy metals are, practically speaking, the only soluble cyanides, the cheapest and most common being the cyanides of potassium and sodium. The relative solvent action of these various cyanides on gold and silver compounds existing in ores has been most carefully and thoroughly investigated by Mr. J. S. Macarthur and Dr. Forrest, who have had a staff of research-chemists at work on the subject for nearly three years. It has been found that the cyanides of potassium and sodium are as active in their solvent action as any of the other valuable cyanides.

"When ores containing gold, silver, copper, zinc, &c., are treated with solutions of cyanide of potassium or sodium they are dissolved more or less, forming soluble double cyanides. The solvent action on the base metal can be reduced to a minimum by reducing the strength of the solutions, the readily soluble gold and silver being easily dissolved out with only traces of copper, zinc, &c. The action of these weak cyanide solutions on the metals, iron, lead, arsenic, antimony, &c., is practically nil, and the solvent action on copper or zinc much depends upon the state of chemical combination in which they exist. Thus, the hydrated oxides and carbonates of copper are more soluble than the sulphides, and the oxide of zinc more soluble than the sulphide of zinc; again, the white sulphide of iron is more soluble than the yellow sulphide. The best strengths of solutions to use in leaching out the gold from these so-called refractory ores depends entirely upon the nature of the ore, and it is impossible to set any hard-and-fast line. The strength of solutions generally used varies from $\frac{1}{8}$ to 1 per cent. of cyanide of potassium. The correct strength to use in treating any class or lot of ore may be readily determined by treating a weighed quantity of the ore with varying strengths of cyanide solutions for various periods of time in the laboratory, and analysing the ore after treatment with the cyanide liquor, and the liquor itself, as to the amount of gold which they contain and the unconsumed cyanide in the liquor, these results being compared with the original contents of gold and silver in the ores, and the original strength in cyanogen of the solution used. (A neat and rapid method of determining the gold in the cyanide liquors is to draw off a known value and evaporate it to dryness over a beaker of water in a capsule shaped out of a piece of silver-free lead-foil. The lead-foil capsule is then wrapped up in a ball and cupelled in the usual way. The liquor should be as free as possible from base metals. When these are present the liquor may be boiled to dryness with litharge, and the solid residue fused in the usual way for its contents of gold and silver.)

"The approximate strength of the solution to use is thus determined, the point aimed at being to reduce the quantity of cyanide actually consumed to a minimum with, at the same time, the highest possible percentage of extraction of the gold and silver.

"The process on a large scale is carried out as follows: The ore (without any previous roasting if sulphur should be present), ground to forty mesh, are placed in pans or wooden vats provided with a stirrer, and to every 1 ton of the ore there is added about 100 gallons of water, containing one-quarter, one-half, or three-quarters of 1 per cent. of cyanide of potassium or sodium, or other percentage which experiment in the laboratory shows to be the best approximate strength to use. The whole is then stirred for four to eight hours, the length of time depending upon the nature of the ore. Some ores give better results by grinding in the pan, others require merely agitation with the liquor. The liquor is run off, carrying with it, on an average, 85 per cent. of the gold contents of the ore and 80 per cent. of the silver. It is filtered, and the gold and silver in it are precipitated by passing slowly through zinc turnings, when complete precipitation of the gold and silver takes place. They attach themselves as a loose powder to the zinc, and are easily removed by shaking or stirring, the gold and silver precipitate or sludge falling to the bottom of the vessel, and is removed, dried, and melted in the usual way. The filtration of the liquor is accelerated by using a vacuum, and there is no practical difficulty about this part of the process, except in the case of ores containing a large percentage of clayey matters. Concentrates work admirably, setting and filtering with the greatest facility.

"The action of the cyanide of potassium or sodium upon the metallic zinc is very trifling, exact experiments, with accurately-weighed quantities of zinc, subjected to the action of hundreds of gallons of liquor, having proved this, and the complete precipitation of the gold, &c., having also been carefully investigated. The precipitation by zinc is superior to electrical and other methods, and hence is adopted on the large scale. The amount of free cyanide existing in the liquors after passing through the zinc is then determined by means of a standard solution of nitrate of silver, and the liquor is again made up to its original strength and again used.

"The actual consumption of cyanide on the large scale per ton of ore necessarily varies, running from 1½lb. to 8lb. per ton. I am, however, of opinion it will average about 5lb. of cyanide of potash or soda per ton. At the same time, I have witnessed ores successfully treated with a consumption of only 1¾lb. of cyanide per ton, notably a very refractory South African pyrites containing over 3oz. of gold per ton, the gold-extraction being over 90 per cent.

"In order to successfully carry out the extraction of the gold from these so-called refractory ores a number of points have to be observed. If the ores contain a noted acidity, due to the presence of basic sulphates of iron, &c. (especially marked in a case of disintegrated and weathered sulphides of the metals), it should be neutralised with the equivalent quantity of caustic lime, in the form of milk of lime. The exact amount of acidity can be readily determined by shaking up a weighed sample of the ore with water, and adding standard normal or tenth normal caustic soda solution till the point of alkalinity is attained, as determined by litmus or other indicator. The amount of lime required, is then easily calculated. Some ores show as much as 4 per cent. of acidity in terms of soda, and such ores, on treatment with cyanide solutions without previous treatment with lime, show no extraction of their gold contents, whereas when previously treated with lime the greater part of the gold was easily extracted. Nearly all sulphides show more or less acidity, but when it is under one-tenth of 1 per cent. it may for practical purposes be neglected.

"The cyanide solution used should be as free from caustic alkali (Na.H.O. or K.H.O.) as possible, as it is apt to form a sulphide of sodium or potassium with the sulphur of the ores, and thus prevent the gold and silver going into solution. This difficulty, when it does occur, is got over by adding chloride of calcium. The cyanide solutions are best preserved from too great exposure to the air, as a part of the cyanide is apt to be converted by oxidation into the cyanate, an extremely stable compound.

"This process is admirably suited for treating iron pyrites containing gold, as no roasting is required, and ores containing fine or float gold, which yield up their gold so easily that they can be

treated by merely percolating the cyanide through them. Complex ores, containing antimony, arsenic, &c., also yield up their gold contents with great facility. A large number of American and Mexican ores were tested by this process, and the average extraction of the gold was 90 per cent., and 85 per cent. of the silver, the percentage of silver extracted being generally less than of the gold. Works on this process are now running in New Zealand and Australia, and a plant is about to be erected at the Cape. The process owes much of its success to the skill and untiring efforts of Mr. J. S. Macarthur and Dr. Forrest, and is now the property of a strong company who have secured patents in all countries of the world.

"The cyanide used on the commercial scale is cyanide (or mixtures of cyanides of potash and soda) made by fusing the yellow ferro-cyanide of potassium with a pure soda-ash and carbon in an iron pot at a dull red heat till the ferro-cyanide is decomposed, as ascertained by testing a small sample with an iron salt. The liquid mass is then ladled or run into iron moulds to cool, and the cooled mass forms a black brick containing 75 per cent. of cyanide of potassium and sodium. These bricks are made of a weight of about sixteen pounds each. They are packed in long zinc cases, soldered up, and shipped in wooden boxes to the mines or works. The actual cost of manufacturing such a cyanide is not greater than 35 cents per pound. The above method is the old and well-known reaction.

"Experiments are now in progress for utilizing the reaction (proposed as early as 1845) of passing nitrogen or furnace gasses (free from oxygen) over highly-heated alkali and carbon, barium being preferred. From experience of this process on a large scale, the cost of the cyanide is likely to be reduced to at least 20 per cent. at an early date, and we may look for an early introduction of this process on a large scale into the United States."

MILLING OF GOLD-ORES IN CALIFORNIA.

The report of the State Mineralogist of California for the year 1888 contains a very useful description of stamp-crushing mills and appliances used for the treatment of auriferous ores in California which is applicable to this colony, and many useful hints are given that may be of service to mill-men and battery-proprietors here. The report referred to is written by Mr. John Hay Hammond, who evidently is well acquainted with the subject on which he is writing. It will be seen from this report that the average duty of stamps is about $2\frac{1}{4}$ tons of pulverized ore for each stamp, and he calls attention to the loss of gold in sulphates, and states that the majority of mills save at least from 75 to 85 per cent. of the assay-value of the ores, which is far above the average percentage obtained in this colony. He also shows that the cost of crushing with a 40-stamp mill working continuously with water-power is from 1s. 6d. to 1s. 11d. per ton, which is much less than the cost given by the Superintendent of the Te Aroha Silver and Gold Company Works at Waiorongomai as the cost of treating the ores at that works. As this is a subject which interests the mining community here, and one on which depends the future development of the mining industry in this colony, the report will be of assistance to guide mill-men in the erection and working of reduction- and gold-saving-plants.

Mineralogical Character of the Auriferous Ores.—Mineralogically the ores consist generally of a quartz-gangue, carrying free gold and iron-pyrites. With the iron-pyrites are sometimes associated arsenical and copper-pyrites, and, more frequently, galena and zinc-blende. In some of the gold-ores are found auriferous tellurides, and also occasionally some other of the rarer minerals. These latter constituents are usually of little economic importance, and their presence can practically be disregarded. Quartz is the characteristic matrix of the veins, though other matrices occur. Sometimes the wall-rock fills the vein, and constitutes the gangue of the ore. Calcspar often accompanies the quartz-vein stone, though it very rarely forms exclusively the matrix of the auriferous ore. The value of gold-ores in California generally varies from 14s. 6d. to £1 13s. 4d. a ton, in the low-grade ores, up to from £3 3s. to £6 6s. a ton in the high-grade ores. I should place £2 2s. to £2 10s. a ton as a rough estimate of the average grade of ore at present treated. The percentage of sulphurets (iron-pyrites, principally) will vary from 1 to 5 per cent. of the ore milled. Two per cent. would represent about the average pyritous contents of the ores. The percentage of sulphurets contained in the ore, and the value of the concentrated sulphurets, are but rarely of so little economic importance as to be ignored in the milling of the gold-ores. The great majority of gold-mills have the plants adapted to the saving of the sulphurets, the value of which though usually subordinate to that of the free gold present in the ore, nevertheless is a significant factor in the output of the mill. I should estimate the average value of the sulphurets saved in the State at from £16 13s. to £18 15s. per ton of concentrates. In the low-grade ores the gold occurs disseminated throughout the ore in particles rarely visible to the naked eye. In ores of high grade it often occurs massive, and sometimes in lamellæ, along the planes of division in the quartz ("ribbon-rock"). The gold often assumes the form of wire (filiform), and is also occasionally arborescent. Ores showing considerable free gold ("specimen ore") is often sold to jewellers, who pay from £4 3s. 4d. to £5 12s. 6d. per ounce of gold contained in the quartz. The pyrites is generally excessive in character, though sometimes it occurs crystallized. Crystallized iron-pyrites rarely carries much gold. The sulphurets contained in the country rock increasing the vein are likewise of but little value.

"*Mill-sites.*—The choice of the mill-site is of paramount importance, as upon its judicious selection will depend in a great degree the cost of the milling of the ore. Considerations of its accessibility, of the attainable fall, which effects the automatism of the process; of the accessibility of water and wood (where used) should generally determine the adaptability of the mill-site. There are, fortunately, but few gold-bearing districts in California where all these desiderata are not obtainable.

"*Outline of the Process.*—The ore is discharged as it comes from the mine upon a grizzly, which separates it into two classes: First, ore which passes directly through the grizzly into the

main ore-bin; second, the coarse ore, which passes into the coarse-ore bin. The ore from Class 2 is passed through the rock-breaker, by which it is reduced to the proper size for stamping; thence it passes through the battery, where part of the free gold is extracted by amalgamation. The pulp, from which part of the free gold has been eliminated, passes from the mortars on to the copper plates, and thence to the concentrators. The concentrators effect the concentration of the auriferous sulphurets, the residual pulp passing off into the sluices below the mill, where a portion of the sulphurets and other valuable contents which have escaped from the concentrators and preceding appliances is saved by various contrivances. From the sluices the pulp passes away as tailings or, comparatively speaking, worthless gangue. Where the topographical conditions admit, it is advantageous to have commodious ore-bins. The consideration of the mill-site oftentimes imposes the economy of fall in the disposition of the several floors of the mill. When rock-breakers are used at the mill the least practicable fall that insures automatism in the process (*i.e.*, the use of gravity in moving the ore through the various operations), is 33ft. from the rock-breaker floor to the concentrator's floor. By curtailing the length usually given to sluice-plates, and having but one concentrator per battery, instead of two as is customary, the requisite fall may be further reduced to about 29½ft.

"*Rock-breakers.*—The arrangement of the rock-breakers as shown in the cross-section drawing of the mill, is a very advantageous one. The rock-breaker is placed directly below and in front of the coarse-ore bin. The chute leads from the gate of the bin into the jaws of the rock-breaker. The gate opening from the coarse-ore bin into this chute is worked by rack and pinion. By this gate the supply of ore delivered to the rock-breaker is controlled. This arrangement insures an almost continuous supply of ore to the rock-breaker, thereby greatly increasing the capacity of that machine. In most mills the coarse ore is discharged over the grizzly ore to the rock-breaker floor, where it is picked up by the man who feeds the rock-breaker. This not only occasions unnecessary labour but decreases the capacity of the rock-breaker, through failing to keep it constantly supplied with ore. At the North Star Mill, where the above arrangement has been introduced, one rock-breaker, 15in. by 9in., crushes from 30 to 40 tons of hard rock in from five to seven hours, effecting a saving of wages of two or three men as compared with the labour required in mills arranged according to the system generally adopted. Further evidence of the comparatively unintermittent working of the rock-breaker requires twelve horse-power instead of eight, as is usually computed for machines of the above dimensions. The crushed ore goes into the main ore-bin, where it joins the fine ore which has passed through the grizzlies. These two classes of ore should be well mixed, to secure uniformity in the character of the charges fed to the stamps. Where the fall permits it will be found advantageous to have two sets of rock-breakers, the first crushing coarse and delivering the crushed ore to the second set of rock-breakers to be crushed finer than is the present custom. This would greatly increase the capacity of the stamp. The rock-breakers are adjusted to break the ore into pieces smaller than 2in. to 3in. The rock-breaker shoes and dies last six to eight months. When of steel they wear about twice as long.

"*Self-feeders.*—The introduction of self-feeders has greatly increased the effectiveness of the stamp-mill as compared with hand-feeding. The use of these feeders has increased the capacity of the battery from 15 to 20 per cent., besides effecting a very considerable reduction in the wearing of screens, dies, shoes, &c. The maximum capacity, other things being equal, of the battery is obtained by "low feeding." By low feeding is denoted the feeding of small quantities of ore upon the die. The ore should be fed steadily and in small quantities. When fed in the mortar with more or less irregularity, and in large charges, the ore is piled up to a height that reduces the fall of the stamp, and also forms a cushion of ore upon the dies that impairs the efficiency of the impact of the shoe. Accordingly, machines constructed so as to have the ore supplied by a "carrier" are preferable to those feeding according to the principle of a percussion- or shaking-table. Their superiority is especially marked in the automatic feeding of the wet clayey and other sticky ores, which adhere to the chute leading to the mortar. Hendy's 'Challenge' ore-feeder is undoubtedly the best self-feeding machine in use. The Tulloch, Stanford, and Roller feeders also give satisfaction for certain classes of ores. They are considerably cheaper than the 'Challenge,' and are often used for that reason. The 'Challenge' ore-feeder costs £52 in San Francisco. When packed for shipment it occupies twenty-three cubic feet, and weighs seven hundred and fifty pounds. A convenient form of the 'Challenge' ore-feeder is the 'Hendy Improved Challenge Suspending Ore-feeder." This arrangement does away with the carriages used for the ordinary Challenge feeder, thereby rendering the feed-side of the mortar more accessible. The machine is supported upon two parallel tracks, which rest upon the battery-posts and upon standards placed against the ore-bin.

"*Mortars.*—The width of the mortars is regulated according to the character of the ore. Narrow mortars accelerate the discharge of the pulp from the battery, but very rapid discharge is not always desirable when battery amalgamation is practised. In hard flinty ores, if the screens are brought close to the die there is excessive breakage of screens, occasioning undue expense, and loss of time in changing them. By raising the lower edge of the screens the liability of breakage may be reduced or obviated, but that increases the height of discharge, which reduces correspondingly the capacity of the battery, and annuls the advantage aimed at in the use of narrow mortars. The feed-opening of the mortars should extend nearly their entire length, and should be 4in. wide, after allowing for the back lining. Each mortar is provided with five inside cast-iron linings, which prevent its wearing. These linings are replaced when worn out. They last from six to nine months.

"*Screens.*—In California five different kinds of screens are used: Steel and brass-wire, slot, and needle-punched sheet-iron, and tin. The slot-and-punched sheet-iron screens are made of soft but tough Russia sheet-iron. This iron has a planished, glossy, and smooth surface. The number of sizes of the steel and brass-wire screens correspond to the number of meshes per linear

inch. The numbers and sizes of the needle-punched and slot screens correspond to the number of needles by which they are perforated. The width of the slots in slotted-screens is equal to the diameter of the holes in a needle-punched screen of the same number. Numbers 5, 6, 7, 8, and 9 are common sizes of slot and needle-punched screens. The slots are either horizonital or diagonal (angle-slots). The lengths of the slots are usually ½in., ⅝in. or ¼in. Some of the slot-and-punched screens are burred or indented, and have their rough edges on the inside of the mortar. This prevents clogging of the screens. Tin screens, with tin burred off, are used at the mills of the Plymouth Consolidated Company, Amador County. These screens are not as thick as the Russia iron, and consequently admit of more rapid discharge through perforations of the same diameter. They do not wear as long, however, as Russia-iron screens. The sizes of brass-wire cloth-screens range from No. 16 to No. 60. The most common sizes are Nos. 30 and 40. No. 30 is made from No. 31 wire. No. 40 is made from No. 33 wire. This size can be purchased in San Francisco for about 36 cents per square foot. Each battery will require about 3 to 4 square feet. The prices in San Francisco for Russia-iron slot and perforated screens are: Nos. 5, 6, and 7, 65 cents; Nos. 8 and 9, 75 cents; No. 10, 80 cents per square foot. Screens wear out near their lower edges: when one edge is worn the screen is turned upside down. Brass-wire screens last from ten to fourteen days. Screens last longest with high discharge and wide mortars. One brass-wire screen, No. 30, will last during the crushing of from 120 to 140 tons of ore. Steel-wire screens are not much used, owing to their tendency to rust. Russia-iron screens last from fifteen to forty days: thirty days is about the average life of these screens. The area of discharge in the brass-wire screens is greater than that of the slot or punched-iron sceens, and the pulp is more uniform in size than that discharged through the latter kind. The screens are set in recesses in the front part of the mortar, and keyed. They are sometimes set vertically, but generally with an inclination of about 10°. There should be a piece of heavy canvas (splash-boards) across the mortar in front of the screens, against which the pulp splashes as it passes through: the screens control the fineness of the pulp. The proper size to which the ore must be stamped depends upon its character. Stamping should not be carried further than necessary for the liberation of the gold and sulphurets from the vein-stone. Where the gold is finely divided (in low-grade ores generally) the stamping must be finer than where the gold occurs coarse. It is desirable to crush as coarse as possible when the sulphurets constitute an important part of the value of the ore, since too fine stamping produces an excessive quantity of pyritous slimes, thereby increasing the loss of the sulphurets. Furthermore, when stamping is carried too far there is great danger of hammering the gold particles so as to render them less sensitive to amalgamation, and also to make them liable to escape as 'float gold.' The great waste of power in 'dead stamping' is attested by the fact that generally over 80 per cent. of ore discharged through a No. 30 screen, and often as much as 50 per cent., will pass through a No. 120 screen.

Table of Sizes, &c., of Screens.

No. of Needle.	Corresponding Mesh.	Width of Slot.	Thickness of Iron (Russian gauge).	Thickness of Iron (American gauge).	Weight per square Foot.
		Inches.	No.	No.	lb.
5	20	$\frac{29}{1000}$	14	23¼	1·15
6	25	$\frac{27}{1000}$	13	24	1·08
7	30	$\frac{22}{1000}$	12	24½	0·987
8	35	$\frac{20}{1000}$	11	25	0·918
9	40	$\frac{18}{1000}$	10	26	0·827
10	50	$\frac{1612}{1000}$	9	27	0·735
11	55	$\frac{15}{1000}$	8	28	0·666
12	60	$\frac{15}{1000}$	8	28	0·666

"Russia iron comes in sheets 28in. by 56in., equal to 10·88 square feet. The measurement of some manufacturers differs somewhat from the above table. Attwood's screen-measure is very convenient for determining the sizes of the orifices of the screen.

Drop of the Stamps.—The height of the drop is regulated with reference to the character of the ore, the speed, and the weight of the stamp. From 4in. to 9in. are the extremes, and 6in. is about the mean height of the drop for the Californian mills. Sufficient drop must be given to obtain a good splash. The soft ores and the highly-sulphuretted ores should be stamped with a low drop.

"*Order of Drop.*—There is much diversity of practice in this respect. It is desirable to drop the stamps in such rotation as to insure an even distribution of the pulp on the several dies. Adjacent stamps should not drop consecutively, as this occasions accumulation of the pulp at one end of the mortar, in consequence of which the efficiency of the stamps at the end is reduced by leaving a decreased height of drop and a cushion, which retards the pulverization of the ore. The stamps at the other end of the mortar have too little work and are liable to "pound iron." The order of the drop 1, 4, 2, 5, 3 (*i.e.*, first stamp drops first, this is followed by No. 4, that by No. 2, that by No. 5, and No. 3 drops last) seems to best fulfil the requirements. It gives a good splash, and satisfactory results in other respects. The order 1, 5, 2, 4, 3 is also extensively adopted. There are several other orders of drops in use, but the two just mentioned are the best. Of these, the order first given is to be preferred. Where the other orders are followed one stamp is usually given greater drop than the others, to counterbalance the piling of ore on one side of the mortar which that order induces. In the following sketch of the battery the stamps are numbered from 1 to 10, but the order of drop is 1, 4, 2, 5, 3.

"*Duty of Stamps.*—The number of tons of ore crushed per stamp will depend chiefly upon the weight of the stamp, the number of drops per minute, the height of drop, the height of discharge, the size of the screens, the width of the mortar, and, chiefly, upon the character of the ore. Hard ores and ores of a clayey nature (from the difficulty experienced in discharging the clayey pulp) decrease the duty of the stamps. Two and one-fourth tons per stamp in twenty-four hours is approximately the average duty of the stamp in this state.

"*Speed of Stamps.*—Heavy stamps and stamps having high drops should have correspondingly low speed. With 900lb. to 950lb. stamps having 6in. to 7in. drop the speed should be from 85 to 95 drops per minute. With double-armed cams the speed must not be great enough to bring the cam into collision with the falling tappit, *i.e.*, the interval between the revolutions of the cam must be sufficient to give the tappit time to finish its drop. When the cam strikes the descending tappit the shoe, boss, or tappit is often dislodged, and breakage is imminent. A fast drop produces a good splash, which is very desirable for battery amalgamation.

"*Shoes and Dies.*—Shoes and dies are either of iron or steel. Within a short time a great improvement has been made in the manufacture of shoes and dies. Formerly, owing to their tendency to chip and cup, their introduction met with but little success. In most mills remote from foundries, where transportation is an important item in the cost of shoes and dies, steel shoes and dies have replaced those of iron. Recently, chrome-steel shoes and dies have been introduced, and have proved their superiority over most other kinds of steel used here. In some mills steel shoes and iron dies are used. The iron dies wear more evenly with steel shoes than the steel dies do. The life of steel is about two and one-half to three times that of iron shoes and dies, and the cost about twice as great as those of iron. The mixture of steel (from the old chrome-steel shoes and dies) with iron produces shoes and dies that wear considerably longer than those of pure iron, and may be advantageously introduced where there is no other disposition possible for the old steel because of want of local facilities for the utilisation of this residue. In many districts the old iron shoes and dies are sold to local foundries for from 1½ cents to 2 cents per pound. The weight of the shoes bears a certain relation to the weights of the tappets, steins, and bosses. Chrome-steel shoes made for samples of 850lb. to 950lb. weigh from 145lb. to 155lb., and measure about 9in. in diameter by 7½in. to 8in. long The neck is from 4½in. to 5in. long, with a taper to correspond to the socket of the boss or stamp-head. Iron shoes are usually from 15lb. to 20lb. lighter than the above weights. The chrome-steel dies weigh from 110lb. to 125lb., and measure (where shoes of the above dimensions are used) 9in. in diameter by 4in. to 4½in. in height, with a rectangular foot-plate 10½in. thick by 9¼in. by 1½in. thick. Iron shoes usually weigh from 20lb. to 25lb. less than the above weights for steel.

"*Life of the Shoes and Dies.*—There are many conditions which affect the durability of shoes and dies—as, for instance, the hardness of the rock, the weight, speed, and height of the drop of the stamp, the manner of feeding the ore, &c. Iron shoes of good quality last from thirty to forty-seven days. Iron dies of good quality last from thirty to forty days. Old shoes wear usually down to 1½in. to 1in. in thickness, and weigh about 20lb. to 50lb. The consumption of iron and steel in shoes and dies depends upon the character of the ore crushed. Other conditions being the same, it will depend upon the coarseness of the stamping and the height of discharge. Dies wear less rapidly than the shoes, as they are protected by the thickness of the pulp, which covers them to the depth of from 1½in. to 3in. But, while the actual wear of dies is less than that of the shoes, the life of the dies is shorter than that of the shoes, owing to the fact that the shoes have several inches of greater length of wearing-part than the dies. The consumption of iron for shoes and dies per ton of ore crushed is from 1½lb. to 3lb. To obtain the maximum crushing-capacity of the battery, the dies must be kept as high (with reference to the lower edge of the screens) as is compatible with the safety of the screens and with successful amalgamation in the battery. To prevent pounding of iron it is necessary to preserve more or less uniformity in the level of the dies. Should one die in the battery project much above the others, little or no pulp would remain upon it, and the shoe would consequently drop upon the naked die.

"*Cams, Stamp-heads, and Stems.*—Cams and stamp-heads ought to last several years. They are usually broken through carelessness. The stems break at the socket of the stamp-head. Stems are reversible. When broken they may be swaged or planed down, and additional lengths welded on when necessary.

"*Tappets.*—The revolving cam, besides lifting the tappet, imparts to it a rotary motion, which to some extent is communicated to the stamp in dropping. This produces a grinding effect, which assists in crushing the ore. The rotation of the stamp performs a far more important office in equalising, and consequently diminishing, the wear of the shoes and dies. When there is but little grease on the tappet it makes a complete revolution in from four to eight lifts by the cam. In falling, of course, but a small portion of the rotary motion imparted to the stamps in rising is retained. When there is much grease on the tappet or cam, or when the tappets have so worn that the face of the cam strikes a grooved instead of a level face on the tappet, the rotary motion is greatly impaired. Tappets last for several years, from four to five years being their usual life; sometimes they are broken by being too tightly keyed. When their faces are worn they are planed down. Tappets are reversible, so that when one face has been worn as far as possible the other face is placed downwards. Tappets are usually of steel, and weigh about 112lb. when 900lb. stamps are used.

"*Mill-water.—Battery-water.*—The amount of water fed to the battery depends upon the character of the ore and the size of the screen. Clayey and highly-sulphuretted ores require the maximum amount of water. The amount of water used per ton of ores stamped varies from 1,000 to 2,400 gallons. The mean amount used per ton of ore stamped is about 1,800 gallons. From three-fourths to one and a half miners' inches per battery should be provided. In winter, when the battery-water is chilly, it should when possible be heated to tepidity, as this promotes amalgamation. A high temperature should be avoided, as it renders the quicksilver too lively.

"*Concentration-water.*—The feed-water required for concentration is from one to two gallons a minute for each concentrator. The wash-water for each concentrator is about one-half to one gallon per minute. Total mill-water required for a forty-stamp gold-mill, with sixteen concentrators, varies from eight to sixteen miners' inches—twelve inches is about the average. Where steam-power is used one miners' inch of water supplies the boilers.

"*Amalgam.*—In battery amalgamation the largest part of the amalgam is caught upon the inside plates, but when gold is coarse the percentage of amalgam caught in the battery (upon the inside plate generally) is greater than when the gold occurs finely divided in the ore. The width of the mortar, the height of the discharge, and the fluidity of the amalgam also influence the ratio between the quantity of the amalgam saved in the battery and that saved upon the outside plates. Narrow mortars, low discharge, and the feeding of much quicksilver, which produces a fluid amalgam, decrease the percentage of the battery amalgam. Sometimes, from these causes more of the amalgam is caught without than within the battery. Generally, however, from 50 to 80 per cent. of the amalgam saved comes from the battery.

"*Value of the Amalgam.*—The amalgam from the inside plates, from the linings of the battery, &c., invariably contains more gold than that from the outside plates. The value of the amalgam increases with the coarseness of gold in the ore. Finely-divided and alloyed gold yields comparatively poor amalgam. At the Original Empire and North Star mills, in Grass Valley, the value of the plate-amalgam averages about 18s. 9d. per ounce, and the value of the battery-amalgam about £1 15s. 4d. per ounce. Probably 70 to 85 per cent. of the gold derived from the amalgam comes from the battery-amalgam. Amalgam from ores of the same mine sometimes varies greatly in value in different clean-ups.

"*Battery Amalgamation.*—In nearly all of the mills of this State, battery amalgamation is practised. Where the percentage of sulphurets is excessive, however, battery amalgamation is not advisable.

"*The Clean-up.*—The frequency of the times of the clean-up depends upon the richness of the ore and upon the local practice in this respect. The outside plates—*i.e.*, the outside battery-plates—the apron-plates, and the sluice-plates are usually cleaned up every twenty-four hours. The amalgam and the 'skimmings' are ground with the addition of quicksilver in the clean-up pan, in order to soften and clean the amalgam. The redundant quicksilver is expressed and the amalgam retorted in conjunction with the amalgam from the general clean-up. The clean-up of the outside plates requires from ten to fifteen minutes for each battery. The general clean-up of the mill is usually once or twice a month. Two batteries are hung up, the outside battery-plates and the screens removed, and the inside plates and dies taken out. These plates are laid over the sluice-plates and the amalgam scraped off. Care must be observed to prevent the plates being scratched. Amalgam will sometimes be found adhering firmly to the linings of the mortar and to the dies. All the amalgam obtained is cleaned in the clean-up pan. In large mills the use of the barrel and clean-up batea is to be recommended. The 'headings,' composed of pulp and uncrushed ore, quicksilver, sulphurets, pieces of iron, steel, &c. (the steel and iron are taken out with a magnet), amounting to two or three pailfuls, are run through one of the batteries, through which the 'headings' from the other batteries are likewise passed. This battery is cleaned up in the manner above described, a part of the worthless material removed by panning with a miner's common gold-pan, and the remaining material is then run through the clean-up pan. After one or two hours' grinding, with the addition of quicksilver, in the clean-up pan, the refuse matter is run off, and the amalgam and the quicksilver collected. Three men can clean up a forty-stamp mill in from five to seven hours. The loss of from five to seven hours for two batteries is consequently incurred by a general clean-up. At this time advantage is taken of the stoppage of the battery to make needed repairs and to change the shoes, dies, screens, &c., if required. It takes from two to four hours to retort the amalgam in the silver-retorts, which are used in large mills. Small mills use the cup-shaped retort. It takes about one to two hours to melt the gold from the retorted amalgam. The melted gold is poured into moulds of suitable dimensions. Bullion-assays should be made to ascertain the fineness of the gold bar.

"*Clean-up Room.*—This room should be as near as possible to the battery. The floor should be of cement to prevent loss of amalgam and quicksilver. There should be two cast-iron tanks, 4ft. long, 3ft. wide, and 3ft. deep, to prevent loss of material and leakage in panning out. In one corner of this room is placed a small clean-up pan, 2½ft. in diameter. This pan is provided with drags of iron or hard rock. The use of the pan has been described before.

"*Battery Discharge.*—In battery amalgamation the height of the discharge—*i.e.*, the vertical height of the lower edge of the screen above the die—is governed by the width of the mortar. Narrow mortars require a higher discharge than wide mortars, in order to avoid breakage of screens, and to prevent scouring of the inside copper plate. It varies from 4in. to 9in., the mean being about 6in. or 7in. A uniform height of discharge should be observed. As the dies wear down the edge of the screen is lowered correspondingly.

"With ores readily crushed and discharged it is necessary to raise the screen—*i.e.*, to increase the height of the discharge—in order to retain the pulp in the mortars sufficiently long for its proper amalgamation. Mortars for California gold-mills have almost invariably but a single discharge. The sentiment of millmen is with remarkable unanimity opposed to double-discharge mortars. The objections urged against double-discharge mortars are—first, the inconvenience in the arrangement of the copper plates when adapted to double-discharge; second, the necessity of using too much battery-water (especially where concentration follows); third, the ore is not given time for proper amalgamation in the battery. While these objections are more or less valid, and it is unquestionably true that some of these conditions do militate against the successful use of double-discharge mortars, it is nevertheless the fact that some of the advantages of mortars of this class generally commend their use for certain classes of ores. Where ores are heavily sulphuretted, and

consequently cannot be amalgamated in the battery, double-discharge mortars may be advantageously used. Their use is especially desirable where the ores contain brittle sulphurets which from being too long subjected to stamping are liable to be slimed. Stamps crush ores of most classes faster than the screens discharge the pulp. Much of the pulp, from lack of adequate facilities of discharge, is retained in the mortar and subjected to continued pulverisation, with the result that a great part of it (especially the sulphurets) is slimed—*i.e*, reduced to an excessive degree of comminution; in consequence there may be considerable loss resulting from the well-known tendency of the slimes to flow off in spite of all endeavours to settle them. Repeated stamping of the fine gold-particles may likewise produce 'float' gold, which is difficult, and, indeed, at times impossible, to save. Gold subjected to heavy pounding is not easily amalgamable.

"*Plates.*—Silver-plated copper has almost everywhere superseded the ordinary amalgamated copper plates. These are more easily kept clean, as they are not so readily affected by impure battery-water or exposure to the air. To insure good amalgamation the plates must be clean and bright. Grease or oil in the battery-water prevents proper amalgamation. The presence of these very deleterious substances should be carefully avoided, and if present they must be counteracted by the introduction into the battery of a saturated solution of wood-ashes. Cyanide of potassium in dilute solution is used to promote amalgamation. The practice of using cyanide of potassium is less common than formerly. One or two pounds will be sufficient to clean the plates of a forty-stamp mill for one year. The copper plates are not generally resilvered, as the coating of amalgam forms upon them, which is very effective in saving gold. This layer of amalgam should not be allowed to accumulate to too great a thickness, but should be removed occasionally by 'sweating' the plates. An improved method in use at the North Star mill is to immerse the plates in boiling water until the amalgam is softened sufficiently to be easily scraped off. Where the pulp carries but little amalgam or quicksilver the silver-plating is soon worn out.

"Where mills have occasion to resilver their copper plates often, they should have a plant for that purpose. Such a plant, to silver 6ft. by 4ft. of copper plates, costs about £250. About £229 of this is expended in the preparation of the solution. This is prepared by dissolving chloride in a solution of cyanide of potassium. The electrolytic action is produced either by batteries or by dynamos. The action of the latter is more expeditious. A dynamo for this purpose costs about £40. About one and one-eighth horse-power is required to run them where used. The quantity of silver taken from the solution must be replaced by the addition of equivalent silver anodes. The cost of silver-plating is but little more than the cost of the silver. One ounce of silver per square foot of copper is the usual amount used.

"The copper plates should be annealed and softened so as to possess an absorbent surface. They are usually about $\frac{1}{16}$in. in thickness, and weigh about 3lb. per square foot. They cost in San Francisco at this date 1s. 1d. per pound. Silver-plating costs 10s. 5d. per foot when 1oz. of silver, which is the usual quantity, is used. That makes the total cost per square foot about 13s. 7d. The sizes of sheet copper are 30in. by 60in., 48in. by 72in., 48in. by 95in., and 6in. by 120in. The widths of sluices, &c., should be made with reference to the size of sheet-copper in market, in order to avoid waste of copper in cutting.

"There is a constant absorption of amalgam by the plates. The amalgam replaces copper, or forms a layer upon it too hard to be rubbed off. At Grass Valley, after a run of a year or two, the outside battery-plates and apron are sweated. Notwithstanding the fact that the plates were quite well cleaned every day, the sweating of the outside battery-plates and the aprons from four batteries of the Empire mill yielded amalgam worth £3,958. This was the result of absorbed amalgam after one and a half years' run. The ore during this period averaged about £3 13s. per ton in free gold.

"*Grades of Plates.*—The grade or inclination of the inside plates is very variable. The grade or inclination given to outside plates varies with the amount of sulphuret in the ore, the amount of water used, and the fineness or coarseness of the gold. It is necessary to give the plates sufficient grade to prevent the deposition of pulp upon them. Heavily-sulphuretted and coarsely-crushed ores require the maximum grade. The frame supporting the plates should be so constructed as to admit of the grade being adjusted comformably to the requirements of the ore treated. Experiments will show the proper grade for the ore in question. The usual grade for the outside battery-plates is from 1½in. to 2in. per foot. The usual grade for the apron-plate is from 1½in. to 1¾in. per foot. The usual grade for the sluice-plates is from 1¼in. to 1½in. per foot. In most mills the sluice-plates are much narrower than the upper plates. This is a reprehensible system, since the depth and flow of the water become so great, being confined to the narrower channel, that some of the gold carried down by the deep and swift current entirely escapes contact with the plates. It is preferable to make the sluices the same width as the aprons.

"For the treatment of most ores, steeper grades for the plates, with less water, are to be preferred. By this plan the gold, &c., is rolled along, and brought into contact with the plates. The shaking-tables, described in the specifications, are an important adjunct to the system of amalgamation-plates. They should be of the same width as the sluice-plates, but set at a slightly less grade, the propulsion of the particles being assisted by the oscillatory motion imparted to the plates. There should be one or two drops along the line of plates, from 2in. to 3in. in height. This gives the gold an opportunity of coming in contact with the plates. It will be found that a crater-like deposit of amalgam accumulates around the point of impact of the dropping pulp. The frames of the plates (with the exception of the battery-plate, which is supported on a casting bolted on to the mortar) should rest upon bearings independent of the framework of the battery, so as to avoid the jar which would otherwise ensue. The plates are held in the framework by wooden cleats.

"*Quicksilver.*—Quicksilver is charged every half-hour or so into the mortars. The quantity added depends upon the quantity of gold in the ore as well as upon the physical character of the

gold. Finely-divided requires more quicksilver than coarse gold. Sulphuretted ores also require larger quicksilver charges than ores which contain no sulphurets. Ores of that character have a scouring effect on the plates, and also carry off, as loss, much quicksilver. The consistency of the amalgam on the outside copper plates indicates whether or not sufficient quicksilver has been added to the battery. When the amalgam is hard and dry more quicksilver must be added; but when it is too fluid to adhere to the plates the quantity of silver charged must be diminished. The amalgam should be sufficiently pasty in consistency to adhere to the plates, but not fluid enough to roll off the plates. From 1oz. to 2oz. of quicksilver is added to the battery for each ounce of free gold contained in the ore. The price of quicksilver fluctuates greatly. At present it is about £8 12s. per flask. The net weight of quicksilver in the flask is 76½lb. At this figure quicksilver costs 2s. 3d. per pound.

"*Quicksilver-loss.*—The loss of quicksilver per ton of ore is very variable. Where battery amalgamation is practised, heavily-sulphuretted ores, especially ores carrying galena and arsenical pyrites, occasion a large loss of quicksilver. Loss of gold undoubtedly accompanies the loss of quicksilver, but not to the extent asserted by many millmen. The loss of quicksilver at the Empire and North Star mills exceeds that of any mills in the State; but, *per contra*, there are few mills that save as high a percentage of the gold contained in the ore as these mills do. The loss at these mills is often as great as 1oz. per ton crushed. One ounce per 2 tons of ore crushed (1lb. for 32 tons) is about the mean quicksilver-loss for the mills of the State. A small part of this loss occurs through carelessness in handling the quicksilver and in retorting. Even after retorting the retorted gold often contains some quicksilver which has not been sublimed during the operation of retorting. This quicksilver is lost in the succeeding operation of melting the gold. The quicksilver-loss occurs generally through its being 'floured' and floated off with the water in extremely finely-divided particles.

"*Concentrators.*—From the distributing-box at the end of the line of copper plates the pulp is conveyed through 2in. pipes to the concentrators. The concentrators have various devices for saving the amalgam, free gold, and quicksilver that may not have been caught by the preceding appliances; but the pulp when it comes to the concentrator ought not to carry these substances. The quicksilver that, because of careless or imperfect amalgamation, finds its way to the belt of the concentrators is lost by volatilisation in the roasting of the concentrates, in their treatment by the Plattner chlorination process. The amalgam and free gold, when coarse, are but imperfectly recovered by the chlorination process. It is therefore important to save these substances, as above stated, before they pass to the belts of the concentrators.

"There is no preliminary sizing of the particles of ore in our gold-mills, and consequently the conditions essential to perfect concentration are lacking. Despite this serious disadvantage, some of the concentrators (the Frue and Triumph machines especially) succeed in obtaining clean concentrates with but a small loss of the auriferous sulphurets. There are the Frue, the Triumph, the Golden Gate, the Duncan, and the Hendy pan. The Triumph and the Frue machines are at present by far the most popular concentrators in use in California. Both of these machines are excellent concentrators. Each has features of superiority as compared with the other, and each has its special advocates among millmen. Briefly described, these concentrators (the Frue and the Triumph) have an endless travelling rubber belt, near the head of which the pulp is fed. The belts are carried upon a supplementary frame mounted upon springs. The table is slightly inclined, and the upper face of the belt travels up-hill. The heavier particles (sulphurets) settle on to the belt, and, adhering to it, are carried over the head of the table and deposited in a tank or wooden box below the table. The travelling belt is immersed on its return under the table to a depth of about ½in. in water, which is kept in the tanks to remove the sulphurets adhering to the belt. The deposition of the sulphurets is also assisted by a jet of water, which plays against the belt as it passes over the tanks. About one-half to one gallon of water per minute for each machine is used for this purpose. There is a patented arrangement used at the Empire Mine for removing the sulphurets from the belt and depositing them in a convenient place for shovelling into wheelbarrows. The specially-lighter particles (gangue) are carried downward by the current, and pass as tailings to the blanket-sluices outside of the mill. A reciprocating motion is imparted to the supplementary frame, by which the specially-lighter particles are kept in agitation and suspension, while those of greater gravity settle and adhere to the belt. The specially-lighter are carried off by the current, as above described.

"To facilitate the settling of the heavier particles, and to clean the sulphurets from all gangue, the battery-pulp is diluted by the addition of a small quantity of feed-water distributed on the belt near the head of the concentrator. This quantity of feed-water varies from one to two gallons per minute for each machine. There is a separate tank outside of the mill into which the overflow-water from the tanks below the belt is conducted, and the fine sulphurets carried in suspension by this water are collected. These fine sulphurets are generally much richer than the coarse sulphurets. The pulp should be evenly distributed over the concentrators to a depth of from $\frac{5}{16}$in. to ½in. This is called the load. The consistency of the pulp should be carefully observed and regulated to attain good results. This is effected by an increase or diminution of the feed-water of the concentrator.

"The Frue vanner has a distributer or spreader, and also, in some instances, a copper well in the spreader. The pulp from the battery passes into this well, and a portion of the amalgam and quicksilver escaping from the battery-plates, &c., is saved on the second board, which is sometimes covered with a silver-plated copper plate. The Triumph concentrator has also an amalgam- and quicksilver-saving apparatus. It consists of a cylindrical trough or bowl, into which the pulp passes before issuing on to the distributer. From 15lb. to 20lb. of quicksilver is placed in the trough or bowl. There is a set of revolving blades in the trough, which stir up the pulp and permit the quicksilver and amalgam to settle, while the lighter pulp is floated over to the distributer, and thence passes to the belt.

"The Frue vanner has a side oscillation of 1in., given by a crank-shaft making from 180 to 200 revolutions per minute. The belt of the Frue vanner travels from 3ft. to 12ft. per minute.

"The Triumph concentrator has an end-shake or oscillatory motion, imparted by a driving-pulley running 230 revolutions per minute. The belt travels from 3ft. to 4ft. per minute. The weight of the Triumph concentrator, boxed, is 2,270lb. The weight of the belt included in the above is 220lb. The weight of the heaviest part of the machine is 80lb. The weight of the Frue vanner, boxed, is about 1,900lb. These machines cost about £114 in San Francisco.

"The capacity of these machines varies with the character of the ore. Ores carrying a large percentage of sulphurets, or carrying sulphurets in a fine state of division (pyritous slimes), require more concentrators than ores which have a smaller percentage of sulphurets or sulphurets of a coarser grain. As a rule, two concentrators are used for each battery of five stamps.

"The concentrating-floor should be sufficiently large to provide a space of 20ft. long by 10ft. wide for each concentrator. Where space is to be economized these figures may be reduced somewhat. When a double row of the concentrators is used they should be placed head to head in front of the batteries. The heads of the concentrators of the first row are set away from the battery, and a passage-way of 5ft. to 6ft. is left between their heads and the heads of the second row of concentrators. A passage-way of 3ft. should be left between the sides of the concentrators. The level of this floor should be at least 9ft. below the lower end of the battery-floor, in order to provide head-room below the pipes which convey the pulp from the distributing-box to the concentrating-floor. The grades of the table, the speed with which the belt travels, the number of oscillations of the machine, the quantity of water fed to the belt, the quantity of pulp—*i.e.*, the load it carries—should be adjusted to conform to the requirements of the ore treated. These conditions must be strenuously maintained in order to secure good results in concentration. To secure regularity in the speed of the belts and in number of shakes, the concentrators must be run by power independent of the other machinery. At the most approved water-power mills there are special wheels for the concentrators. When the concentrator is connected with the main driving-shaft of the mill, the stoppage of any of the other machinery, as rock-breakers, batteries, &c., has a disastrous effect upon the work of the concentrator.

"*Labour for Concentrators.*—Three men—one head concentrator of a forty-stamp mill per twenty-four hours. The duty of the head concentrator is to repair the machines, oil them, &c., and also to attend to the machines while the assistant is raking out and removing the concentrates to the sulphuret-room. In a large mill, having eighty or more stamps, with thirty-two or more concentrators, for example, it is preferable to have one man per shift to attend solely to the adjustment of the machines, and an engineer to make repairs for all machinery about the mill. One roustabout can remove the accumulated sulphurets.

"*Concentrates or Sulphurets Room.*—Adjoining the concentrating-room, and on a level with it, on the sunny side of the building where practicable, there should be a room in which to store sulphurets. It should have a concrete floor, slightly inclined towards the centre, so as to drain the water from the concentrates. It should also have glass windows, to assist in drying the concentrates by solar heat.

"*Treatment of the Concentrates.*—The concentrates are treated by the Plattner chlorination process. This consists in roasting the concentrates in reverberatory furnaces to expel the sulphur, arsenic, and other volatile deleterious substances. Salt is added as the roast nears completion. The thoroughly roasted (dead roast) concentrates are charged into impregnation-vats, through which chlorine gas is passed. The chlorine gas is generated by the reaction of sulphuric acid upon salts and binoxide of manganese. The chlorine gas in the nascent state attacks the gold, forming with it terchloride of gold. Then water is added to the vats, by which the terchloride of gold is leached out. The lixivium is run into precipitating-tanks, where, by the addition of a solution of sulphate of iron, the gold is precipitated. This gold is collected upon filters, thoroughly washed, dried, and melted. Chlorination gold averages from 998 to 999½ fine. When the concentrates are argentiferous, as is often the case (rarely containing more than 10oz. to 15oz. of silver per ton), the silver, which has been converted into the chloride of silver by the roasting with salt, is leached out by hyposulphite of soda (or of lime), the lixivium run into precipitating-tanks, where the silver is precipitated by the addition of a solution of polysulphide of sodium (or of calcium). The sulphide of silver is collected upon filters, washed, and dried, and then reduced to the metallic state. A chlorination plant, with a capacity of 6 tons per twenty-four hours, costs from £1,250 to £1,458. It costs, with such a plant, about £2 0s. 8d. a ton to treat the concentrates. About 92 per cent. of the assay-value of the gold contained in the concentrates is recovered. Some of the large mills have their own chlorination-works, but most of the mills have the concentrates treated at custom chlorination-works situated in the district. Most of the important mining districts have custom chlorination-works. These works charge about £4 3s. 4d. per ton to treat the concentrates, and guarantee a return of 90 to 92 per cent. of the assay-value of the gold in them.

"*Blanket-sluices.*—The length of the blanket-sluices outside the mill is governed by the value of the tailings from the mill. From 100ft. to 200ft. usually suffice. These sluices have a grade of from 1in. to 1¼in. per foot. The sands collected on these blankets are usually ground in a pan used for that purpose. These pans have a diameter of from 3½ft. to 4ft., and are essentially like those used in silver-mills.

"*Tailings.*—The pulp leaving the sluices is called the 'tailings' of the mill. In order to keep a proper supervision over the mill-tailings, samples ought to be taken several times during the day and night, and the value of the tailings ascertained. Millmen are exceedingly remiss in this regard, as very few mills have any systematic method of sampling and assaying the tailings.

"At the Original Empire mill there is an automatic tailings-sampler, the invention of Mr. Starr, the superintendent. This machine can be regulated to take samples as frequently as desired. The samples are taken every hour, and the pulp assayed three times a week. The samples ars

examined carefully to ascertain to what the loss is to be ascribed. Microscopical examinations of the sands should be made occasionally, to ascertain if a perfect liberation of the particles of gold from the gangue has taken place. Such thorough sampling is a check upon the men at the concentrators, and causes them to be alert and zealous in the discharge of their duties. Very beneficial results have followed the introduction of this system, and it is to be strongly commended to all superintendents. The wooden batea and miner's gold-pan are used for panning out.

"The average value of the ore worked is the value of the gold saved, *plus* the value of the sulphurets saved, *plus* the value of the tailings lost. From these factors is calculated the percentage of gold saved by the mill. This represents the efficiency of the process. Other things being equal, this will vary with the character of the ore. Where the gold is very fine, and where the sulphurets are of a brittle character, the percentage saved will be less than in the treatment of more favourable ores. Most of the loss occurs in the loss of sulphurets; consequently ores carrying a large percentage of rich sulphurets may have comparatively rich tailings. There are few ores in mines in operation in this State from which 80 per cent. and upwards of the assay-value cannot be extracted by skilled millmen with good mills. The majority of mills save at least 75 to 85 per cent. of the assay-value of the ores. Careful investigation at the North Star and Empire mills, carried on for a year and a half, show a saving of from 82 to 94 per cent. of the assay-value, deduced as explained above. The usual percentage saved, according to reliable semi-monthly reports from these mills, is from 86 to 90 per cent. of the assay-value of the ores. In these estimates, of course, no deduction is made for the loss of gold in the subsequent treatment of the sulphurets, usually unimportant in this connection.

Mill-labour per twenty-four hours (forty-stamp mill)—	£	s.	d.
One man at rock-breaker at $2·50 per day	0	10	4
Two amalgamators at $3 per day	1	5	0
Three concentrators—one at $3 and two at $2·50	1	13	4
Total	3	8	8

"The rock-breaker man also attends to the blanket-sluices, and is employed at other tasks about the mill. Where steam-power is employed, in addition to the above force two engineers and one man to pile the wood near the boilers, &c., are required.

Cost of milling per ton in forty-stamp mill, with water-power, having a capacity of eighty tons in twenty-four hours—	s.	d.		s.	d.
Mill-labour as above	...			0	10¼
Assaying, retorting, and superintendence	...			0	1¼
Castings	0	3½	to	0	5
Quicksilver	0	0¾	to	0	2
Lubricants, screens, illuminants, machinists, lime, and incidentals	0	2	to	0	4
Total	1	5¾	to	1	10½

"To this must be added the cost of water-power, which is very variable. Where steam is used the above estimate should be increased about 5d. per ton for labour. Repairs, lubricators, &c., incident to the use of steam-power plant increase the cost about ½d. per ton. An electric plant to illuminate the mill, office, &c., costs about £125. The cost of producing the light is little beyond the cost of the power to run the dynamo. Good illumination is very desirable about a mill.

"The charge for assaying, retorting, and superintendence is based upon the salary of £25 per month for a man to perform these duties in addition to rendering other servicess—*i.e.*, clerk, timekeeper, &c.—about the mine. One half of his time is charged to the cost of working, while the other half is charged to the cost of mining. At some works the superintendent of the mine performs these duties.

Power for a forty-stamp mill—	
1 rock-breaker	12 horse-power.
40 stamps	66 "
16 concentrators	8 "
8 shaking-tables	2½ "
1 clean-up pan	1½ "
1 revolving barrel and batea	2 "
Total	92 "

"The revolving barrel, batea, and clean-up pan may be run while the rock-breaker is stopped, thus saving 3½-horse power. About ninety-horse power will be required for a forty-stamp battery.

"Where the cost admits of its use, water-power is preferable to steam-power. The use of water for power effects a saving in—(1) the cost of a steam-plant; (2) the cost of labour; (3) the cost of fuel (the cost of fuel is from 12s. 2d. to £1 0s. 8d. per cord in California: it takes from one-fifteenth to one-eighth of a cord of wood per ton of ore crushed); (4) the cost of repair of engines, boilers, lubricants, &c.; (5) it decreases the liability of fire, and affords at the same time a means of extinguishing fires; (6) the water-power is more constant than steam-power. When water-power is used in California the power is developed, where sufficient pressure is attainable, by improved hurdy-gurdy wheels. These wheels revolve vertically. They have buckets of various designs set radially upon the periphery of the wheel. The water is projected through a nozzle against these

buckets, and generates the power. Where water under high pressure cannot be obtained Leffel's turbines, or overshot water-wheels, are used. Of the class of hurdy-gurdy wheels, the Pelton and Knight wheels are commonly used. The power developed by the Pelton may be placed at about 75 to 80 per cent. of the theoretical power of the water. Under more favourable conditions this wheel is capable of developing several per cent. higher efficiency than the above figures."

In regard to gold-mining, C. H. Aaron, a distinguished metallurgist in America, in writing for the *Engineering and Mining Journal*, of New York, of the 10th and 17th of August last, gives a great deal of useful information with reference to the treatment of auriferous ores. He states "that in many gold-quartz mills no attempt is made to ascertain the true contents of the gold in the ore that is crushed; consequently the proportions of recovery and loss are not known. This seems to be due in part to the conceit of some millmen, who imagine that what they fail to save cannot be saved, and in part to an idea that it is not possible to obtain samples of the ore which will correctly represent the average. The question of individual skill and ability is beyond discussion. It is contended by many that the average loss of fine gold, and, where concentrators are used, of gold in sulphurets also, is below the estimates of many writers and workers, some of whom put it as high as 30 per cent.; but it is admitted by all that there is a loss: and the reduction of that to the lowest possible limit consistent with the object in view, which is profit, should be the subject of constant endeavour; and the most likely thing to promote such endeavour is an exact knowledge of the extent of the loss in percentage of the original content of the ore."

The absolute loss is easily ascertained if proper precautions are taken—namely, to assay the tailings and also to ascertain the quantity of float-gold that passes off in the water. Experiments recently made at the Spring Gully Mines, Thornborough, Hodgkinson Goldfields, Queensland, when treating ordinary clear white auriferous quartz, proved that there was a considerable loss of gold that was carried away with the water and did not remain in the tailings. Steps were taken to ascertain this loss, as it was found that the assay-value of the ore and the quantity of gold saved, together with the assay-value of the tailings, did not agree, and in order to determine in a practical manner the cause of the discrepancy the following experiment was carried out: Two batteries of five stamps each, side by side, were fed equally from a heap of quartz weighing 100 tons. The crushed material in both cases passed over amalgamating-plates. From one battery the tailings were deposited in a pit from which the water overflowed; and from the other battery the tailings were led into a pit with a filter bottom, which had a holding-capacity of 500 tons. The water from this pit was not allowed to overflow, but it filtered through the crushed material and escaped from the bottom. In both cases the yield of gold from the ore caught in the battery and on the plates was equal to 1oz. 10dwt. per ton. The tailings from both pits were carefully sampled and assayed, and in the pit where the water overflowed the returns were 7dwt. of gold per ton, but in the pit where the water filtered though the bottom, the returns were 15dwt. to the ton, thus showing that there was a constant loss of 8dwt. of gold per ton that was carried away with the water. This experiment is quoted by Mr. Florence O'Driscoll in his book on the treatment of gold-ores.

During my recent visit to the Thames experiments were made on the water coming from the mines, which showed that a considerable quantity of gold was carried away in solution in the water coming out of old workings. This should be carefully looked into, and if found in appreciable quantity the gold might be precipitated and collected by a cheap and simple process.

Mr. Aaron does not, however, take into account the loss of float-gold when he states that the weight of the tailings being equal to the quantity of ore crushed, the assay of these will give the loss of gold in the treatment. He goes on to state: "In some cases—that is, when the gold is distributed in extremely small particles through the gangue, samples of ore can be taken before it goes to the battery with the same facility as in the case of smelting-ores. Samples should be taken every hour from the feeders or from the breakers, and the accumulation of each twenty-four hours well mixed, crushed by a small breaker, reduced by quartering to the proper extent, and the resulting quantity passed through a fine sieve for assay. Any coarse gold that does not pass through the sieve must be separately estimated, and the assay of the powder corrected in the usual way as explained in works on assaying.

"In case the rock contains a considerable proportion of coarse gold, the battery-samples will be unreliable, and the required information must be obtained in a different way. The weight of the tailings equals that of the ore crushed except where concentration is practised, in which case it is only necessary to deduct from the known weight of the ore crushed that of the concentrates, in order to obtain the weight of the final tailings. If now the tailings are properly sampled and assayed, and their total value for a given period is added to that of the amalgam and of the concentrates for the same period, it will furnish the data necessary for calculating the percentage loss in crushing. The subsequent loss in treating the concentrates is another matter. It will, of course, be necessary to weigh the ore that is sent to the mill, and to correct the weight for moisture in case the ore is not dry: this is an easy matter if proper arrangements are made.

"By 'free gold' is meant gold which, originally inclosed in the gangue, has been or might have been released by mechanical means, and, while including such gold as, though imbedded in galena and other sulphurets, can be released by crushing the enclosing substance, excludes that portion of the metal which exists in sulphurets, in such a condition as to be practically incapable of amalgamation in the batteries or on the plates. The first thing is to ascertain how much of the gold has been carried off in the tailings. There should be a systematic weighing of the ore crushed in each run, and sampling of the tailings, both of which can be done automatically. The concentrates must also be weighed, and a correct sample taken and sealed in a bottle, in order that the percentage of water and the gold-value per ton may be ascertained. Next, an investigation should be made as to the manner and causes of the loss, as a guide to the direction in which to seek such remedy. Amongst these causes are or may be the following:—

"(*a.*) *Flotation.*—The loss of this will increase, firstly, with the fineness of the gold-particles; secondly, in absolute quantity, though not in percentage of the whole, with the richness of the ore in such fine particles; thirdly, in percentage, though not in absolute quantity, with the poverty of the rock in such gold; fourthly, with the quantity of water used; fifthly, with the muddiness of the water—hence a just medium must be found in this respect by trial, so much water being used to dilute the mud as far as possible without causing much of the gold to be swept away by the too-forcible current (in connection with this, the inclination of the plates must be considered, and it seems probable that Gauthier's shaking-apron will be found very useful by allowing less inclination with a given quantity of water, or less water with a given inclination); sixthly, on the degree to which the coarser particles of gold and the amalgam are abraded and comminuted by the stamps, which indicates that the prevalent practice of amalgamating as much as possible in the mortars by means of fine screens, high discharge, and a minimum quantity of water in the battery, with a proportionally greater addition on the plates, may not always be the best, and that the grinding action claimed for revolving stamps may not be an advantage."

"(*b.*) *Enclosure in Particles of Gangue.*—Evidently there is no remedy for this but fine crushing. But a consideration of the causes of loss under (*a*) will show that there is a limit in practice to the fineness to which ore can be crushed in one operation with advantage, for the finer it is crushed the more will the particles of gold be comminuted, as well as the rock, and the more will the settling of the gold to a contact with the amalgamated plates be obstructed by the fine particles of rock with which the water will be charged to excess. This suggests that in some cases it will be found advantageous to submit the ore to two distinct operations of crushing and amalgamation, with an immediate separation of slimes. This is done, in effect, at the Plumas Eureka Mine, where tailings from the mill are taken up by Italians—who pay a royalty for the privilege—and passed into wide, shallow boxes, which retain the sand while the slimes pass on. The sands are then ground and amalgamated in arastras driven by water-power. There are about thirty arastras thus occupied on the tailings from that mill.

"(*c.*) *Inaptness of Gold to amalgamate.*—The difficulty occasionally met with in causing the gold to unite with the quicksilver is sometimes due to a film of iron-oxide or other substance which envelops the auriferous grains: this is notably the case with gold in beach-sand, which sometimes obstinately refuses amalgamation until cleaned by chemical or mechanical means."

When gold in quartz is in this condition it may be benefited by a certain amount of grinding; but it is probable that the difficulty is sometimes caused by the quality of the water used. Mr. William Skey, Colonial Laboratory, has made a study of this subject, and states that the presence of iron-sulphate in water is injurious to amalgamation; and this is often found in water coming from a mine, which is sometimes used in the battery.

It has been proved that gold which has been hammered does not amalgamate well, and especially when hammered in presence of quartz or other matter, particles of which adhere to the metal and prevent the contact of quicksilver—which is another argument in favour of two or more separate crushing and amalgamating operations. The temperature of the water used has a considerable influence, and in some mills the water for the batteries is warmed artificially in cold weather. Also, some drift-gravel mines suspend operations during the winter for the same reason.

In one instance, at least, it has been found advantageous to allow a small stream of a solution of potassium-cyanide to flow constantly into the battery, and Mr. Aaron states it would be better still if some red oxide of mercury were dissolved in the cyanide solution. In such a liquid every particle of gold becomes coated with quicksilver. It has been found that gold out of beach-sand which refused to amalgamate, even with the aid of potassium-cyanide, yielded instantly in the presence of mercury-cyanide in potassium-cyanide solution. As these salts are rather expensive, it would be well to save the water and use it again in the battery, if it could be cleared sufficiently of slimes. A little lime would be useful also if there should be any soluble iron or copper salt in the water.

"(*d.*) *Impure Mercury.*—It is generally understood that the presence of lead, copper, mercurous-oxide, sulphur, &c., in the mercury is injurious to the amalgamation of gold. Sometimes the ore contains sulphate of lead, which, being to some extent reduced to a metallic state by the chemical action of the iron in the battery, will amalgamate with the quicksilver. In a similar manner soluble salts of copper either in the ore or in the water cause a precipitation and amalgamation of copper, which, although less injurious than lead, and in one way beneficial, by causing the iron surfaces to become coated with quicksilver, thus giving additional opportunity for catching the fine gold, is still injurious. In all such cases the quicksilver strained from amalgamation should be purified before being used again.

"It seems probable that the injurious effect of base metal in the quicksilver may be due rather to the formation of oxides than to the metal itself: at all events, the effect is bad; and those who have investigated the subject have come to the conclusion that pure mercury, or silver-amalgam, is best, although there is some reason to think that zinc-amalgam is sometimes useful; and cadmium-amalgam shows remarkable readiness to attach gold to itself.

"There are some instances of gold failing to amalgamate immediately in pans, where the material treated was a coarse sand saved from the tailings in 'riffle-sluices' and containing gold to the value £4 15s. per ton, also a little iron-oxides and a few sulphurets. After grinding in the pans four hours the mullers were raised, quicksilver was added, and the working was continued two hours. No gold was found in the quicksilver, and the tailings assayed the same as at first. After trying repeatedly with the same result, the sand was ground to an impalpable pulp, allowed to dry during a couple of days, and then worked in the pan with raised muller. By this method from 85 to 90 per cent. of the value was recovered. It is to be presumed that the gold was in the fine particles of pyrites, which become oxidised on exposure when finely ground.

"In order to remove small quantities of copper and lead from mercury retorting is not necessary.

Such impurities may be removed by simply keeping the quicksilver for some hours in a wooden or suitable vessel—for instance, an enamelled pot—under dilute nitric acid, which is better warmed, and occasionally the metal should be stirred. The acid will dissolve the copper and lead until it becomes saturated; it may also dissolve some mercury, but that will be deposited again when a fresh lot containing copper and lead is treated with it; or the dissolved quicksilver may be recovered by immersing a piece of copper in the liquid. It is likely that the amalgam removed from the plates will contain a little copper, and it might be as well to keep the stock of quicksilver always under dilute nitric acid; when wanted for use it should be washed with clean water. The precipitation of lead or copper in the mortars may be prevented by adding a little soda or milk of lime to the water used, or by causing that to flow over broken limestone, if the difficulty is in the water itself, and not in the ore. Oxygen, sulphur, and chlorine may be removed from quicksilver by the addition of sodium-amalgam, but an excess should be avoided. Lead is not usually wholly removed by retorting, unless the quicksilver is covered to a depth of an inch or two with powdered charcoal. Leady quicksilver retorted once without charcoal will show a residue of lead when distilled a second time with charcoal.

"(*e.*) *Bad Condition of Plates.*—Discoloration of the amalgamated copper plates, indicating oxidation of copper, is one of the difficulties of gold-millmen. This is an interesting and important subject for investigation, in regard to which many inquiries have been made. The electro-plating of the copper surfaces does not seem to be efficient in preventing discoloration in all cases, and it is not universally favoured by millmen. Some consider silver-plating as very advantageous, while others say it is void of merit. One gentleman observed that, although silver soon wears off, yet when this occurs it leaves the plate in good condition for saving gold. A remarkable fact is that in the lower mill of the Sierra Buttes Company they discarded silvered plates for the reason that silver disappeared too soon, and that it cost too much for frequent replating; while in the upper mill of the same company it is—to use the language of the superintendent—"impossible to work without silvered plates." The only observed difference between the two cases is that in the lower mill the ore contains a small portion of sulphurets, chiefly iron-pyrites; while the upper mill works surface-ore with no sulphurets. But in the Plumas Eureka mill the ore contains pyrites as well as galena, and in the mills in the Washington District, in Nevada County, they have pyrrhotite and zinc-blende; yet all these mills use silvered plates. In the latter mills it is found that with plain copper plates the quicksilver soon wears off. In connection with this the following results have been obtained by experiment: Pieces of sheet-copper were coated with quicksilver and exposed to immersion in Spring Valley water. The plates, which were amalgamated with the aid of nitric acid and mercuric chloride, became tarnished in a few minutes, and on being cleaned with a solution of potassium-cyanide, washed in water, and again exposed, were again promptly tarnished, and so on indefinitely. Plates amalgamated by means of potassium-cyanide, not using nitric acid, resisted tarnishing during the first hour, after which they behaved in the same manner as those on which nitric acid was used. Tarnishing was lessened by using slaked lime in the water, also by a small quantity of ferrous sulphate, and also by a trace of potassium-bisulphate; but not at all by caustic potash. Tarnishing was permanently prevented by placing an iron nail in contact with the amalgamated strip of sheet-copper; also by contact with a piece of zinc. This makes a galvanic couple, and the oxidation is transferred to the more positive iron or zinc. Iron-pyrites on the plates had no perceptible effect. One of the strips was then smeared with zinc-amalgam, and it remained bright for a number of hours, but after twenty-four hours it became slightly tarnished. One of the strips, treated with a little mercury containing a little cadmium, retained its colour three days.

"In view of these and other known facts, millmen who have trouble with their plates are recommended to make experiments, each separately, as follows: (1.) Place some bars of iron on the apron—say one across the upper end and one on each side edge, also one in the middle. (2.) Use zinc-amalgam on the apron. (3.) Dissolve a little cadmium in the quicksilver for use on the apron and in the mortar. (4.) Fix a tank so as to deliver a small stream of water containing potassium-cyanide into the mortar constantly while crushing.

"The above has been done in some mills with good effect. Those who have occasion to work auriferous material in pans would do well to try a solution of potassium-cyanide in which a little red oxide of mercury is dissolved: the effect of this solution is to coat every particle of gold with quicksilver, which greatly aids the amalgamation. Not too much of the solution must be used, as it dissolves gold. However, it is believed that the dissolved gold can be recovered by using zinc-amalgam in the pan towards the end of the operation. Before adding the solution, the pulp should be made slightly alkaline by the addition of potash or soda. It is believed by many that zinc-amalgam is very effective in catching gold, and still greater efficiency is claimed for cadmium-amalgam. The presence of zinc-blende in the ore has probably a favourable effect on amalgamation by tending to prevent the oxidation of the plates, with which it forms a galvanic couple in the same way as a piece of zinc does.

"As to the loss of auriferous sulphurets, admitting that the best-known concentrators are used with requisite skill and care as to the adjustment of the machine, and the quantity of ore and water supplied to it, the manifest causes of loss are similar to those of free gold under (*a*) and (*b*). Flotation is prompted by the fineness of the particles of sulphurets, by the quantity and rapidity of the flow, and the turbidity of the water; to which may be added two other causes—namely, the tendency of cubical grains, as of some galena and pyrites, to roll down the inclined apron of the machines, and the property which some sulphurets have of not being wetted by water, in consequence of which, though specifically heavier than water, and remaining submerged when once beneath the surface, they will float if removed from beneath the water and again assailed by a wavelet. This phenomenon was observed particularly in Arizona, where ore containing copper-pyrites was treated on an Embrey concentrator, which is a travelling belt with an "end shake." The sulphurets would remain on the belt until the travel had carried them to a point beyond the jets,

when the reflux of water would leave them stranded, as it were; and when again overtaken by the wavelet produced by the "end shake," or longitudinal oscillation of the belt, would float. On viewing the belt from a suitable position, the surface of the water upon it was seen constantly covered by the floating particles. The attempt to concentrate the ore was a failure, the waste being too great. Perhaps a machine of a different class would have been more successful.

"The loss of particles by rolling will be probably prevented by the new corrugated belts which are now being introduced with the Frue machines. Some loss of sulphurets may be occasioned by their not being entirely separated from the rock-particles, in consequence of which there is not sufficient difference of density between the compound mass and the particles of pure gangue to enable a separation to be effected. The percentage which is lost is even more rarely known than that of gold, and is more difficult to determine. The percentage of value saved from that going on to the concentrators is readily found by assays of the pulp supplied to the machines and of the tailings leaving them, corrected for the proportion of the weight which is retained as headings. Thus, suppose the material to be concentrated assays 10s. per ton, and the tailings assay 1s. per ton, while one ton in ten is retained as headings, we have in 10 tons of material a value of £5, and in 9 tons of tailings a value of 9s. Consequently the 1 ton of headings must contain a value of £4 11s., or 91 per cent. of the total contents.

"The loss of quicksilver on the mother-lode varies from ½d. to 1d. per ton of ore, usually according to the richness of the ore. The monthly loss at the Keystone mill one year was 1,276oz. troy, and 10oz. additional in retorting. In another mill the loss was 861oz. troy and 10oz. additional in retorting. At the Bunker Hill Mine 67½lb. avoirdupois is lost monthly, with about the same number of tons of ore crushed as at the other mills—say 100 tons per day, or 3,000 tons per month. Testing tailings in a horn at these mills does not show any quicksilver or floured amalgam usually, but only apparently a trifling amount of sulphurets. The loss of mercury is caused largely by floating, and is usually less when the outside plates are cleaned up every day or two. In the few cases in which the loss is stated in gold-mills, it amounts to only a small fraction of an ounce to the ton of ore, and does not of itself constitute a serious item of expense.

"The question suggests itself whether the lost mercury is charged with gold, which is therefore also lost. That some amalgam passes the aprons and plated sluices is proved in the North Star mill, Nevada County, where Gauthier's shaking amalgam-table saves £10 per day between the sluices and the concentrators. In this case the greater portion of the amalgam would most likely have been saved by the concentrators had not the shaking-apron intervened, and, though the mercury would have been lost in the subsequent treatment of the headings by roasting and chlorination, the gold would have been saved, *minus* the loss that would accrue during that treatment. But, aside from the fact that it is not desirable to have amalgam mixed with the concentrates for treatment by chlorination, there are many cases in which concentrators are not used. In such cases the loss of £10 per day would not be insignificant in any mill, however large.

"It is generally supposed by millmen that if they find but little amalgam or none on the lower plates they are saving all the gold, or, at least, the loss is infinitesimal. That this may be an erroneous supposition is shown by the fact that the Spanish mill amalgam is collected on the lower portion of the tail-plates, when none is found near the upper end; and a significant circumstance is that it is collected at a point where a curve is formed by reducing the pitch of the plates. The effect of a curve in the plates is worth attention. Mr. Tregido and others have found by direct experiment that a curved plate collects more gold than a flat one, and that a convexity is better than a concavity. That which collects gold will also be likely to collect amalgam and mercury. In the Plumas Eureka mill 76lb. of mercury is lost in working 4,600 tons of ore. The proportion of gold contained by dry amalgam varies with the degree of comminution of the gold from one-half to one-fifth. If we admit that mercury is lost in the form of dry amalgam containing one-fifth of its weight of gold, the above quantity represents 95lb. of amalgam, containing 19lb. of gold. However, it may be conceded that not all the lost mercury is in the form of dry amalgam.

"As to the causes of the loss of mercury, it may be well supposed that a portion of that loss is due to ordinary wear—that is, the metal is to a certain extent subject to attrition by sand and water, the result being a quicksilver-dust of such extreme fineness as to be incapable of being recovered. Another portion is lost by handling, by adherence to the fingers of the workman, by splashing when poured, &c., and it is quite possible that a little may become oxidized or combined with sulphur or other mineral matter from the ore. Some undoubtedly evaporates at ordinary temperatures, though in scarcely appreciable quantities. In the process of retorting the amalgam there may be a failure to expel all the quicksilver, a portion of it remaining with the gold, and not all that is expelled is condensed and collected as at the Keystone mill, where 10oz. are lost monthly. Another way in which some quicksilver may be lost in gold-mills, as it certainly is in silver-mills, is by adherence to metallic particles which are attached to the gangue. In this case it is the gold that steals the quicksilver, instead of the reverse.

"The discovery of the cause and prevention of undue oxidation of the plates will obviate one important source of loss of amalgam. Frequent removal of the amalgam from the mortars seems to be beneficial, and the common practice of running a month, or until the shoes and dies are worn out, before cleaning up, appears to be bad. Therefore, on account of the waste of amalgam by abrasion or extreme comminution, it might be found profitable to clean the batteries, at least partially, every two or three days, notwithstanding the loss of time in so doing.

"As a substitute for silver-plating, some millmen smear the amalgamated plate with silver-amalgam. There is some diversity of opinion and practice in the matter of preparing the copper plates when not silvered, and some operators think they have a process of unequalled efficacy. It makes no difference as to how the mercury is induced to attach itself to the plate, unless it may be the expense, provided the amalgamation is thorough, and that any chemicals used in the process are afterwards completely removed by washing. An efficient way in which to amalgamate a plate

is to first clean the surface thoroughly by pouring on nitric acid of such a strength as to bite promptly and effectively; then wash repeatedly with clean water; next pour on a solution of corrosive sublimate, which will cover the entire surface with a slight film of mercury; again wash, and then, on pouring quicksilver upon the plate, it will spread over the entire surface with the greatest facility—even a film of oil on the plate cannot prevent the spreading or adhering. A method preferred by some, though more laborious, is to scour the plate with sand until it presents a bright and clean surface, afterwards rubbing it with quicksilver and a solution of potassium-cyanide. Others prime the plates by means of a solution of mercury in nitric acid, following that with metallic mercury. One gentleman claimed magical virtues for his process of amalgamating a plate by rubbing it while dry with a red powder, the composition of which was his secret. The powder had the appearance of iodide of mercury, and an experiment showed that a copper plate rubbed with dry iodide of mercury became amalgamated and possessed the precise property claimed as peculiar, which was that sulphurets would adhere to such a plate with sufficient force to prevent their falling off when the plate was turned over. Unfortunately for the magic powder, another plate, amalgamated with the aid of nitric acid, had the same property."

Professor Black, of the Otago University, advocates amalgamating the plates with sodium-amalgam, and deprecates the use of nitric or other acids in silvering the plates. He calls attention to the loss of gold and mercury caused by a green salt or scum that often grows on the plates newly amalgamated. This, however, is due to the plates not being properly washed with clean water after using the acid. He describes the process of amalgamating the plates as follows: "(1.) The plate is thoroughly cleaned on the side which is to be amalgamated by rubbing it perseveringly with a wet cloth and fine sand. The rubbing must be continued until there is not a speck or spot or stain left on that side of the plate. (2.) It is then, without a moment's delay, rubbed vigorously for, say, ten seconds with a cloth steeped in a strong solution of caustic soda or caustic potash. Ten or twelve inches of soda- or potash-stick, dissolved in a pint of water, makes a suitable solution for this purpose. (3.) A solution of 4-per-cent. amalgam, in dry mercury, is now, without a moment's delay, rubbed into the surface of the copper plate with the same cloth that was used for rubbing in the soda or potash. The rubbing is continued, with small additions of the dissolved amalgam, till the surface of the plate appears in a satisfactory condition. A little more dissolved amalgam is then poured on, and spread uniformly all over the surface, and the plate is ready for use." It is very questionable if this process of amalgamating the plates has any advantage over the process described by Mr. Aaron. It is certainly more laborious, and, if proper care is taken to wash every trace of the nitric acid from the plate, the process of silvering with corrosive sublimate is certainly the easiest, and answers the same end. The great object to be attained is to silver the plates in such a manner that they will not easily tarnish, and will present a bright, clear surface, and as long as this is attained it is of no consequence what process is adopted consistent with economy.

Mr. Aaron goes on to state: "It does not require any great skill to amalgamate copper plates; but to keep them always bright and active while in use is more difficult. What seems, however, to be a good plan is to anneal a new plate before amalgamating it. This softens the hard film produced by the rolling-mill, and leaves the plate in a better condition for catching the gold on its surface.

"There is in most gold-mills a want of intelligent adaptation of means to the end sought in amalgamation. The finer particles of gold are those which are most liable to be carried away in suspension, and which consequently require the greatest feasible exposure to the possibility of contact with the amalgamated surface of the plate. The coarse gold is amalgamated in the battery; the coarser of those particles which are thrown out of the mortar by violent agitation of the water within are readily arrested on the apron. What, then, is the object of the plated sluices through which the pulp is afterwards conducted? Manifestly it is to save those finer particles which continue to move with the current. Is it, then, philosophical to increase the volume of that current by restricting it to a narrower channel, which is done in almost every instance, as will be seen in the late report of the Mining Bureau, the aprons having a width of from 4ft. to 5ft., while the plated sluices are only from 14in. to 16in. wide. If the sluice were turned sidewise to the stream, the plates curved as a segment of a cylinder, and the pulp spread over a width of 12ft., instead of 16in., and at the same time suitably diluted with clean water, it would probably deposit more of the suspended gold in the 16in. of transverse across the plate than it now does while rushing through 12ft. length with only 16in. of breadth. The principle has been demonstrated to be correct by actual experiment.

"There is a manifest tendency towards an increased use of wire-gauze screens in wet-crushing mills in some parts of the State. It has often been asserted, and is perhaps generally believed, that brass-wire screens cannot be used with quicksilver in a battery, and for this reason screens of that character have been left generally to silver-mills, while even they have more commonly used punched screens for wet work. The general idea is that brass screens will become amalgamated, and that first choking and then destruction of the screens will ensue; but this does not seem to be the case—which will not greatly surprise any one who has had to amalgamate brass without using some kind of chemical to induce adherence of the mercury. With some ores, especially those which contain zinc-blende, the brass screens have been known to become amalgamated in twelve hours without the use of chemicals in the battery.

"Screens made of common tin-plate, punched in the usual manner, are being used, to the astonishment of many, who had supposed that the mercury would lay hold of the tinned surface, and cause choking of the screen, whereas, in fact, the special merit claimed for tin screens by those who use them is freedom from choking, which may be due to the thinness of the plates. Tin screens are used in Amador County by one or two mills. The tin is burned off previous to using. They do not last long, but the old screens, having little or no gold attached, are returned for new ones pound for pound, and they are found to discharge well."

"In many, if not all, of the best gold-mills the screens are not more than 8in. high—often not more than 6in.—and experience proves that this is ample, and that the old style of 14in. to 16in. high has no advantage over the present.

"In batteries the tendency is towards heavy stamps, some of the new mills having them 1,100lb. weight, while 1,000lb. stamps in some sections are becoming quite common. Another change is the increasing substitution of riffles for inside plates. The riffles are cast on an iron back-plate, which is fixed in the mortars, and are said to catch a great portion of the amalgam. Steel shoes and dies are considered more economical than iron, and are being more generally used than formerly. In some Californian mills, as well as in Silver the King mill, in Arizona, it has been found that steel dies become worn in holes, and so irregular as to be rendered useless long before they were worn down to the requisite size for abandonment; while the shoes remained in excellent form. In these cases cast-iron dies were used with steel shoes very advantageously. The inference to be drawn from this irregularity of the wearing of the dies is that the material of which they were made was of a bad quality. It is commonly stated at the mills where steel is used that the shoes and dies of Eastern make are much superior to those made in California, and at the Plumas Eureka mill the English article is declared to be better than either of the others.

"Tappets and cams of steel are now becoming common, and give great satisfaction. The tappets are generally counterbored, and this practice is also being applied, though less generally as yet, to cams. The effect of the counterbore is to give the cam or tappet three points of contact with the shaft, instead of only two as when the core is circular, the counterbore being slightly oval, with the longer axis passing through the key-seat in the cam, or the gib in the tappet. This gives greate stability by preventing oscillation or wobbling.

"In regard to the weight of the stamp, it must be remarked that nominal weight, as given at the foundries, is greater than the actual weight. The former is the gross weight; the latter the net weight of the finished stamp, including stem, boss, and shoe. The difference may be 50lb., by which amount the reported weight must be reduced in general. Unfortunately the most advantageous weight of stamps for crushing gold-quartz cannot be deduced from a comparison of the stamp duties in different mills, because the stamp duty is a function of many different quantities. The hardness of quartz, as tested by scratching, is nearly uniform, but the facility with which it may be crushed depends greatly on its texture, as whether it is friable, like that of the Yuba Mine, or compact. The size of the lumps of ore falling under the stamps exercises an important influence on the stamp duty, for, while a large piece manifestly requires more force to crush it than a small piece, it unfortunately happens in a battery that the larger the piece the less force is applied, because the drop of the stamp is proportionately reduced at the time when it should be increased. For the same reason the manner of feeding makes a great difference, high feed taking more from the fall of the stamps than low feed.

"Naturally, the more the rock is broken into small pieces before it goes to a battery, the lower and more uniform can the feed be made, and the less drops will the stamps require; hence the frequency of the drops can be increased, and more ore can be crushed with the expenditure of a given amount of power in lifting the stamps.

"At the Silver King mill, in Arizona, the stamp duty with a given drop was increased fully 20 per cent. by the use of a good rock-breaker, as compared with the results of breaking by means of hand-hammers. Then, not only the grade of screen used, but the height of the discharge above the dies, the width of the mortar, the extent and rate of stamp-drop, the quantity of water used in the battery, the proportion of the sulphurets, all influence the rate of crushing, even though the ore may be essentially quartz; and when different kinds of rock also enter into the question it becomes so much the more involved.

"In the Delhi mill stamps of different weight are used—namely, 1,000lb. and 1,100lb., the screens and drops being equal. This would afford a good basis for comparison but for certain circumstances. In the first place the diameters of the shoes are not proportioned in the ratio of the weight, being respectively 9in. and 10in., giving the crushing-surface ratios as 81 to 100, while the weight-ratios are as 90 to 100. In the second place, the heavier stamps are five in battery while the lighter are but four, which places the latter at a disadvantage in two ways—first, because the order of the drops cannot be so well arranged, in consequence of which two adjacent stamps follow each other, which is a disadvantage; second, because one-half of the four stamps are necessarily end stamps, while in the other case only two-fifths are end stamps, and it is conceded that the end stamps do less crushing than the others in a mortar. Thus the statement of the mill foreman that the five-stamp batteries crush one-half ton per stamp a day more than the four-stamp batteries, while doubtless true, cannot be accepted as proof of the superiority of the heavier stamps, which consume less power in proportion to the work done—that is, they require one-tenth more power, and do one-fifth more work, nearly.

"The Blue Bell and Washington mills, in Nevada County, are alike in the weight of stamps, drop, number of drops, and grade of screens; yet the respective stamp duties are $1\frac{7}{10}$ and $2\frac{1}{5}$ tons: while the Yuba, with 50lb. more weight of stamp, $1\frac{1}{4}$in. more drop, and four less to the minute, has a duty of 2 tons. The power required for the Blue Bell and Washington is to that required by the Yuba as 4·399 to 5·418, while the mean duty of the first two is to the mean duty of the last as 195 through 30 meshes to the inch to 200 through 40 meshes. The additional power consumed in the Yuba, equal to nearly 23 per cent., gives nearly 2·7 per cent. more ore crushed through a sieve which has nearly 78 per cent. more meshes to the square inch. The value of the difference it is impossible to compute in terms of power required, hence this comparison is of little utility.

"The Gaston Ridge mill, with 750lb. stamps, consuming a power represented by 58, has a duty of $2\frac{3}{4}$ tons daily, while the Omaha, with 900lb. stamps and a power-consumption represented by 50, gives a duty of $1\frac{3}{5}$ tons daily, the screens being of the same grade in both. In this case the lighter stamp consumes the greater amount of power owing to the higher and more frequent drop,

and it crushes nearly 72 per cent. more ore with 16 per cent. more power, which is largely in favour of the lighter stamps. Again, the Mayflower, with 950lb. stamps and a power in the proportion of 59, crushes 2½ tons through the same screen; hence, with slightly less power, the lighter stamp again crushes more than the heavier by 10 per cent.

"Of machines other than stamp-batteries for the reduction of auriferous rocks little can be said, unless as to the work at the Spanish Mine, in Nevada County, where is successfully worked in Huntington centrifugal rolling-mills perhaps the lowest grade of milling-rock that has ever been made profitable in this country.

"By reference to the notes on the mine in question in the report of the State Mineralogist, 1888, it will be seen that the ore yields an average of 2s. 11d. per ton, on which a profit of 10d. per ton is realised. It goes without saying that the conditions are exceptionally favourable for extracting and milling the ore at little cost, and that a cheap class of labour is mainly employed; yet we cannot but admire the courage of a man who not only undertakes to handle 70 per cent. without loss, but has actually paid off some £1,600 of debts from the proceeds. In this plant the 5ft. Huntington mills work daily some 35 tons each of soft slate mixed with a little ferruginous quartz. It must not be hastily inferred that this mill is suitable in all cases.

"The Tustin mills have worked satisfactorily in Calaveras County, at the Willard Mine, where they have been used for crushing ore for amalgamation on plates and concentration of the sulphurets. T. B. Morse, E.M., in his report on this mine, published in the reports of the State Mineralogist for 1886, speaks of the work of this machine in comparison with stamps as follows:—

"A comparison of the two methods of crushing shows a marked difference in the results. In crushing through the battery a large amount of slimes is produced; with the pulveriser a very small quantity of slimes is made. As a consequence, with our ore, where the rock is very hard, the gold exceedingly fine, and the sulphurets soft and brittle, we find that on the same ore we amalgamate a much greater percentage of the fine gold after the pulveriser than after the stamps; and when we come to concentrate we can save only 18 to 20 per cent. of the assay-value of the ore after stamps, and 85 per cent. after the pulverisers. On the same ore and with the same screen one pulveriser is about the equivalent of six to eight stamps, according to the character of the ore." This verifies what has been said as to some of the causes of loss of gold and of sulphurets.

"Another machine, which is the acme of simplicity and cheapness, is Kendall's National Rocker. A mill of this kind is worked at Bald Hill, in Placer County, and Mr. Bell, the owner, states it is giving excellent results from hard quartz containing free gold and pyrites. It was also tried at the Spanish Mine, and, although not so satisfactory as the Huntington, it did as well as a stamp-battery. The Wiswell and Bryant mills, which are modifications of the well-known Chili mill, or edge-wheel, are well spoken of in some quarters. All these mills are essentially rolls, differing from the Cornish and Krom rolls chiefly in that they consist of a roller or rollers working against a plane, or a ring-formed base, instead of against another roller, with the advantage that the ore does not escape until it is fine enough, while, especially in the Tustin pulveriser, it is not subjected to much needless trituration. It is well known that they produce less slime than batteries do, and crush the ore with more evenness. While stamps may be best in many cases, it may well be that some of our millmen go too far in giving them the preference in all.

"We have seen that one cause of a loss of gold may be excessive trituration in the battery. One of the radical defects of the battery is, that the rock is not completely expelled from the mortar as it becomes fine enough to pass the screen; it would be easy to demonstrate that it cannot be, but that is unnecessary, as the point is universally conceded. On the other hand, a loss, more or less, is always sustained for the want of trituration of a portion of the ore, leaving many particles of gold still enclosed in the stone.

"The notes in the report show a very general preference for the Frue concentrator; nevertheless, where the Frue and the Triumph are used side by side in the same mill, there seems to be no difference in the results obtained, though preference is still given to the Frue, for the reason, as stated by the millmen, that it requires less care and attention than the other—which is to say, equally good results are obtained with less trouble. How far the preference may be due to the fact that the Frue was first in the field the future must determine.

"As a motor, where water-power under high fall is available, the practical verdict of the millmen is in favour of the Pelton wheel. In Amador County more Knight wheels are used than Pelton, and as many Donnelly as Pelton. Knight's are generally used in hoisting-works, on account of the hydraulic nozzle. With two 6ft. Knight wheels, and power-gates and nozzle, the engineer can run the cable 400ft. per minute, and stop the skip within a foot from the place it occupied when the gate was closed. These nozzles do not work in a bucket shaped like the Pelton. The Pelton wheels, under most heads, work to a higher percentage. The Donnelly wheel is used with any number of round nozzles. The buckets are fastened on the wheel as in the case of the Pelton.

"Overshot wheels are rather frequently used with low falls, but are open to the objection of a great tendency to become loaded with ice in cold weather; moreover, a Pelton will work with a low fall, and is cheaper than an overshot of large diameter. The true turbine wheels are not much used in quartz-mills, probably because a turbine for high fall is of very small diameter, and consequently must make so many revolutions per minute that excessive 'gearing down' is necessary in order to obtain the very moderate rate of revolution required in most parts of a rock-mill; which is not the case with a Pelton, a Knight, or a Donnelly, as these can be made of much larger diameter for any given fall, and hence make fewer revolutions per minute. Another difficulty with at least one of the best turbines, is that, if not worked at full gate, any suspended matter in the water, even mica, lodges in the wheel-case and obstructs the movement of the gates. Also, the efficiency of such wheels is much impaired by a small amount of wear.

"The feeders in use, where not some simple home-made contrivance, as the 'box-feeder,' or the more ingenious 'bucket-roller' feeder in the Ready Relief mill, are almost universally the Hendy

Challenge. The Templeton, or roller-feeder, is used exclusively in the Keystone mill, and is giving entire satisfaction, and the same feeder in the Bunker Hill mill works side by side with the Challenge, and, though the latter is considered the better machine, it is much more costly. On examining a sample of concentrated sulphurets as to an alleged volatilisation of gold in roasting them in the muffle without salt: the sender stated that he found a loss of 1oz. 9dwt. in gold and 2oz. of silver to the ton. Two assays were made on the raw material with very nearly concordant results, and two other assays were carefully roasted prior to the smelting, the results of these two also nearly agreeing. The difference between the means of the raw and the roasted assays showed a loss of 0·3oz. of silver per ton, or about 1½ per cent. of the total silver. There was no loss of gold. The ore contains, besides iron-pyrites, tellurium and antimony, but not any copper. In the experiment the ore was roasted with very low heat, and under a perforated cover to prevent loss by decrepitation, for about forty-five minutes, being twice removed from the muffle, cooled, uncovered, and stirred. Afterwards the covers were removed, and the roasting continued for half an hour longer under higher heat. The ore then smelled quite 'sweet,' and was assayed in the usual manner. The roasting-dishes were well coated on inside with reddle, and after the roasting the bottoms were scoured with ground glass to remove any metal which might have passed into or adhered to the substance of the dishes, the resulting dust being added to the assays."

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, including roads and other works for 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

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.
1886–87.	£ s. d.	£ s. d.	£ s. d.
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
1888–89.			
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
SUMMARY.			
Roads on goldfields	96,050 2 5	88,044 17 1	8,005 5 4
Subsidised roads and tracks	112,619 9 8	62,529 8 1	5,928 1 3
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	39,964 14 11	38,166 15 3	681 0 0
Wharves	589 19 5	246 6 0	193 13 5
Schools of Mines	9,138 17 9	9,088 3 9	50 14 0
Drainage channels	21,401 9 3	14,885 5 3	..
Diamond drills	4,448 9 11	2,746 9 11	..
Treatment of ores	1,342 8 9	742 8 9	..
Tracks to open up mineral lands	1,000 0 0	207 3 6	792 16 6
	341,183 4 9	234,430 16 6	16,314 10 6

* There is £48 16s. deducted this year on deep levels, Manaia, which sum has been cancelled.

The foregoing statements show that the value of new works undertaken last year was £17,150, as against £19,531 for the former year, while the actual expenditure last year amounted to £15,279, as against £8,555 for the year previous. The liabilities on works in progress at the end of March last were £16,315. The total value of works constructed and in progress that have been carried on under this department since the votes were placed under the control of the Hon. the Minister of Mines is £341,183, out of which payments have been made to the extent of £234,431. The balance, less the liabilities now shown, has been subscribed by local bodies.

Although this large expenditure has been made within goldfield districts, there is still a great deal wanting in roads and tracks. Indeed, it is only since the votes have been placed under the Hon. the Minister of Mines that the goldfields have been opened out, with the exception of some of the main roads in the colony; and, if these roads and tracks had not been constructed, the mining industry would have been in a worse state than it is at present, as the construction of these not only has cheapened the cost of transit of all supplies, but it enables machinery to be conveyed on to the ground adjacent to the different mines, and gives facilities to prospect and open up the country.

The mining industry is on the whole looking better than it has done for years. The principle of working wet alluvial shallow ground by dredges is being successfully done, and working the beaches and river-beds by dredges is now an accomplished fact. These dredging operations will develop into a large industry. Improvements will no doubt be made in the washing and gold-saving appliances, whereby a much larger percentage of the gold will be obtained. There is also great attention being given to the treatment of auriferous and argentiferous ores, and improvements in mining machinery, that cannot fail to bring about good results, and establish the mining industry on a firmer footing. If mining properties were held merely for the dividends accruing from the working they would be conducted on a much more satisfactory basis, but the great element at present is the trafficing in sale of shares. It may be asserted that the fluctuations in the share market denote the values of the properties, but such is not always the case. There is sometimes the principle of "bull" and "bear" the market adopted, and in that case the value of shares is raised to prices not at all warranted by the value of the property itself as a dividend-paying concern; but this principle is becoming less and less every year; and when it is entirely done away with, and mining ventures conducted on the same commercial basis as other industries, it will attract the attention of capitalists, and much of the treasures now hidden from the eyes of man will be unfolded, and the industry will become in a more prosperous condition.

Annexed is a statement showing the cost of construction of the various roads, tracks, and other works, as taken from the departmental records, since the votes have been administered by the Hon. the Minister of Mines; and also a list of the certificated mine-managers in the colony.

I have, &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, 1890.

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).			
Coromandel County.	£ s. d.	£ s. d.	£ s. d.
Matarangi Goldfields Track	400 0 0	100 0 0	100 0 0
Harbour View Track extension	222 0 0	105 0 0	6 0 0
Mercury Bay Road	1,300 0 0	420 0 0	230 0 0
Mokepoke Gully Track	47 0 0	..	23 10 0
Widening and extending Manaia road	10 0 0	..	5 0 0
Kapanga to Paul's Creek	200 0 0	..	100 0 0
Coromandel to Cabbage Bay	200 0 0	..	100 0 0
Mercury Bay to Kuaotuna	360 0 0	..	180 0 0
Wainaru to Kuaotuna	450 0 0	..	225 0 0
Sea-beach to Kuaotuna	200 0 0	..	100 0 0
Thames–Coromandel Road *viâ* Manaia	300 0 0	..	150 0 0
Road to Tarawera Claim	100 0 0	..	50 0 0
	3,789 0 0	625 0 0	1,269 10 0
Thames County.			
Karaka Creek to Lucky Hit	600 0 0	170 0 0	130 0 0
Waiomo Creek to Tapu	1,500 0 0	659 1 10	90 18 2
Puriri to New Discovery	200 0 0	..	100 0 0
Hikutaia towards Marototo	200 0 0	..	100 0 0
Alabama Creek Track	100 0 0	..	50 0 0
Track to Hikutaia Goldfield	200 0 0	73 17 7	26 2 5
Sylvia Claim to Tararu	250 0 0	..	125 0 0
Te Papa Gully Road	100 0 0	..	50 0 0
	3,150 0 0	902 19 5	672 0 7
Ohinemuri County.			
Road from Battery to Waihi Mines	300 0 0	..	150 0 0
Marototo Track	100 0 0	..	50 0 0
Repairs, flood damages	200 0 0	17 6 10	82 13 2
Hikutaia River to Marototo Mine	300 0 0	80 7 6	69 12 6
	900 0 0	97 14 4	352 5 8
Piako County.			
Premier Mine to Katikati	500 0 0	..	250 0 0
MIDDLE ISLAND.			
ROADS (SUBSIDISED.)			
Marlborough County.			
Formation of road to Cullensville, Mahakipawa Mines	217 4 0	..	108 12 0
Waimea County.			
Repairing horse-track, Baton to Karamea Road	100 0 0	..	50 0 0
Buller County.			
Waimangaroa to Sea-beach	240 0 0	..	120 0 0
Addison's to Wilson's Lead	400 0 0	..	200 0 0
Cedar Creek towards Coalbrookdale	100 0 0	..	50 0 0
Addison's Flat to Caroline Terrace	200 0 0	..	100 0 0
	940 0 0	..	470 0 0
Inangahua County.			
Globe Hill to Merrijigs	1,560 0 0	464 8 0	315 12 0
Mangles Valley to McGregor's Station	1,200 0 0	..	600 0 0
Horse Terrace to Hunter's	1,280 0 0	..	640 0 0
Larry's Creek to Lyell	1,080 0 0	423 10 0	116 10 0
	5,120 0 0	887 18 0	1,672 2 0
Westland County.			
New Rush, south side Hokitika River	100 0 0	18 19 3	31 0 9
Extension of Tucker's Flat Road to New Rush	500 0 0	85 9 9	164 10 3
	600 0 0	104 9 0	195 11 0
Grey County.			
Deep Creek to Bell Hill	1,400 0 0	401 0 0	299 0 0
Track to Blackball Diggings	800 0 0	240 0 0	160 0 0
Track to connect Baird's Terrace track with Irishman's	250 0 0	76 0 0	49 0 0
	2,450 0 0	717 0 0	508 0 0

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.
Collingwood County.	£ s. d.	£ s. d.	£ s. d.
Extending Anatoko Bridle-track	160 0 0	..	80 0 0
Taieri County.			
Nenthorne Road	600 0 0	..	300 0 0
ROADS CONSTRUCTED WHOLLY BY MINES DEPARTMENT.			
Waikawau to Manaia	1,000 0 0	625 2 6	374 17 6
Karangahape through Gorge	1,000 0 0	505 3 1	494 16 11
Aorere to Karamea and Mokihinui	25,196 8 6	20,163 12 0	5,032 16 6
Tapu to Waikawau	770 0 0	400 0 0	370 0 0
Grey Valley to Teremakau	900 0 0	633 6 0	266 14 0
Jackson's Bay to Cascade and Gorge River Districts	5,270 16 9	4,709 3 3	561 13 6
Arthur's Point to Skipper's	11,782 9 1	11,167 4 1	615 5 0
Improving roads and tracks, Collingwood to Takaka and Motueka	11,194 10 10	10,905 8 11	289 1 11
Contingencies	292 13 4	292 13 4	..
	57,406 18 6	49,401 13 2	8,005 5 4
WATER-RACES.			
New Water-mains, Thames Water-race	1,500 0 0	285 0 0	465 0 0
Argyle Water-race	7,653 15 1	7,653 15 1	..
Nelson Creek Water-race	957 16 7	957 16 7	..
Waimea–Kumara Water-race	11,265 10 3	11,049 10 3	216 0 0
Mikonui Water-race	13,997 1 4	13,997 1 4	..
Mount Ida Water-race	3,200 0 0	3,200 0 0	..
Contingencies	639 12 8	639 12 8	..
	39,213 15 11	37,782 15 11	681 0 0
WHARVES.			
Anikiwa Jetty, Marlborough	289 19 5	96 6 0	193 13 5
PROSPECTING SUBSIDIES.			
Kapanga Gold-mining Company (Limited)	20,000 0 0	337 0 0	663 0 0
SCHOOLS OF MINES	9,138 17 9	9,088 3 9	50 14 0
TRACKS FOR OPENING UP MINERAL LANDS.			
Foot Bridge, Ngakawau River	350 0 0	1 16 0	348 4 0
Port Pegasus Pack Track	600 0 0	155 7 6	444 12 6
	950 0 0	157 3 6	792 16 6

Summary of Works.

	£ s. d.	£ s. d.	£ s. d.
Roads (subsidised)—			
Coromandel County	3,789 0 0	625 0 0	1,269 10 0
Thames County	3,150 0 0	902 19 5	672 0 7
Ohinemuri County	900 0 0	97 14 4	352 5 8
Piako County	500 0 0	..	250 0 0
Marlborough County	217 4 0	..	108 12 0
Waimea County	100 0 0	..	50 0 0
Buller County	940 0 0	..	470 0 0
Inangahua County	5,120 0 0	887 18 0	1,672 2 0
Westland County	600 0 0	104 9 0	195 11 0
Grey County	2,450 0 0	717 0 0	508 0 0
Collingwood County	160 0 0	..	80 0 0
Taieri County	600 0 0	..	300 0 0
	18,526 4 0	3,335 0 9	5,928 1 3
Roads wholly constructed by Mines Department	57,406 18 6	49,401 13 2	8,005 5 4
Water-races	39,213 15 11	37,782 15 11	681 0 0
Wharves	289 19 5	96 6 0	193 13 5
Prospecting subsidies	20,000 0 0	337 0 0	663 0 0
Schools of Mines	9,138 17 9	9,088 3 9	50 14 0
Tracks to open up mineral lands	950 0 0	157 3 6	792 16 6
	145,525 15 7	100,198 3 1	16,314 10 6

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, 1890.

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
	7,213 13 9	4,525 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	350 0 0	175 0 0
Waiotahi towards Mercury Bay	522 11 0	261 5 6
Te Mata Road	178 17 6	89 8 9
	9,150 18 11	5,544 14 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
	1,624 0 0	912 0 0
Piako County.		
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

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.
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
	9,731 0 0	6,191 18 4
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
	15,058 4 0	9,700 18 2
Buller County.		
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

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.
Buller County—continued.						
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
Ngakawhau 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
	7,678	1	4	4,461	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
	518	0	0	270	6	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	289	0	0	144	10	0
	1,656	6	1	1,035	4	6
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

LIST of WORKS on GOLDFIELDS, &c.—*continued.*

Locality and Nature of Works.	Total Cost.	Amount of Contribution paid by Mines Departmen
	£ s. d.	£ s. d.
Collingwood County.		
Road, West Wanganui	300 0 0	200 0 0
Bridge over Aorere River	173 14 0	115 16 0
	473 14 0	315 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
AIDS TO PROSPECTING.		
Construction of low-level tunnel, Terawhiti	750 0 0	150 0 0
Queen of Beauty Company, prospecting deep-levels	300 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
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

LIST of WORKS on GOLDFIELDS, &c.—*continued*.

Locality and Nature of Works.	Total Cost.	Amount of Contribution paid by Mines Department.
WATER-RACES.	£ s. d.	£ s. d.
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
	750 19 0	383 19 4
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
	38,643 3 11	38,643 3 11
ROADS TO OPEN UP MINES OTHER THAN GOLD.		
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

Summary of Works.

Liability and Nature of Work.	Total Cost.	Amount of Contribution paid by Mines Department.
	£ s. d.	£ s. d.
Roads (subsidised)—		
Coromandel County	7,213 13 9	4,525 15 10
Thames County	9,150 18 11	5,544 14 5
Ohinemuri County	1,624 0 0	912 0 0
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	9,731 0 0	6,191 18 4
Grey County	15,058 4 0	9,700 18 2
Buller County	7,678 1 4	4,461 15 4
Marlborough County	518 0 0	270 6 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 Road Board	473 14 0	315 16 0
Fiord County	300 0 0	200 0 0
Waitaki County	41 12 0	20 16 0
	94,093 5 8	59,194 7 4
Diamond and other drills	4,448 9 11	2,706 9 11
Wharves	300 0 0	150 0 0
Aids to prospecting	28,481 2 10	12,717 12 9
Water-races	750 19 0	383 19 4
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	38,643 3 11	38,643 3 11
Roads to open up mines other than gold	6,146 9 10	4,759 6 2
Tracks to open up mineral lands	50 0 0	50 0 0
	195,657 9 2	134,232 13 5

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 the 31st March, 1890.

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	1,240 9 7	795 7 7	*445 2 0	118,762 11 8	173,647 7 1	0·4	91	2,603	9,891 8 0	1 16 7
Kumara	5,745 12 6	1,424 13 3	*4,320 19 3	37,706 2 11		11·4	175	7,543	28,663 8 0	2 10 4
Kumara Sludge-channel	687 2 8	3,213 15 11	†2,526 13 3	17,200 12 6		..	79	..	..	..
Nelson Creek	529 18 4	917 10 4	†387 12 0	..	90,722 10 8	..	27	846	3,235 19 0	1 18 6
Argyle	326 10 10	423 8 1	†96 17 3	..	14,701 15 3	..	15	421	1,619 12 0	1 13 4
Mikonui	‡50 0 0	..	..	..	25,644 9 6	..	..	..	..	..
Totals	8,579 13 11	6,774 15 2	1,804 18 9	..	304,716 2 6	..	387	11,413	43,410 7 0	2 4 2

* Profit. † Loss. ‡ Rent.

HENRY A. GORDON, M.A.Inst.M.E.,
Inspecting Engineer.

STATEMENT showing the NAMES of MINE MANAGERS in the Colony who have received CERTIFICATES of COMPETENCY and CERTIFICATES after having passed an EXAMINATION.

I.—*Issued under Section 203 of "The Mining Act, 1886.*

Resta, Lawrence, "Tipperary," Macetown.
Vivian, John G., "Enterprise," Thames.
Waite, Charles D., "Rocky Point," Thames.
Moore, J. H., "Martha," Waihi.
Coutts, James, "Waiotahi," Thames.
Moore, Henry William, "Cambria," Thames.
James, F., "Saxon," Thames.
Clarke, G. S., "New Prince Imperial," Thames.
Radford, Thomas, "Moanataiari," Thames.
Crawford, Thomas H., "Beach," Thames.
McCullough, Robert, "New Eureka," Otanui, Thames.
Walker, J. W., "Queen," Thames.
Stone, Frederick, "Ivanhoe," Karangahake.
Elliott, John, "Premier," Macetown.
Benney, John, "Tokatea," Coromandel.
Smith, J. E., "Waiotahi," Thames.
Wylie, William, "Ross United," Ross.
Hansen, Peter Chris., "Auckland," Thames.
Harrison, Rich. Herb., "Bullion," Coromandel.
Fitzmaurice, Raymond, "Keep-it-Dark," Reefton.
McGruer, Norman, "Crown," Karangahake.
Davis, James Edward, "Crown," Stony Creek, Queenstown.
Corin, William, "Old Caledonian," Thames.
Reid, Peter, "Success," Coromandel.
Tripp, Richard Stephen, "Gallant Tipperary," Arrowtown.
Hall, John Paxton.
McCallum, James.
Morrisby, Alfred A.
Hilton, George Phil., "New Cromwell," Bendigo.
Barclay, Thomas H., Karaka Creek, Thames.
Wilcox, John, Clarence Street, Parawai, Thames.
Steedman, James Bramwell, Tararu, Thames.
Andrews, Thomas.
Conradson, Martin.
McLiver, Hugh.
Dunlop, Thomas A., "Golden Crown," Thames.
Adams, Henry Hopper, Waiorongomai.
Byrne, James F., Stafford.
Williams, John, Skipper's.
Julian, John, Boatman's.
Bray, John, Lyell.
Donald, James, Carrick Range, Cromwell.
Comer, Robert, Thames.
Lowe, Edwin Wass, Thames.
Greenville, William, Owharoa, Ohinemuri.
Edwards, James, Skipper's.
Evans, James Harvey, Skipper's.
Evans, Frederick, Skipper's.
Hodge, Francis, Coromandel.
Martin, W. G., Thames.
Kerr, James, Thames.
Chapman, John Alwent, Dunedin.
Lawn, John, Reefton.
Gilmour, Thomas, Thames.
Glass, William M., Rough Ridge, Naseby.
Jamieson, Andrew, Coromandel.
Kelly, John, Lyell.
McLeod, George, Coromandel.
Newman, William, Naseby.
McKenzie, William, "New Alburnia," Thames.
Senior, James, "Bright Smile," Thames.
Rasmussen, Christopher Peter, "Seatonville," Mokihinui.
Lawn, Henry, Boatman's.
Gilbert, John, "Inkerman," Reefton.
Jenkins, Morgan, "Bullendale," Wakatipu.
O'Sullivan, Daniel Ennis, "Pinafore," Thames.
Cameron, Edward, Te Aroha.
Quinn, Edward, Te Aroha.
Goldsworthy, John, Waiorongomai.
Scott, Thomas, "Waiorongomai," Waiorongomai.
Rooney, Francis, "Welcome," Reefton.
Harris, John, "Enterprise," Owen's Reefs.
McIlhaney, James, "Little Nell," Thames.
Giles, Giles Francis, West Wanganui.
Hicks, Thomas B., "Koranui," Thames.
Todd, Charles, "Cromwell," Bendigo.
Cameron, Archibald, "New All Nations," Macetown.
Cummings, William, "Golden Treasure," Reefton.
Polton, Alfred, "Diamond," Karangahake.
Ralph, John Guest, "Mangakaroa," Thames.
Frewen, John Bernard, Invincible Quartz-mine, Queenstown.
Nasmyth, Thomas, "Just-in-Time," Reefton.
Ranger, James, "Result," Reefton.
Watson, Thomas, "Wealth of Nations," Reefton.
Taylor, Nicholas, "Kuranui," Thames.
Bennett, John, "White's Reef," Alexandra.
Sturm, Arnold, Waipori.
Lawn, Edmund, "Pandora," Black's Point.
Littlejohn, William, Karangahake.
Black, Thomas, "Paroquet Mine," Waiomo.
Anderson, Peter, Waiotahi Gold-mining Company, Thames.
Vivian, Stephen, Reefton.
McMaster, John, "Nil Desperandum," Reefton.
McKenney, Jacob, "Venus Extended," Reefton.
McLiver, Finlay, "Tairua," Thames.
Porter, James, Waipori.
Waite, Edward, "Dixon's No. 1," Thames.
Dryden, Samuel, Thames.
McKay, John, Mount Greenland Company, Ross.
Davey, Charles, Mont d'Or Company, Ross.
Burch, William Henry, Thames.
Treloer, J. Sampson, Reefton.
Rasmussen, Christopher Lauritz, Crœsus Quartz mining Company, Mokihinui.
Crowley, Cornelius, Reefton.
Hollis, William, Waitekauri, Thames.
Cornes, Clement A., Karangahake.
Bradbury, Mathew, Reefton.
Searight, Andrew, Reefton.
Roberts, Edward, "Ross United," Ross.
Greenish, James, Reefton.
Bollerslev, Neils, Boatman's.
Malfroy, J. M. C., Ross.
Wearne, J. E., Endeavour Inlet.
Purvis, George, Ross.
McIntosh, David, Bluespur.
Johnstone, H., Bluespur.
Andrews, Richard, Coromandel.
Young, George, Skipper's.
Wright, George, Boatman's.
Gavin, Thomas, Te Aroha.
Morgan, R., "White's Reefs," Otago.
Hunter, Ratcliffe, Thames.
Northey, John, "Hauraki," Thames.

Certificates issued after Examination.

Watkins, C. E., Reefton.
Hosking, George Francis, Auckland.
Kruizenga, Walter, Reefton.
Casley, George, Reefton.
Colebrook, John Drew, Coromandel.
Cummings, W., Reefton.
Gardner, W. P., Reefton.
Coombe, John, Reefton.
Donaldson, William, Otago.
Harris, William, Thames.
Black, George, Reefton.

II.—*Issued under Section 19 of "The Coal-Mines Act, 1886.*

Brown, Thomas, Westport.
Ferguson, Archibald, Whitecliffs.
Geary, Joseph, Kamo.
Collins, William, Taupiri.
Alexander, Thomas, Brunnerton.
Jemison, William, Waimangaroa.
Moody, Thomas Pearson, Kawakawa.
Kerr, George, Kamo.
Binns, George J., Dunedin.
Lindop, Alfred Benjamin, Springfield.
Moore, William Joseph, Springfield.
Campbell, John Comrie, Fairfield.
Cameron, John, Denniston, Westport.
Smith, Thomas Frederick, Nelson.
Smith, Albert Edward, Nelson.
Walker, James, Collingwood.
May, Jonathan, Greymouth.
Swinbanks, John, Kawakawa.
Bishop, James, Brunnerton.
Freeman, James, Green Island, Otago.
Cochrane, Neil Dundonald, Duddington, North-east Valley, Dunedin.
Shore, Thomas, Orepuki.
Smart, William, Ferry Road, Christchurch.
Elliott, Robert, Wallsend.
Cater, Thomas, Auckland.
Garrett, J. H., Auckland.
Nimmo, J., Oamaru.
Macalister, James, Invercargill.
Lindsay, William.
Harrison, Jonathan, Brunnerton.
Brown, Thomas.
Reed, Frank.
Williams, William Henry.
Lloyd, John, Invercargill.
Redshaw, William, Whangarei.
Love, Alexander, Whangarei.
Taylor, Edward Brooke, Huntly, Waikato.
Dando, Maurice, Brunnerton.
Shore, William Martin, Kaitangata.
Aitken, Thomas, Wendon.
Mason, James, Nightcaps.
Kenyon, John, Shag Point.
Austin, J., Sheffield.
Sneddon, James, Mosgiel.
Richardson, David, Abbotsford.
Ord, John, Huntley.
Shore, John, Kaitangata.
Irving, John, Kaitangata.
Gray, James, Abbotsford.
Thompson, Andrew, Whitecliffs.
Loudon, James, Green Island.
Nelson, John, Green Island.
Hodgson, J. W., Ross.
Tattley, W. Auckland.
Black, T. H., Waipori.
Straw, Michael, Westport.

Certificates issued after Examination.

Armitage, F. W., Auckland.
Hosking, George Francis, Auckland.
Green, Edwin Ridley, Otago.

APPENDIX I.

WARDENS' AND WATER-RACE MANAGERS' REPORTS.

No. 1.

Mr. Warden CLENDON to the UNDER-SECRETARY of MINES.

SIR,— Warden's Office, Whangarei, 24th April, 1890.

I have the honour to make the following report upon the Puhipuhi Mining District for the year ending 31st March, 1890.

The Warden's office was opened at Whangarei on Saturday, the 8th March last, for the issue of miners' rights and business licenses, and receiving applications. A rush took place to Puhipuhi, where the Prospectors' Claim is situate, as soon as the proclamation of the district was published. Upwards of two hundred men were on the ground on the 7th and 8th March, since which time the numbers have decreased, and about a hundred men now remain in the district. Since the opening of this office 164 miners' rights and four business licenses have been issued. Applications were received for one special claim and eighteen licensed holdings, also three water-races, two machine-sites, one residence, and three business sites.

The first Warden's Court was held at Hikurangi on the 26th March, 1890, as being the most suitable place nearest Puhipuhi; but, in consequence of delays in surveys, only one special claim was granted.

The miners have not as yet settled down to work their ground, the titles being still incomplete, and it is feared that, as the wet weather has now set in, it may be early spring before any extensive works are carried on. The miners are generally well satisfied with their prospects and in hopes of rich returns from Puhipuhi. The opinions of experts in silver-mining who have visited the claims are very sanguine as to the ultimate results from the reefs.

The enclosed report (No. 2) from the Inspector of Mines furnishes the details of the mining work.

One great drawback to work being carried on in the winter months is the want of a good road through the Puhipuhi Forest, the Waiotu Valley Road being often covered with water during winter, and communication being frequently cut off for several days. The miners and others have adopted a new route to the mines, and a track is being cut and a road laid off from the main road near the Whakapara Bridge. The Whangarei County Council have promised a contribution towards this road from the first goldfield revenue received by the county. When completed this route will be several miles shorter than the main road to the mines.

As the mining district of Puhipuhi has so recently been proclaimed and placed under my charge as Warden, I have nothing further calling for special report. In conclusion I would beg to acknowledge the valuable assistance I have received from Mr. Wilson, the Mining Inspector, in opening the business of the field. I have, &c.,

The Under-Secretary, Mines Department, Wellington. JAMES A. CLENDON, Warden.

No. 2.

Mr. G. WILSON, Inspector of Mines, to the UNDER-SECRETARY of MINES.

SIR,— Warden's Office, Whangarei, 25th April, 1890.

I have the honour to furnish the following report on mines in the Puhipuhi Mining District for the period ending the 31st March, 1890.

The proclamation of the Puhipuhi Mining District did not take effect until the 7th March, and in consequence very little new mining work was done prior to the 31st.

Prospectors' Special Claim (60 acres).—A considerable amount of work was done in prospecting this land, under a prospecting license, for about six months previous to the opening of the field. A number of reefs were discovered and tested for gold and silver. It was found that silver largely predominated, gold being found in very small quantities, not sufficient to enhance the value of such samples of silver bullion as were obtained. The reef to which most attention has been devoted, and on which the greatest amount of work has been done, is named the Silver Reef. This reef, which near the surface was from 2ft. to 2½ft. in thickness, has been sunk on for 50ft., and increased in thickness as sinking proceeded. A drive was put in for 65ft., and the reef cut near the bottom of the winze, where there is about 7ft. of quartz and vein-stuff between the walls of the reef. The quartz in this reef, both at the surface and in the winze, is of a rubbly nature, generally whitish in colour. Sulphide of silver is seen in the quartz, and is easily detected from the bluish colour it presents. Silver-glance, ruby silver, and small grains of native silver are also seen in the quartz. The quantity of quartz produced from the winze must have been about 40 tons, from which a parcel of about 5 or 6 tons was saved. On the 29th March I took what I considered to be an average sample from this parcel of quartz which had been selected and saved, and had it assayed at the School of Mines, Thames, where it was found to contain 97½oz. of silver per ton. This return may be considered to be very encouraging. If ore of such value can be selected in quantities it could be profitably treated in the locality; and the chief question is, can a sufficient quantity be obtained? This matter can only be determined by opening up the reef into blocks by drives and winzes, carefully testing the ore, and sorting and selecting it, so as to ascertain what

percentage of 97½oz. ore is contained in a given quantity of quartz broken out, then ascertaining if the actual cost of mining the whole bulk of the reef will not be excessive when charged against the smaller quantity of ore selected. The sorting and selection of the quartz will necessitate assays to be made daily until the nature and value of the ore is known to the men employed, otherwise sorting is not likely to be correctly done. A low level, to cut this reef at a depth of 150ft. from the surface, has been driven about 80ft., and when extended to the reef will give 160ft. of backs, and enable the owners to proceed with works such as I have mentioned, to thoroughly prospect this portion of the mine. Other reefs which contain silver-ore might also be prospected in the same way, and their value ascertained; and, as there are numerous reefs and leaders in the ground, much time must elapse and a great deal of money be expended before it can be said that this ground is fairly prospected. From the appearance of the silver-ore I am of opinion that dry crushing, chloridising roasting, and pan-amalgamation will be one of the most effectual methods of extracting the silver. Six men have been employed in this mine.

No. 2 Licensed Holding (30 acres) lies to the northward of the Prospectors' Claim. Several reefs have been discovered in this ground, and assays made from small parcels of quartz show that silver is contained in the quartz in such quantities as to warrant further expenditure in prospecting. Two men are employed on this ground.

The Christey's, Ophir, Kamo, United, Comstock No. 3, and Just in Time licensed holdings and several claims have been taken up in the vicinity of the Prospectors' Claim, but work to any great extent has not been carried on; there are, however, several reefs discovered showing silver in the quartz.

Number Three, Jubilee, Caberfeigh, Comstock, Nelson, and the Ruby licensed holdings and several claims have been taken up at the Wairiki, which lies about two miles south-east from the Prospectors' Claim, and assays made from quartz in this locality show that fair prospects of silver are present in the reefs.

Prospecting is being carried on in many parts of the district outside of Puhipuhi Forest, and quartz is occasionally found, so that probably other discoveries of gold and silver may be made.

I have, &c.,

G. Wilson, Inspector of Mines.

The Under-Secretary, Mines Department, Wellington.

No. 3.

Mr. Warden Northcroft to the Under-Secretary of Mines.

Sir,— Warden's Office, Thames, 26th April, 1890.

I have the honour to forward herewith statistical returns for the Hauraki Mining District for the year ended the 31st March last, together with a general report on the district.

I am glad to report that mining has been fairly prosperous in this large and important district during the year now past, though the hopes I entertained at the date of my last annual report have not altogether been borne out, and we have suffered from some serious disappointments, too often the result of the want of care, foresight, and local knowledge so essential in all mining undertakings.

The large reduction-works at Te Aroha have been shut down since the 18th January last, having treated all the ore they had on hand. As these are the largest and most important works of this kind in New Zealand, it may be interesting to give a description of the plant and an account of some of the work done. The quartz is conveyed in trucks from the mines by branch lines to the ground tramway, which extends up the hill for a distance of about three miles, having three very steep self-acting grades. The ore when it arrives at the battery-platform is discharged direct from the trucks on to the "grizzlies" or gratings, the bars of which are fixed 2in. apart, and all ore sufficiently small, drops through into hoppers and is fed from thence direct into the stamper-boxes by means of automatic self-feeders. The coarse ore, passing down over the gratings referred to on to three rock-breakers, is discharged from them into shoots and conveyed to the automatic feeders. The rock-breakers are driven from a line-shaft by means of an independent Pelton wheel of thirty-horse power, and are capable of breaking 50 tons of quartz each per day of twenty-four hours. The stampers are sixty in number, forty of which are constructed on the old principle generally in vogue in the batteries throughout the Hauraki Goldfield, and were erected several years ago, long before the present owners purchased the property. Each of these stamps weighs about 850lb., and in working has a drop of about 10in., and is generally run at a speed of about sixty-five strokes per minute. These forty stamps are capable of reducing about 40 tons per diem. The twenty head of new stampers, constructed on a greatly-improved principle, and including a mortar patented in America by Mr. Howell, the company's manager, also weigh about 850lb. each, with a drop of 7½in., but are run at a much higher speed—namely, ninety-five strokes per minute—and are capable of satisfactorily reducing as much as 50 tons of quartz per diem. These stampers are furnished with steel cams and steel tappets (or discs), and in the manner of construction are an immense improvement on the old style. By a very ingenious arrangement any one of these stampers, or any desired number of them, can be hung up without altering the speed in any way or stopping the battery. This alone is a very great advantage, as with the old stampers, if it is desired to hang any one or more of them up it is necessary the battery be first slowed down, and even then it requires two men to hang them up; whereas a boy, with a piece of stick made for the purpose, can connect or disconnect any one or more with ease. The stampers are driven by two Pelton wheels of fifty-horse power each—one for each thirty head of stampers. The crushed quartz, as it is forced through the gratings of the stamper-boxes, passes directly over quicksilvered copper plates, upon which most of the free gold is retained, while the complex minerals, and all the sulphides containing either gold or

silver, escaping over these plates, are conveyed direct to the concentrators through pipes or shoots by means of a current of water. These concentrators perform a most important work—namely, the separation of all base sulphides from the valueless gangue—and this result is obtained by a simple and yet most ingenious arrangement. The concentrators are fixed in two rows immediately in front of the stampers, and are driven by two line-shafts, the power being furnished by a double 3ft. Pelton wheel of forty-horse power. The crushed quartz, as it is discharged from the pipe, whereby it is at once evenly distributed across the whole breadth of the belt. As the belt moves round a spray of water from a perforated pipe plays direct on the ore, and washes away the lighter or valueless particles, which we may term tailings. These tailings are of so little value they are not deemed worthy of any further treatment, but pass away by means of a stream of water through shoots to the tailings-pits, whilst the heavy particles, containing any metal of value, are by their own specific gravity carried up the inclined endless belt, and, passing round and underneath, drop into a receiver filled with water, through which the belt passes, and are there washed off and retained. The concentrates are removed from the receivers and then fed into an elevator, which discharges them direct into a Howell patent revolving cylinder-furnace, 60in. in diameter. This furnace revolves at a speed of five revolutions per minute, at an inclination from the feed to the discharge end of 6in., the length of the furnace being 24ft. The result obtained by passing the concentrates through the furnace is that fully 90 per cent. of the sulphur, together with all other volatile matter, is driven off by the action of the heat and atmospheric air passing through the furnace. As it is discharged from the furnace the now desulphurised ore passes into a receiver, and from thence is conveyed to the reverberatory or slagging furnace close by. As it is fed into this furnace it is mixed with a percentage of lead-ores, and in the furnace is subjected to a strong heat, the result being that it is rolled out at the other end in the form of slag—*i.e.*, partly fused—and is then ready for smelting. The slag-ore is conveyed direct to the water-jacket furnace, and discharged on the feeding-and-mixing floor immediately above the furnace. Here the ore is mixed with the necessary fluxes and fed into the furnace, which is capable of smelting 20 to 30 tons of ore per day, the quantity varying according to the character of ore under treatment. The general value of the bullion obtained has been about £60 per ton. In connection with the works there is a most complete laboratory and assay plant. The present plant is capable of treating 100 tons of ore per day, and ore can be both crushed and concentrated at a cost of 4s. per ton.

CINDERING OF CONCENTRATES, LEAD AND SILICEOUS CUSTOMS ORES, IN THE REVERBERATORY FURNACE.

Contra Cr.

	£	s.	d.
By treatment-charges for sundry customs ore, products of concentrates	3	1	7
To net cost of smelting 517 tons 10cwt. 3qr. 9lb. ore and concentrates	782	18	1

Or equal to about £1 10s. 4d. per ton smelted.

Summary of Expenditures.

	£	s.	d.
For account crushing and concentrating	702	19	3
Half charged each to Smelting Account, and to Battery-plates Amalgamation Account	351	9	7½
For account desulphurising and roasting, Howell furnace ...	23	18	11
For cindering, reverberatory furnace	440	19	3
For smelting, water-jacket furnace	782	18	1
Cost of treatment 517 tons 10cwt. 3qr. 9lb. ore and concentrates...	1,599	5	10½

Or equal to about £3 1s. 10d. per ton for the crushing and concentrating, roasting, cindering, and smelting; and equal to £2 8s. 2d. for roasting, cindering, and smelting only.

The water-jacket furnace was charged on the 18th September, and continued running at intervals until the 1st November, during which time the furnace was under charge and tap for thirty days, treating an average of 20½ tons per day of twenty-four hours.

The highest assay of slag from the tap was—gold, nil; silver, 1oz. 12dwt. 16gr.; lead, 10 per cent.

Water-jacket Smelter Records.

			£	s.	d.
To 156 tons 11cwt. 3qr. 17lb. concentrates, assay-value ...			3,405	16	10
357 tons lead-ore, assay-value	£2,699	6 7			
Less 100 tons lead-ore on hand	713	15 0			
			1,985	11	7
103 tons 18cwt. 3qr. 20lb. siliceous customs ore, at purchase-price	£1,677	11 6			
Add margin to make total assay-value of ditto	763	6 0			
			2,440	17	6
Base bullion from tailings plant			622	19	2
Base bullion bought of old battery company			15	0	0
			8,470	5	1

Contra Cr.

	£	s.	d.
By 125 tons 9cwt. 3qr. 21lb. auriferous silver-lead bullion shipped to London	8,258	3	11
Estimated value of lead-well, &c., on hand	100	0	0
Total products	8,358	3	11

Or equal to a saving of about 99½ per cent. of the assay-value of all ores, concentrates, and base bullion treated.

At present it appears problematical whether these works will reopen, as their late manager considered the only way to open up the company's ground would be to drive from the Army Gully. This would undoubtedly open up the property, but the cost would be considerable, and I think it is very doubtful whether the gentlemen comprising the present company care to risk so much capital in mere speculation, which, like nearly all gold-mining ventures, it really is. If they determine not to drive this tunnel, I am informed they will pull down and remove whatever portion of the plant they can dispose of in Australia. This will no doubt be a great loss to the district; but it would have been greater still had the battery occupied a more central position. Their late manager treated the complex and refractory ores found there, giving a substantial profit to the shareholders, and the property would have been a good going concern now had there been as much ore in sight as the owners were led to believe when they erected their works. I think there is little doubt that in time the process used at Te Aroha, or a modification of it, will be the one universally used in this peninsula for treating all classes of base ore. I think the day is not far distant when we shall see on many of our creeks affording sufficient water for motive-power small batteries with concentrators. The ore can then be crushed and concentrated close to the mine (for all base ores can be very closely concentrated), thus allowing the miners to save freight on dead-weight of gangue, and the concentrates could then be sent to some central reduction-works. I find the average percentage of concentration at the Te Aroha works was 2·85—in other words, 100 tons of ore would give 2·85 tons concentrates, or, 1 ton would give about 64lb. The percentage with different ores fluctuated greatly, ranging from less than 1 per cent. up to 13 per cent., which is accounted for by some of them containing a greater percentage of gold than others, which is, or should be, caught on the amalgamated copper plates after crushing, and is obtained separate from the concentrates; and producers of high-grade dry ore, such as the Kenilworth, Silverton, and many more mines in our district, would obtain better results by selling their ore for reduction with low-grade fluxing ores than if they treated them in the ordinary way.

The MacArthur-Forrest Process, or Cassell's Company.—This process is based on the affinity which cyanogen has for gold and silver, and on the facility with which it dissolves these metals, when free or in combination. The operation may be carried out in two ways, by percolation or by agitation. By percolation: If the ore be very clean quartz, with little clayey matter, it is, after being ground fine enough to pass through a sixty-mesh screen, charged into large vats (capable of holding 5 or 6 tons) covered on the bottom with some porous material to form a filter. On top of the ore thus charged is run a weak solution of cyanide of potassium, the strength of which is determined by the richness of the ore under treatment. When the whole of the solution has passed through, the ore is washed with a weak solution from a former operation, and, thirdly, with pure water. The gold and silver are now in solution, and are precipitated by allowing the solution to pass through towers or boxes filled with zinc in a very finely-divided state. The bullion is precipitated in the form of a fine black powder. When the precipitating-vessels are charged with the metallic precipitate it is freed from the unconsumed zinc by washing; the zinc is used over again, and the powder, which is usually mixed with a certain quantity of zinc, is digested in weak sulphuric or muriatic acid, which dissolves the zinc, but leaves the gold and silver. These are collected on a cloth filter, washed, and then dried and smelted into bar bullion. Secondly, agitation: For ores which contain a large quantity of clay, which renders percolation difficult, or with auriferous pyrites, the ground ore is charged into large agitators provided with stirrers. To every ton of ore is added about 100 gallons of water, having dissolved in it about one-half of 1 per cent. of its weight of cyanide of potassium (but the exact quantity has to be determined by experiment previously). The mixture is then stirred for some six or eight hours, according to the nature of the ore. At the end of this time the machinery is stopped, and the contents passed through filter-presses to press out the gold-and-silver solution. By this operation the ore is pressed into solid cakes, and, as they still contain some gold and silver, they are thrown into another agitator, with a very weak solution of cyanide of potassium, or weak solution from a previous operation, and agitated for some time, and again passed through the filter-press. This operation is once more repeated with pure water, when the ore should be exhausted. The liquors containing the gold and silver are treated as in the percolation process to obtain the bullion.

The results obtained at the Karangahake trial plant on the Silverton, Martha, and Kenilworth ores were highly satisfactory as far as yield was concerned, the extraction being 90 per cent. of the gold and over 70 of silver; but I cannot give the cost of treatment, nor do the company's people know, because the experiments were only made with the view of ascertaining what the process could do with our ores. With some it was highly successful; from others it failed to extract anything, such as the "tin" ore, containing sulphide of zinc, and it failed or was found unsuitable for the Woodstock tailings.

A plant has been erected in the Waitawheta Gorge, in a most inaccessible and out-of-the-way place, and the only excuse I have heard for putting it there is, that the instructions from Home were to the effect that it was to be erected on or near the Crown Mine, and for that mine's use. It is quite patent that where it now is it cannot be used for more than two or three mines; whereas, had it been built where the old La Monte plant stood, it could, in the event of its

proving a success, and being able to do what the promoters claim it can, have treated all the ore in the Karangahake part of the district.

New Finds.

There have been but two new discoveries during the year—one on a branch of the Mahakirau, in the Mercury Bay portion of the district. Some small pieces of quartz were found showing free gold, and after prospecting for a short time the reef was exposed, showing some very rich stone, but after working on it for a short time it did not reach the expectations first formed, the gold being a patch. Though the claim is still being worked, I think the prospectors have not discovered any thing very encouraging.

The other discovery was made by the McIsaacs on the Kauri Timber Company's property in the Opitanui Valley, on the opposite side of the divide to the Matawai, where Mr. James Vizard has successfully mined for years. Ten tons of stone was brought from the Opitanui Claim by Mr. Pierce Lanigan, the lessee from the company, to the Thames, where it was crushed and treated, and found to contain over 2oz. free gold to the ton. This will undoubtedly pay, as there is splendid water-power at hand. When the result of this crushing became public, the miners rushed the Opitanui Valley, pegged, and gave notice of marking out; but the Kauri Timber Company objected on the ground that the land was private property, and had never been acquired for mining purposes, therefore the Warden had no power to grant claims or holdings. The miners contended that an agreement had been entered into between the Natives and Mr. James Mackay (as shown by Enclosure K, submitted with his report of July, 1869) that as soon as payable gold was found this land should be open for mining purposes, that the transferrors of this land to the company obtained the land from the Maoris after this agreement, and knew of it; therefore it was available for gold-mining purposes. The case was brought on in the Warden's Court, Coromandel, and I refused the application; whereupon they appealed to the Supreme Court, where the question has not yet been settled. It is unfortunate that the Government have not obtained the right to mine over all the Native lands in this part of the peninsula, for there is very little doubt that they are auriferous, gold having been found at Tokatea, Waikoromiko, Te Tiki, and Matawai on one side of the divide, and at Waitekuri, Opitanui, Matarangi, Kuaotunu, Waitara, and Mahakirau on the other, with outcrops of quartz all through the Kauri Timber Company's property between these places. If this land cannot be thrown open for mining purposes it will be a great drawback to the mining industry, and a loss to the colony generally.

Kuaotunu is the most important of the discoveries I mentioned as new finds in my last year's report. There good payable dirt has been found, averaging from 2oz. to 10oz. to the ton, not only on Crown land, but also on Native land, which as yet we have no authority to mine over, and also on Messrs. Comer and McPherson's private land. The Maoris, I believe, agreed to lease their land to the miners through Mr. James Mackay, but have since expressed a wish to enter into an agreement similar to that made by the other Natives in the peninsula, who have leased their land to Her Majesty the Queen for mining purposes. I have therefore sent them a copy of the Ohinemuri agreement to look over, and sign if they think fit, for both Maoris and miners seem to consider it would be far more satisfactory if the land were held by the Crown. At present the miners have no legal title to the claims they are working on, but only Mr. Mackay's and the Natives' promise to give them one at some future date, which makes their tenure very insecure. Messrs. Comer and McPherson are leasing their land to the miners for twenty-one years in blocks not to exceed 15 acres at a rental of £3 per acre. At least, those are the conditions Mr. Comer informed me he was letting his property on; but I hear Mr. McPherson's rent is £1 per acre, the same as the Government terms. I think if the Government can obtain the land from the Natives matters will run much more smoothly, and the miners and Natives be more satisfied in the end.

Kuaotunu.

The best mine in this part of the district is undoubtedly at present the Try Fluke, several parcels of stone sent to the Thames having yielded on an average 10oz. per ton. The mine is not large, being about five acres, but the reef the company is getting its gold from will average 3ft. They are still in brown-sandstone country, and have 70ft. to 80ft. of backs. What the reef will do when they get into the blue-sandstone country, which in this district is invariably found underlying the brown, is yet to be ascertained. The gold is very fine, and they will have great difficulty in saving it if they adhere to the battery process only. The last 10 tons they crushed at the Thames, the tailings fetched £30, and Mr. Peel, who bought them, informed me he got gold worth £65 out of them, thus clearing over £30 profit, by putting them through the Watson and Denny pans; but it appears to me from the following extract from the *Engineering and Mining Journal* of the 22nd February last that the Cassell Company's process is best suited for tailings of this description: "The following statement has been furnished to us by the Cassell Gold-extracting Company, of Glasgow, Scotland, of the result of treatment of 100 tons (of 2,240lb.) of auriferous-pyrites ore at Ravenswood, Queensland, Australia, by the MacArthur-Forrest process, which is owned by the Cassell Company: Cost of the ore at 16s. per ton, £80; cyanide, labour, fuel, and sundries, £1 5s. per ton, £125: total, £205. Produce of treatment, 115oz. of gold and 134oz. of silver; value, £480. Leaving a net profit of £275 to the Cassell Company. The ore on the dump assays before treatment 26dwt. of gold per ton, there was left in the tailings 3dwt.; making an extraction of 23dwt. per ton, or 88½ per cent." Therefore, had these tailings from the Try Fluke Mine been run into a river, a very common thing in old times, and too common even now, there would have been a clear loss of £65 to the colony. This company is erecting a battery on the Kuaotunu Creek below their mine, which should be working in a few weeks.

The drawbacks to this field will be the want of water, there not being more than enough in the creek for the battery-tables. Had there been sufficient for motive-power a much greater percentage of stuff would be found payable.

Almost on the southern boundary of the Try Fluke, the Try Fluke reef heaves to the west, and is broken up on the surface for 200ft. or more. From this break southward through the Kapai Claim and Hidden Treasure licensed holding (as far as has been prospected,) not a trace of gold has been found, but the reef is found making back to its original course, and when it reaches it it will in all probability make gold again. It may, however, have been only a surface-heave caused by the hill coming away; though, had that been so, one would have expected to find gold in the stone where it made after the break. The Just in Time Claim, on the opposite side of the ridge, has a good strong reef, which goes 2oz. to the ton. There are several other claims and holdings that have done a considerable amount of work; but the want of a battery to treat their ore has kept the miners back. Of the claims on the Maori and private land, the two most prominent at present are the Waitaia, on Comer and McPherson's land, which has yielded 2oz. to the ton of gold, worth £3 per oz., and the Otama, on the Maori land nearer the landing, which went 8oz. per ton.

The general opinion is that Kuaotunu is going to be a very "good thing," but I think we should be cautious. Until we see how our reefs run in the blue country, I do not think any one can speak with any certainty as to the future of this field.

Opitanui.

Mr. Pierce Lanigan, with the McIsaacs, have this lease in the Kauri Timber Company's property, and from what has been done in the holding one would be inclined to think it a valuable property, especially as they have splendid water-power convenient to the mine.

Coromandel.

The most important mines here are the Kapanga, Royal Oak, Coromandel, &c. The Kapanga and Royal Oak have produced the most gold for the year. The opening of Kuaotunu has retarded this place, a great many of the miners having left for there. A new find has always great attractions. Little has been done with the two special claims granted on the intake below high-water mark. The holders of the Golden Point sunk a shaft 50ft., but found the water difficult to deal with, and I do not think they could raise capital enough to erect a pump, so at present they are doing nothing. The Coromandel Mint holders are doing a little by sinking a shaft.

Matawai.

Mr. James Vizard is still working here, and has done the only work of importance since my last report.

Manaia.

The attractions of Kuaotunu have taken all the miners from here, which would, perhaps, not have been the case could they have treated their ore on the ground, and I feel sure this part of the district will yet show a good return of gold.

Mata and Tapu.

Nothing of importance has been done at Mata since my last report. Disputes I then spoke of terminated in a dissolution of the partnerships existing between the battery-owners and mine shareholders. The holdings were abandoned and forfeited, but fortunately the battery has been left, and no doubt will resume work in a few months.

At Tapu a new battery has been put up by the Messrs. Bull to crush for the Panama Route, making two batteries at Tapu. A license has been granted to Daniel Sheridan for his holding, and payable quartz is being obtained.

Waiomo

Has had a visitation of bad luck and worse management. When I wrote my last report the Paroquet Company was in existence, having a mine of twenty-eight acres, a battery of twenty-one stamps, and six berdans; but before opening up their mine they built manager's house and assay-house, erected a wire tram at great cost, added Watson and Denny pans, and numerous other outside improvements that were not then required, and when they wanted to open up the mine the money was gone. The shareholders refused to advance any more, and the whole plant was sold and pulled down, and a mine "duffered" that deserved a better fate. At all events it deserved opening up and a fair trial. Now the battery has gone—sold at less than one-sixth what it cost. Failures such as this come of companies spending all their money in plant before they open up their mine and see what they have to crush. A prospector has since cut a reef averaging 3ft., which assays 219oz. 5dwt. 18gr. gold, and 557oz. 0dwt. 22gr. silver per ton. This reef runs up the main ridge through the Gem ground.

Thames (comprising that portion of the field between the Tararu and Hape Creeks).

In this part of the district there are seven special claims, sixty-two licensed holdings, forty claims held under miners' rights, and fifteen batteries and tailing plants. I regret to say the yield of gold has fallen short this year owing to various causes, not the least being the exceptional drought, which caused many of the batteries to hang up some of their stampers. But for this last cause I think the yield would have equalled, if it had not exceeded, that of last year. On the whole I think the tone of this part of the field is much more hopeful, in spite of the falling-off of gold for the year.

The fact that Messrs. Cooper, Styak, and Crawford have picked up lost specimen-reefs and are doing well on them, has put new heart into the miners and mine-owners. It shows them that there is plenty of gold still left, if systematic prospecting is carried on; but most of this work will have to be done by the capitalist. If a thoroughly strong company once took up a claim such as

the Queen of Beauty, and were successful, as I have every reason to believe they would be, there is little doubt twice the energy would be shown in our mining, and our output of gold would considerably increase.

The discovery of a galena reef rich in gold and silver on the Sylvia ground was as unexpected as welcome. The proprietors thoroughly deserved their good fortune, for they had very pluckily pushed on their low level through very hard country. They are now going to put up a battery, for which they have obtained a site, tramway, and water-race.

There is not much work being done in the Upper Tararu, chiefly for want of a road where several new holdings were taken out; but on the Puru side Montgomery and party are putting up the battery they bought that stood on the Mangakara Creek.

There is no denying the fact that it is from the Thames portion of the district that we get the greater portion of our gold.

Puriri, Tairua, Whangamata, and Marototo.

Very little has been done at any of these places. Messrs. Hogg and Bedford still have faith in Puriri, and the former is moving the Woodstock battery from Karangahake to crush the ore from his holding.

Mr. J. H. Moore, the Marototo Company's manager, is getting some pans to grind what ore they have on hand, after which, I believe, they intend to abandon their holdings. There are only two other holdings being prospected on this field, that only three years ago appeared to have such a bright future.

Whangamata was deserted for a time, and everything forfeited, but lately the Goldwater has been taken up again.

Karangahake, Owharoa, and Waitekauri.

The first-named place is almost at a standstill, in a great measure because the mineholders are losing heart at the repeated failures of the different processes tried there to extract the gold and silver from their rich but complex ores. The Crown Mine has done a great deal of work, and the reef cut in their low level appears to be very good.

At Owharoa a few parties are at work, and the Smile of Fortune tributers are still getting gold; but it is not a popular part of the district, though I think it deserves a better fate.

There are only a few men prospecting at Waitekauri, nearly all the special claims and licensed holdings having been forfeited. The battery and plant put up by Mr. Chappel has been sold and removed to the Puru. It was put up without the proprietor first ascertaining whether there was any payable ore for it to crush. The Jubilee plant is standing idle; the boulders and wash-dirt it was put up to crush proved not payable. The old Waitekauri Company's mine has not been touched for over two years; all the workings are collapsing, and the tramway to their battery is sadly out of repair.

Waihi.

The Waihi Company's plant is working well at last. For a long time they had disappointment after disappointment. They erected Globe ore-crushers, and when everything was ready they found they were not adapted for the work; then a portion was pulled down, and Howell's patent stamps put in their place. This caused considerable delay, but now the plant is in full working-order, and can put through from 45 to 50 tons per twenty-four hours; and from what Mr. Russell informs me, they appear to have found a successful method of treating the Waihi ore, and one that will leave a good profit. If this is so, it will be very satisfactory to the Waihi Company's shareholders, for, as far as can be ascertained at present, they have a great quantity of the ore on their property, and the surrounding claimholders would, no doubt, either have their "dirt" treated by this company, or sell it to them; for this plant, with a few additional processes, will be able to treat all the ore found in this part of the district, and no doubt they will add to their plant if the surrounding mineholders offer them any encouragement to do so.

Te Aroha.

The Tui mines are waiting for a process to treat their ore, which contains a large percentage of sulphide of zinc. The Champion Mine is well opened up, and plenty of ore could be turned out if a method to treat it could be found. At Waiorongomai, the Werahiko and New Era Special Claim are the only mines being worked. The Te Aroha Silver- and Gold-mining Company's ground is protected, but I think it very doubtful if the latter company will recommence; if not, their works will be dismantled, and very little will be done at Te Aroha for some considerable time to come.

Occupation Licenses.

There were fifty-one granted last year. A great many more would have been taken up could larger areas have been granted in the outlying parts of the districts, where, the land being so poor, it is not possible for a family to make a living on 50 acres, and it is only where a large family are of age, and willing to unite, that it is practicable.

Return of Gold for Year ending 31st March, 1890.

Thames, 33,816oz. 14dwt. 8gr.; valued at £88,768 15s. 6d. Ohinemuri, 6,382oz.; valued at £8,615 14s. Coromandel, 6,707oz. 18dwt. 7gr.; valued at £18,837 15s. Te Aroha, 20,416oz.; valued at £11,739 4s. Value of ore exported, £3,000.

I have, &c.,

H. W. Northcroft, Warden.

The Under-Secretary, Mines Department, Wellington.

No. 4.

Mr. G. Wilson, Inspector of Mines, to the Under-Secretary of Mines.

Sir,— Inspector of Mines' Office, Thames, 17th April, 1890.

I have the honour to forward the following report on mines, with returns showing quantity of quartz crushed and yield of gold in the Hauraki Mining District for the year ending the 31st March, 1889.

The returns of gold show that the quantity is considerably less at Coromandel and Thames compared with last year's returns. The decrease in the yield for the Kapanga accounts largely for the shortcoming at Coromandel, while the continuous drought for the last three months caused many of the stampers at Thames to be hung up (as the whole of the batteries in the Thames district, with the exception of the Waiotahi, are driven by water-power), and a less quantity of quartz crushed in consequence. The mines at Mata and Waiomo also did not come up to expectations, and work was soon suspended in those localities. At Ohinemuri and Te Aroha the returns show an improvement, notwithstanding many drawbacks with new machinery.

Coromandel District.

Tokatea Range.

Tokatea Mine (Mr. John Benney, manager).—Operations in this mine have been carried on by tributers in the same manner as last year, and have been chiefly confined to workings on small leaders near the surface. Twenty-three and a half tons of quartz has been crushed for a yield of 433oz. 2dwt. of gold. An average of sixteen men have been employed during the year. The manager of this mine is of opinion that if the creeks on the Kennedy Bay watershed were brought in and the battery driven by water-power, many thousands of tons of quartz and mullock might be profitably worked in the upper portion of the mine.

Queen of the North Mine (Mr. Carlo Blasch, manager).—Twenty tons of quartz has been crushed for a yield of 132oz. of gold, wholly obtained by tributers from the surface-workings of the mine. Six men are employed.

Royal Oak Mine (Mr. Peter Reid, manager).—This mine is worked by wages-men and tributers, and operations have been very successful during the year. The company's men obtained 1 ton of quartz and 300lb. of specimens, which yielded 399oz. of gold, and the tributers 6 tons for 630oz. of gold. Six wages-men and six tributers were employed.

The Bachelors' Mine, Regan's, Ogilvie's, Simms's, Stirling Castle, and Young American Claims have also added considerably to the year's returns.

Kapanga Mine (Mr. Francis Hodge, manager).—Operations in this mine are still being profitably carried on, and a large amount of work has been done during the year. The main shaft (Larnach's shaft) has been sunk 25ft., and is now 565ft. in depth. A plunger-lift 8in. in diameter has been fixed from the 420ft. cistern to 550ft. The shaft is to be sunk to a depth of 600ft. The channel of country rock (sandstone) is improving in appearance, and is favourable for gold in the shaft as sinking progresses. Driving and stoping have been carried on, on both the Kapanga and Scotty's reefs, at the 300ft., intermediate, and 420ft. levels, chiefly in a southerly direction from the main shaft; 500ft. of cross-cut drives has been put in, and 1,400ft. of drives on reefs; 250ft. of winze-sinking and 340 fathoms of reef stoped out; and 1,334 tons of quartz has been crushed for a return of 3,153oz. of gold. An average of fifty-four men are employed in the mine during the year. The mine-workings and pumping and winding gear are in good condition and order, and ventilation very good.

South Kapanga Mine (Mr. Thomas Blair, manager).—Operations have been carried on in driving from the shaft at the 100ft. level; a considerable amount of driving on the reefs has been done, and occasionally small patches of gold are found. Ten men are employed. The shaft is 100ft. in depth, and the pumping and winding are done by a small portable engine.

Scotty's and North Kapanga Mine (Mr. J. D. Colebrook, manager).—Operations have been confined to extending the low-level cross-cut. Several small reefs have been discovered, but as yet they have not proved to be of any value. Six men have been employed.

Kauri Block.

Coromandel Mine (Mr. Francis Hodge, manager).—A large amount of prospecting has been done in this mine, chiefly at the low level in the Palmerston Shaft, and also at the intermediate and adit levels; 834ft. of driving has been done at the different levels; 100 tons of quartz crushed for a yield of 65oz. of gold. An average of twenty-seven men have been employed during the year. The mine-workings and pumping and winding gear are in good order, and the ventilation good.

Tiki District.

The Colonist, Edith, and several other small claims are occasionally worked, but the returns have not been of much importance.

Matawai District.

Castle Rock Mine (Mr. James Vizard, manager and owner).—Operations were chiefly confined to making a connection with the low level. The winze was holed through and good ventilation secured. Stoping was carried on under the floor of the upper level; 100lb. of specimens was crushed for a yield of 150oz. of gold.

Manaia District.

Operations in this district have been suspended, Blackmore and party and others having gone to Kuaotunu.

WHANGAPOUA DISTRICT.

Lanigan's Lease.—This mine is situated on the Opitonui Creek, about a mile and a half to the west of the Whangapoua and Mercury Bay Track, and on ground claimed by the Kauri Timber Company. Gold was discovered near an old log-rolling road, and several prospecting-drives have been put in. A reef about 3ft. in thickness was discovered near the surface, and a cutting put in on the quartz. Gold is frequently seen in the stone, and there is every indication that a payable reef has been discovered. A low level has been driven and the reef cut about 60ft. deeper than the open cutting: the reef in this level is from 6ft. to 8ft. in thickness, and gold is seen in the quartz. Thirty tons of quartz from the open cutting was crushed for a yield of 61oz. 3dwt. of gold. Four men have been employed. It is the intention of the owners to erect a battery at the most convenient place to the mine.

MATARANGI DISTRICT.

This district has been deserted for the past year: the attractions of Kuaotunu caused the miners to abandon their claims.

MAHAKIRAU.

Mahakirau Claim (Mr. H. C. Reede, manager).—This claim is situated on one of the south branches of the Mahakirau, about a mile from the main stream, and five miles up from Hooker's farm. Gold was discovered in a leader varying from a few inches to 2ft. in thickness. A drive has been put in on the leader for a distance of 20ft., and the reef has been cut on the lower level. Several tons of quartz were broken out; and 9cwt. of stone, picked out and packed to Coromandel, yielded 89oz. of gold. Three men are employed. No other payable gold has been discovered in this locality, although several parties have been prospecting during the year.

KUAOTUNU DISTRICT.

Try Fluke (Mr. Henry P. Hornibrook, manager).—A considerable amount of work has been done in this mine since the discovery of a gold-bearing reef in the early part of the year. The reef was found at the surface and a cross-cut put in 112ft., and the reef cut about 40ft. below the surface and driven on about 60ft. The reef in this drive is from 4ft. to 5ft. in thickness, and has yielded rich stone. A winze has been sunk from this level and is now down about 50ft. A low level is being driven to cut the reef at a depth of 130ft. from the surface. The reef being in a steep range, it can be worked to a great depth from tunnels. An average of six men have been employed during the year. Thirty tons of quartz was crushed at the Thames for a return of 351oz. of gold. Two hundred tons of quartz is stacked at the surface. A battery of ten stamps, to be driven by steam-power, is being erected on Kuaotunu Creek, and a wire tramway is to be erected to connect the mine with the battery.

Just in Time Mine (Mr. J. Lindsay, manager).—This claim is situated on the eastern side of the main line of reef, adjacent to the Carbine and Try Fluke. Several reefs have been discovered carrying gold; and 4 tons of quartz taken from a reef about 18in. in thickness yielded 10oz. 6dwt. of gold. Four men have been employed during the year.

Carbine Mine (Mr. Charles Swanson, manager).—This mine is next to the Try Fluke, on the line of the main reef; and a cross-cut has been driven, and the reef cut at about 30ft. below the outcrop, and about 50ft. driven on the reef, which will average 4ft. in thickness. Two men have been employed. Twenty tons of quartz has been crushed for a yield of 21oz. 18dwt. 12gr. of gold.

Mariposa Mine (Mr. John Stewart, manager).—This mine is next the Carbine, on the same line of reef. The reef has been cut in a cross-cut driven about 70ft., and fair prospects of gold are obtained. Two hundred feet of driving has been done. Two men have been employed.

John Bull Mine, next the Mariposa, on the same line of reef, has got fair prospects of gold in two reefs driven on from the surface. Two men have been employed.

Red Mercury Mine (Mr. Samuel Youlden, manager), next the John Bull, on the same line of reef. The reef has been cut in two cross-cuts of 64ft. and 45ft. respectively. It is about 3ft. in thickness, and yields fair prospects of gold. Three men have been employed.

Great Mercury Mine (Mr. Alex. Peebles, manager) is next the Red Mercury, and is known as the Prospectors' Claim. A considerable amount of prospecting has been done in this mine. Over 272ft. has been driven in five separate cross-cuts, and 60 chains of trenching done on the surface. Twelve reefs and leaders have been discovered, varying from 6in. to 10ft. in thickness. Four men have been employed. Five hundredweight of quartz yielded 11dwt. 9gr. of gold.

Otama Mine (Mr. H. T. Rowe, manager).—This mine lies to the westward of the Great Mercury, and is situated on Native land. A reef was cut near the surface, and payable gold discovered in two different veins, one 6in. and the other 15in. in thickness. Two hundred and sixty feet of driving has been done in the cross-cut, and 60ft. on the leaders. Four fathoms of leader stoped out, and 31 tons of quartz crushed for a good return of 189oz. 10dwt. of gold; and 25 tons of first-class and 70 tons of second-class quartz are stacked at the surface. An average of nine men have been employed.

Nemesis Mine (Mr. H. T. Rowe, manager).—This mine adjoins the Otama, and is also on Native land. A considerable amount of prospecting has been done, 132ft. driven in cross-cuts, and six leaders discovered. Five men have been employed.

Woodcock and Wilson's Mine (Mr. James R. S. Wilson, manager).—This mine is situated on Native land, on the range near McPherson's land. Six reefs have been discovered, varying from 1ft. to 6ft. One cross-cut tunnel has been driven 46ft. Ten tons of quartz has been crushed for a return of 26oz. of gold. Two men have been employed.

Black Jack Mine.—This mine is situated on Native lands, on the spur near the beach at the landing. A considerable amount of work has been done on the reef, which is about 2ft. in thick-

ness. Fifteen tons of quartz was crushed for a yield of 14oz. 10dwt. of gold. Two men were employed during the year.

Maori Dream.—This claim is situated on Crown land, about a mile and a half to the eastward of the Black Jack. A parcel of 10 tons of quartz was crushed for a yield of 6oz. 5dwt. of gold. Three men have been employed.

The Sea View, Snell's, Golden Gate, Dyer's, Banks's claim, Kapai, and a number of other claims have been occupied on Crown land and also on Native lands, and a considerable amount of prospecting has been done and many reefs and leaders have been discovered, and, as a rule, gold, more or less, is found in all the quartz veins and reefs.

Thames District.

Boat Harbour.—Prospecting to a small extent has been carried on during the year, and one party have discovered a reef giving sufficient inducement for them to take up and apply for a special claim.

Mata.

Small parcels of quartz from the Gentle Annie Mine and other claims were crushed at Fraser's battery. 164 tons yielded 84oz. of gold; but the returns were not payable, and the district is now deserted.

Tapu.

About twenty miners are working in the different claims to the northward of the creek. McMahon's claim crushed 395 tons of quartz for a yield of 50oz. 15dwt. of gold; the Centennial crushed 26 tons for 16oz. of gold; Draffin's, 2 tons for 6oz. 6dwt.; Hawke's, 72 tons for 6oz. 14dwt.; McCormack's, 10 tons for 2oz. 14dwt.; Manuel's, 19 tons for 1oz. 6dwt.; and Bundrie's, 1oz. 7dwt. Total, 524 tons for 85oz. 3dwt. of gold.

Sheridan's Claim (Mr. Daniel Sheridan, owner).—This mine is situated on the southward side of the creek, about a mile from the beach. A low-level cross-cut was driven, and the reef, which is about 10in. in thickness, has been driven on for 80ft. Twenty tons of quartz is stacked at the surface, and 35lb. of specimens was crushed for a yield of 35oz. 10dwt. of gold. Three men have been employed.

Broken Hills Claim (Mr. Charles Bull, owner).—This claim was lately taken up, and is situated about a mile from Sheridan's. They have erected a small battery of four stamps, driven by water-power from the Bullion Creek. Twenty-four tons of quartz has been crushed for a yield of 5oz. 9dwt. of gold. Three men have been employed.

Tapu Sluicing Company's Claim.—This claim was worked for a considerable time by sluicing and paddocking; but the returns of 20oz. 18dwt. of gold from 1,320 tons were not payable, and the machinery has been removed.

Nevis Claim (situated at Die Hard Creek).—This claim has lately been taken up. Twelve tons of quartz for 6oz. 8dwt. of gold. Two men are employed.

Puru.

Sir Colin Campbell Claim.—S. Montgomery and party have been prospecting during the past twelve months, and have discovered several reefs, which, although not rich, are considered to be payable. They have purchased a battery of ten stamps, which will be erected on one of the branches of the Puru Creek, and driven by water-power.

Waiomo.

Paroquet Mine.—The quartz crushed for this mine was 226 tons for a yield of 37oz. 14dwt. of gold. The mine was closed in June last, and since then the whole plant, battery, and aerial tramway have been sold and removed.

Golden Gem Mine.—This mine was worked in the early part of last year. Sixty-two tons of quartz was crushed for 16oz. 19dwt. of gold. Operations in the mine were suspended shortly after the Paroquet was closed down. There has been a fresh discovery near the Gem ground, and several claims are again taken up. An average of ten men were employed during the year.

Karioi.

Lady Mary Claim (Charles Brown and party).—This claim is situated near the Tapu Road, about one mile north of Tararu Creek. A considerable amount of work has been done in prospecting, and a reef about 2ft. in thickness yielded from a trial-crushing 15dwt. of gold per ton. The owners have erected a small battery of three stamps, driven by the old bone-mill steam-engine; but no returns have yet been received. Three men are employed.

Tararu.

Sylvia Special Claim (Mr. William Tregoweth, manager).—The reef which was cut in the low level has been driven on for 290ft., and is from 4ft. to 7ft. in thickness. A rise has been put up 145ft. to connect with the upper level, on which 130ft. was driven on the reef. Very rich prospects have been got from the reef in the low-level drive, and also in the rise and the upper level. The quartz is of a complex nature, and contains, besides gold, silver-glance, copper, galena, and zinc. A battery of ten stamps, Howell's patent, and the necessary plant for treatment of the ore is to be erected near the junction of the Ohio and Tararu Creeks, and an aerial tramway about 30 chains in length will connect the mine with the battery. A water-race 37 chains in length is constructed, and a 5ft. Pelton wheel will be used to drive the machinery. Eleven men are employed.

Norfolk Mine (Mr. James S. Thorburn, manager).—A considerable amount of work has been done in opening up this mine, and connecting the low level with the road by a shoot. A parcel of

quartz crushed was not payable, but they have discovered what appears to be a continuation of the old Star of California reef, and payable prospects are obtained, and the next crushing will most probably be a payable one. Five men are employed.

Dunedin Mine (Mr. John Bowler, manager).—This ground, which comprises the old City of Dunedin, Royal Charter, and Lady Bird claims, has only lately been taken up. They have, however, cleared out and repaired the old Lady Bird low level, which can be connected with Darrow's battery by a few chains of ground-tramway. A rise is being put up on one of the reefs to connect the low level with the upper portion of the mine, and it is expected that a large quantity of low-grade quartz may be profitably worked. Four men are employed.

Nymph and Mermaid Mine is situated at Upper Tararu. Small prospects are found in several of the reefs, and 2½ tons of quartz was crushed for 4oz. 8dwt. of gold. A considerable amount of prospecting has been done in this locality, and eight licensed holdings were taken up, but on account of want of a road to the place they are nearly all abandoned. Two men only are employed in this neighbourhood.

The battery near the Tararu Gardens, which was formerly known as Brown and Campbell's Battery, has lately been purchased by the Norfolk Gold-mining Company, and the water-race and machinery repaired, so that it is now in working-order. Messrs. Darrow and Company are also erecting a twenty-stamp mill on the site of the old Russell Battery at the foot of Tinker's Gully. This battery will be connected with the old Ballarat and Clunes low level, near the head of the gully, by means of a self-acting wire tramway 60 chains in length. The owners of this mill have purchased from the owners of Dixon's No. 1 Mine the right to work all that portion between the low level and the surface (a depth of about 200ft.), and they intend to send down and crush large quantities of surface-stuff and mullock as well as quartz from the reef and leaders. Ten men are employed on this work.

Kuranui.

Hansen's Kuranui No. 3 Mine (Mr. Peter Hansen, manager).—Operations in this mine have been chiefly confined to mining surface-stuff from an open face. Fifteen thousand seven hundred and fifty-five tons was put through the battery for a yield of 1,014oz. 6dwt. of gold. Sixty tons of quartz was also crushed for tributers for a yield of 56oz. 10dwt. of gold. Seventeen wages-men and three tributers are employed.

Comer's Kuranui No. 2 Mine (Mr. Robert Comer, owner and manager).—Operations in this mine are also chiefly confined to mining from an open cutting near the old Albion shaft. Ten thousand five hundred and fifty tons was crushed by the owner for a yield of 616oz. 18dwt. of gold, and 873 tons for tributers for a yield of 954oz. 12dwt. of gold. Twenty wages-men and thirty-five tributers are employed. A battery of twenty stamps, driven by water-power, is erected close to the mine, and the returns from the surface-stuff, although only 1dwt. 4·0067gr. per ton, have paid all working-expenses and leave a profit.

Turtle's Kuranui No. 1 Mine.—This mine is worked entirely by tributers. Two hundred and ninety-two tons of quartz was crushed for a yield of 116oz. 3dwt. of gold. Six tributers are employed.

Deep Level Cross Mine (Mr. J. A. James, manager).—Work in this mine has been confined to working leaders in the Tookey section of the mine. Five tributers were employed, but the returns could not be ascertained.

Moanataiari.

Moanataiari Mine (Mr. George S. Clark, manager).—This mine still continues to furnish employment for a large number of miners. The operations for the past year have chiefly been in the extension of the main tunnel, opening up a reef in the Reuben Parr section of the mine, crushing a quantity of surface-stuff of low grade, and driving on reefs from the Cambria shaft, No. 4 level, workings. The tributers are employed chiefly in working leaders from the surface-levels in all parts of the ground. The prospects in the Reuben Parr reef are very encouraging. The main tunnel will shortly be extended far enough to admit of a rise being put up to connect with the workings on this reef below the Point Russell level: this will give over 90ft. of backs on the run of gold, from which over 1,000oz. of gold has been obtained. The main tunnel, which is now 3,030ft. in length, was extended 250ft., and about 1,100ft. of driving has been done, 2,600ft. of old tunnels cleared out and repaired, and 400 fathoms of reef stoped out by the company. Three thousand five hundred and sixty tons of quartz and surface-stuff has been crushed for a yield of 615oz. of gold, and the tributers crushed 2,346 tons of quartz for a yield of 2,346oz. of gold. Fifty-six wages-men and fifty-nine tributers have been employed.

Coliban Mine (Mr. James R. Hunter, manager).—Very little work has been done in this mine for the year. Seventy-six tons of quartz was crushed for a yield of 23oz. 17dwt. of gold. Three men were employed.

Orlando Mine (Mr. W. H. Potts, manager).—The chief work in this mine was clearing out and repairing the old Independent low level, which is 900ft. in length. Thirty-five tons of quartz was crushed for 99oz. of gold, and the tributers obtained 115oz. of gold from 10 tons of quartz and 225 tons of mullock. Three wages-men and six tributers are employed.

Whau Mine (Downie and party, owners).—This mine was purchased by the present owners during the year, and since they obtained possession a large amount of work has been done in clearing out old drives at the old battery-level and driving 300ft. on different leaders. One hundred and twenty tons of quartz was crushed for 65oz. of gold, and the tributers crushed 210 tons for 196oz. of gold. Four shareholders and eight tributers have been employed.

Alburnia Mine (Mr. Thomas Radford, manager).—Operations in this mine have principally been in driving a cross-cut at the battery-level to cut the Sons of Freedom reef. Three hundred feet has been driven on this reef, and 210 tons of quartz crushed for a yield of 418oz. of gold. The

tributers crushed 100 tons for a return of 60oz. of gold. Eighteen wages-men and six tributers are employed.

Dixon's No. 1 Mine (Mr. Edward White, manager).—The workings in this mine have been chiefly in old ground. Three hundred and fifty feet of drives was cleared up and repaired, and a winze sunk 90ft. to connect with the Whau level. One hundred and twenty tons of quartz was crushed for 121oz. of gold, and the tributers crushed 295 tons for 235oz. of gold. Five owners and four tributers are employed. The owners of this mine have disposed of the upper portion of their ground, to a depth from the surface of about 200ft., to Messrs. Darrow and Company, who are making provision to work the ground from the old Ballarat and Clunes level, on the Tinker's Gully side of the range.

About twenty men are employed working about the old mullock-tips and in small claims in the Moanataiari district.

GRAHAMSTOWN.

New Prince Imperial Mine (Mr. Dawson Crawford, manager).—This mine has been chiefly worked in the upper levels. Sixty-four tons of quartz was crushed for 55oz. of gold, and the tributers crushed 450 tons for 905oz. of gold. Five wages-men and ten tributers were employed.

The Saxon Mine (Mr. Thomas A. Dunlop, manager).—The principal works in this mine during the year have been at No. 4 and No. 5 levels, and in opening a new level, No. 6, at a depth of 461ft. from the surface. Stoping on No. 1 and No. 2 reefs and foot-wall leader has been carried on over No. 3, No. 4, and No. 5 levels, and the first two mentioned and hanging-wall leader are worked up to the Trenton boundary. The water in the shaft has not been lowered sufficiently to admit of its being cleared out for the purpose of opening the No. 6 level. The company have therefore made arrangements to drive a cross-cut from the No. 4 level in the New Prince Imperial Mine. Forty feet has already been driven, and, as the total length of this drive is to be 400ft., some time will elapse before the No. 6 level can be opened, unless the water in the meantime gets drained from the shaft. A winze was commenced on No. 1 Reef, at No. 5 level, to a depth of 38ft., but sinking had to be stopped on account of water. During the year 1,300ft. of driving has been done, 351ft. of winze-sinking, 2,500 fathoms of reef and leaders stoped out, 14,550 tons of quartz and 965lb. of specimens crushed for a return of 8,171oz. of gold. One hundred and fifteen men are employed. The mine machinery consists of a twenty-five-horse-power winding-engine and tubular boiler, and (a Rand's No. 2 Little Giant, and a Slugger No. 13) rock-drills are used in driving. A 12in. by 16in. Rand's air-compressor on the surface is driven by a Pelton water-wheel. The battery consists of thirty-three stamps and sixteen berdans, driven by Pelton water-wheels. The electric light is used for lighting the mill, the dynamo being driven by a small Pelton wheel.

Caledonian Mine (Mr. J. A. James, manager).—A considerable quantity of low-grade quartz, chiefly from the No. 1 level, has been crushed by the company—4,128 tons of quartz for 395oz. 6dwt. of gold; and the tributers crushed 619 tons of quartz and 133lb. of specimens for a yield of 237oz. 12dwt. of gold. Seventeen wages-men and eight tributers were employed.

WAIOTAHI.

Waiotahi Mine (Mr. James E. Smith, manager).—This mine continues to be successfully worked, and has again yielded good returns. The workings are chiefly on leaders and reefs between No. 3 and No. 4 levels. The veins vary from ⅛in. to 6ft. in thickness. About 1,000ft. of driving has been done on various leaders and reefs, and about 1,000 fathoms stoped out. Two thousand four hundred and thirty-one tons of quartz crushed yielded 3,218oz. 10dwt. of gold. Forty wages-men are employed.

New Manukau Mine (Mr. James E. Smith, manager).—This mine adjoins the Waiotahi, and is worked in a similar manner. Two hundred and nine tons of quartz was crushed for 286oz. 10dwt. of gold, and the tributers crushed 132 tons for 144oz. 1dwt. of gold. Six wages-men and two tributers are employed.

Cambria Mine (Mr. William Baker, manager).—The workings in this mine have been principally on the hanging- and foot-wall leaders from the main reef, between No. 3 and No. 4 levels from the shaft. The workings are towards the western end of the mine, and these leaders may possibly be a continuation of those worked in the Waiotahi Mine. The quantity of quartz crushed was 532 tons for 831oz. of gold, and specimens 181lb. for 187oz. of gold. Thirty men have been employed.

Trenton Mine (Mr. James Coutts, manager).—The south cross-cut from Cambria was driven, and the Saxon reef cut; but the chief operations were driving the low level from the bottom of the shaft to the Saxon No. 5 level, 630ft. On breaking through and securing ventilation, 75 tons of quartz was obtained, and crushed for 41oz. 6dwt. of gold. Twenty-seven wages-men were employed.

Fame and Fortune Mine (Mr. E. K. Cooper, manager).—This mine extends from the Moanataiari to the Waiotahi Creek. The chief work during the year has been towards opening up and ventilating the mines. An old tunnel named the Balmoral, on the Waiotahi Creek, was cleared out, repaired, and driven to a distance of 700ft. Several reefs and leaders were cut and worked on. A large reef at the end of the drive has been cut, and a rise is to be put up for 95ft. This will connect with a level on the Moanataiari side of the range and secure ventilation. Another low level has been driven 450ft. on the Waiotahi Creek, about 150ft. deeper than the Balmoral level. This will become the main adit-level of the mine. The owners have purchased the twenty-stamp battery from the Caledonian Company, and the manager informs me that a self-acting wire tramway (to be 60 chains in length) is to be erected from the adit-level in the Waiotahi Creek to this battery. One thousand two hundred and five feet has been driven on reefs and leaders, and 980 fathoms of reef stoped out. The total output of quartz was 1,146 tons, which yielded 1,809oz. 9dwt. 12gr. of gold. Fifty-three men are employed.

The Blanche, Pinafore, Mount Edwards, Little Maggie, Norman, Edwards's Claim, Berrys' Claim, New Fearnought, Burns's Claim, and Bright Smile have all been worked in the Waiotahi district, and about twenty-four men employed, the returns of gold from which cannot be ascertained.

Calliope Mine (Mr. Simon Dryden, owner and manager).—The owner and six tributers have been employed. Ten tons of quartz crushed yielded 7oz. 6dwt. of gold, and the tributers crushed 84 tons for 60oz. 15dwt. of gold.

Waiokaraka.

May Queen Mine (Mr. H. W. Moore, manager).—In this mine work was commenced at the beginning of the year. The main shaft was sunk 300ft.; an old drive, 700ft. in length, was cleared out and repaired, giving connection with the old City of London shaft. A drive was then put in to the eastward on a reef known as the No. 4 Reef for a distance of 320ft., in the last 50ft. of which gold was seen and a few pounds of specimens obtained. The reef is about 15in. in thickness. A drive was also cleared out for 150ft. on the reef in a westerly direction, in which No. 1 Reef had been cut. This reef (No. 1 Reef), which is 5in. in thickness, was driven on to the northward for 40ft., and 5lb. of specimens obtained. A cross-cut is now being put in from the shaft to cut No. 4 Reef, where the gold was got; and the drive on the reef will be continued to the eastward, when the manager expects payable quartz. The winding-gear is worked by a ten-horse-power portable engine. Ten men have been employed.

Crawford's Special Claim (Mr. Thomas Henry Crawford, manager).—A shaft has been sunk to a depth of 100ft., but operations had to be discontinued until winding and pumping machinery can be erected. The drive on the reef in Collarbone Creek has been extended for about 200ft., and payable quartz obtained. An air-shaft has also been sunk from the surface for ventilation. The next level on this reef must be from a cross-cut to be driven from the shaft. Seventy fathoms of the reef, averaging 3ft. in thickness, has been stoped out, and 221 tons of quartz crushed for 254oz. of gold. Twenty wages-men are employed.

Karaka.

Adelaide Mine (Mr. George Bull and party, owners).—Operations in this mine were chiefly in stoping out a block of reef about the low level, and working portions of the reef near the surface by tributers. Two hundred and forty-nine tons of quartz was crushed for the owners, for a yield of 780oz. of gold, and for the tributers 70 tons for 61oz. of gold. Six wages-men and two tributers were employed.

Lone Hand Mine (Mr. H. W. Moore, manager).—During the year work has been vigorously carried on. A low level from the Rocky Point tunnel has been driven a distance of 875ft.—300ft. through the Lone Hand, 425ft. through the Adelaide, and 150ft. again in the Lone Hand ground. The Moa reef was cut, and has been driven on for 400ft. The Manchester reef is now cut 90ft. below the Moa level, and gold is seen in this reef, which is about 1ft. thick. A winze has been sunk 40ft. on the reef at the Moa level, where the reef is 15in. in thickness and showing gold. The total number of feet driven was 1,200; and blocks in the Lone Hand and Manchester sections have been worked. Two hundred and fifty-seven fathoms of reef was stoped out. Five hundred and fifty-one tons of quartz has been crushed for 1,089oz. 17dwt. of gold, and for the tributers 20 tons for 68oz. 4dwt. of gold. Sixteen wages-men and five tributers are employed.

E. and M. Claim (Messrs. Richard Feney and John Johnson, owners).—Ten tons of quartz from small leaders was crushed for 30oz. of gold. Two men are employed.

Claremont Claim (Mr. George Bryant, owner).—The leaders in this claim are from ½in. to 6in. in thickness. One hundred and twenty-eight pounds of specimens were crushed for 78oz. 5dwt. of gold. Two men are employed.

Hokianga Mine (Mr. Richard Jenkins and party, owners).—The reef worked in this ground averages 2ft. 6in. in thickness. Eighteen tons of quartz and 144lb. of specimens were crushed for 124oz. 1dwt. of gold. Two men are employed.

Lucky Hit Mine (Mr. J. G. Vivian, manager).—This mine is situated near the head of the Karaka Creek, and is worked by tributers. Three reefs, varying from 6in. to 15in., have been worked, and 115 tons of quartz crushed for 289oz. 19dwt. of gold. Thirteen tributers are employed.

The Little Nell, Prosperity, Hongkong, Helping Hand, Carbine, and several other claims are occupied in the Karaka district, but the returns cannot be ascertained. About twenty-four men have been employed.

Una Hill and Te Papa.

Dives Mine (Mr. John Williams, manager).—This mine includes a portion of the old Una ground. The Una No. 2 and No. 3 levels have been cleaned out and repaired, and a cross-cut 98ft. driven on No. 2 level. A winze has been sunk on the main reef and another on the hanging-wall leader, 80 fathoms of reef stoped out, and 142 tons of quartz crushed for 275oz. of gold. Eleven wages-men are employed.

Occidental Mine (Mr. Thomas Black, manager; Styak and Bruce, owners).—This mine is situated at the Una Hill, and is part of the old Una Mine. A leader was discovered in the low-level tunnel about 800ft. from the entrance. This leader had been cut through about twenty years ago, but not worked on. The present owners have driven about 60ft. on the leader and stoped out for about 30ft. in height. Sixteen tons of quartz and specimens has been crushed for 470oz. 19dwt. 8gr. of gold. Eight men are employed.

Little Edwin Mine (Hardman and party, owners).—The owners crushed 29 tons of quartz for 50oz. of gold, and tributers 18 tons for 20oz. of gold. Three owners and two tributers were employed.

North Star Mine (Mr. Robert Harvie, manager).—This mine has been entirely worked by tributers. The leaders are generally from 6in. to 1ft. in thickness. One hundred and fifteen tons of quartz was crushed for 296oz. of gold. Nine tributers were employed.

The Magnolia Mine (Mr. Henry Rabe, manager).—This mine has been worked entirely by tributers, who have been working on small veins near the surface. The returns could not be ascertained. Seven tributers are employed.

About ten small claims are also worked in this locality from which no returns can be obtained. Sixteen men are employed.

HAPE CREEK.

Consols Mine (Mr. W. S. McCormick, manager).—The workings in this mine, which are from two drives near the surface, have been chiefly on two leaders. The owners crushed 30 tons for 22oz. of gold, and the tributers 124 tons for 91oz. of gold. Two owners and nine tributers were employed.

The Weymouth, Fogarty's Claim, Brown's Claim, and several other small claims are occasionally worked, but the returns could not be obtained. Twelve men were employed.

OTANUI.

New Eureka Mine.—This mine has been worked by tributers, who have been engaged in driving a low level, which has been extended about 80ft. Six tributers were employed.

PURIRI.

Old Prospectors' Mine (Mr. A. Hogg, manager).—This mine, which includes several old claims, has been taken up, and a large amount of prospecting has been done during the year, and 400 tons of quartz taken from a large reef and stacked at the surface. A parcel of 20 tons of quartz crushed yielded 27oz. of gold. Six men were employed. The owners of this mine have such confidence in it that they have purchased a fourteen-stamp battery, which will be erected on the Puriri Creek, and driven by water-power.

Bedford's Mine (Mr. John McInnes, manager).—Work has been steadily carried on in this mine during the year, and the returns are satisfactory. Three hundred and fifty-one tons of quartz was crushed for a yield of 230oz. of gold. Six wages-men are employed.

TAIRUA.

Decide Mine (Mr. Finlay McLiver, manager and owner).—This mine has been steadily worked during the year. A large block of the reef, which is 4ft. in thickness, has been stoped out. One hundred and eighty-eight tons of quartz has been crushed for 89oz. of gold. Six men were employed.

OHINEMURI DISTRICT.

Marototo.

Marototo Mine (Mr. John H. Moore, manager).—A large amount of work has been done in this mine during the year, in sinking winze and stoping out the reef. About 200 tons of rich ore is stacked at the mine, and 1 ton was exported valued at £96. Ten men were employed. A small plant consisting of grinding-and-amalgamating pans is in course of erection near the mine, and will be ready for work in about a month.

The Silver Queen ground was taken up by Fagan and party, who obtained 4 tons of ore, which was sold for £200. Another party are now in possession of the ground, but have had no returns as yet. Four men were employed.

The Arizona ground has also been taken up—by McDonough and party—but no returns have been obtained. Two men are employed.

KARANGAHAKE.

Ivanhoe and Truro Mine (Mr. John McCombie, manager).—Work has been steadily carried on in this mine during the year. About 400ft. of driving has been done on different reefs and leaders, and 300 fathoms of reef stoped out. The owners have crushed 329 tons of quartz for 292oz. of gold, and the tributers 120 tons for 82oz. of gold. Ten wages-men and two tributers were employed.

Woodstock Mine (Mr. John McCombie, manager).—Very little work has been done in this mine, and no quartz has been crushed. One man was employed.

Kenilworth Mine (Mr. John McCombie, manager).—This mine has been worked entirely by tributers. Forty-five tons of quartz was sold on assay-value for £1,660, and 45 tons of ore is now stacked, estimated to be worth from £30 to £40 per ton. Seven tributers were employed.

Crown Mine (Mr. G. M. McGruer, manager).—This mine is now well opened up from three levels, and another level is being driven at a greater depth, gold having been discovered in a large reef near the Waitawheta Stream. One hundred and sixty fathoms of reef has been stoped out, and 100 tons of quartz forwarded to the mill and crushed, but the treatment of the "pulp" has not been yet completed. The crushing-mill consists of a stone-breaker and two Lamberton mills, which crush dry ore, in which state the crushed ore is handed over to the Cassell Company for extraction by their process. Forty men have been employed.

Several other claims, including the Monastery, Priory, Specimen Hill, and Adeline Amalgamated, have been partially worked, but no returns of quartz crushed or gold got can be obtained. Ten men are employed.

OWHAROA.

Smile of Fortune Mine (Mr. C. S. Farmer, manager).—This mine is entirely worked by tributers. The run of gold in the main reef has been stoped out to the surface, and the party is now engaged

in stoping a block over the low level. Two hundred fathoms of reef has been taken out altogether, and 820 tons of quartz crushed for 362oz. 16dwt. of gold. Eight men were employed.

The Madden's Folly and Marie Claims.—A considerable amount of prospecting has been done by driving cross-cuts, but no returns have yet been obtained. Four men are employed.

Waitekauri.

Welcome Claim.—Forty tons of quartz was crushed for 28oz. 10dwt.

Australian Special Claim.—Two hundred tons of quartz was crushed for 3½oz. of gold.

Eclipse Claim.—Eight tons of quartz was crushed for 10oz. 17dwt. of gold.

The battery erected at the Jubilee Mine, and also the one erected at the Australian Special Claim, proved that the material which they were meant to crush was of no value, and work was suspended at both places after a few weeks' crushing for almost nil returns.

Waitekauri Mine.—This mine was protected for the greater part of the year, and no crushing was done. Ten men were employed in this district.

Waihi.

Martha Mine (Mr. William Hollis, manager).—This mine was worked by tributers. One thousand two hundred and thirty-two tons of quartz yielded 303oz. 5dwt. of gold. Eight tributers were employed.

Silverton Mine.—Very little work was done in this mine. Seventy tons of quartz was crushed for a yield of 340oz. of gold. The mine is now let on tribute and rich quartz is being obtained, but no returns have yet been received from the tributers. Three wages-men and four tributers were employed.

Waihi Mine (Mr. J. W. Walker, manager).—Work in the mine was chiefly confined to stoping out a large block of the reef between the Union level and the surface. Two hundred and thirty fathoms of reef was stoped out, and 2,200 tons of quartz crushed and treated for 5,124oz. of gold. The returns would have been much greater had the battery been at work the whole year; but delays occurred in removing the Globe mills and exchanging other portions of the machinery, so that no crushing took place for six months. One hundred and twenty-eight men were employed during the year.

Te Aroha District.

Waiorongomai.

Te Aroha Silver- and Gold-mining Company's Mine.—A large amount of work was done in this mine in driving levels on the various reefs—in all 369ft.—and stoping out that portion of the reef (No. 1) which had been left in the wall by the New Find Company, and also a block on the same reef below the smithy level. The quantity stoped out was 453 fathoms for 4,745 tons of quartz. The quartz was crushed and concentrated, together with the quartz obtained in the Colonist Mine, for 978oz. of gold; and bullion obtained from melting concentrates was exported, 19,300oz., estimated value £9,000. An average of forty-seven men were employed during the year. The value of the quartz now in sight is not considered to be sufficient to pay for working, and operations are suspended and the mine and reduction plant shut down, with the exception of the berdans, which are used to grind tailings. It is therefore probable that most of this fine plant and machinery will be removed from the district.

The Ferguson Syndicate Company's Mine (Mr. Peter Ferguson, manager).—A large amount of prospecting-work has been done in this mine. Work has been carried on in five different levels, and in a few weeks the whole of the levels will be connected, and crushing will be commenced. The reefs are from 1ft. to 7ft. in thickness. Drives on reef 275ft., cross-cut drives 177ft., and winzes 145ft. Two tons of selected quartz has been crushed for a yield of 90oz. 5dwt. of bullion, valued at £154. Fifteen men have been employed. The reduction-works will consist of two Lamberton mills, eight Mackay pans, and four settlers, and Cassell process. The main tramway connects the mine with the reduction-works.

Colonist Mine.—A block of the reef was worked out on the northern boundary of the Te Aroha Company's mine, and 142 tons of quartz was crushed and concentrated at the Te Aroha Reduction-works: 35oz. 10dwt. of gold was obtained by amalgamation, and the concentrates were sold for £107 12s. Three men were employed.

Werahiko Mine.—A small parcel of quartz from this mine (5 tons) yielded 12oz. 7dwt. of gold. Two men were employed.

Tui Creek.

Champion Mine (Mr. C. A. Comes, manager).—This mine is now well opened up. Four levels are driven and connected by passes, and another level lower down is commenced. Seven hundred and eighty-one feet has been driven at the various levels during the year, and a block of 30 fathoms stoped out at No. 3 pass. Forty tons of ore was shipped to England, valued at £360. Twenty-three tons was sent to Waiorongomai, the bullion extracted from the concentrates of which was sold for £36 9s. 8d. Thirty wages-men were employed. The cost of shipping ore to England is too great to leave a profit, and this company are endeavouring to get a cheaper process to treat the ore here, instead of sending it out of the country. The quantity of zinc-blende mixed with the galena is so far the greatest trouble, but it is expected that they will be clear of the blende at the deeper level which is to be put in. An aerial tramway has been erected over a mile in length: it works well, and quartz is conveyed from the mine to the flat at a cost of 9d. per ton. Work in the mine is for a time suspended until a suitable process of treatment can be adopted.

The other mines which were held in the Tui district have been abandoned. An average of eight men were employed during the year.

Drainage.

The Big Pump at the Thames is still maintained for draining an extensive area, and is managed by the Drainage Board. Pumping operations for the first seven months of the year were confined to keeping the water clear of the 400ft. level, the pump going 3¾ strokes per minute, 145 gallons per stroke. The total cost per month was £284; and coal consumed, 184 tons per month. For the other five months of the year the water was kept clear of the 500ft. level, the pump going 4½ strokes per minute. Total cost per month was £375, and the consumption of coal 308 tons per month. The cost of forking the water during the months of November and December was heavy, but since the 1st January it has been less, and is now £340 per month. The average number of men employed is eight. Mr. William Phillips is manager of the works.

Mining Accidents.

Two fatal accidents occurred during the year. A man named Patrick Nolan, boss of a shift in the Saxon Mine, Thames, was seriously injured by a fall of rock from the stopes of that mine on the 12th April, 1889. The rock parted at a "soapy head," without giving warning, and crushed him. He was at once conveyed to the hospital, where he lingered until the 15th August of the same year, when he died from the effects of the injury.

The second fatal accident occurred at Waiorongomai. On the 4th December last a miner named Richard Hill got on a full truck of quartz coming down the self-acting grade of the Waiorongomai tramway: the rope broke shortly after the truck left the top of the grade; the truck then ran down at a tremendous rate, upset near the bottom, and was broken in pieces. The man was instantly killed. The miners were forbidden to use the trucks for travelling up and down the line, and the whole blame lay with the deceased.

General Remarks.

The present condition of mining matters leads to the expectation that operations for the next year will again be successful. The returns from Kuaotunu and Whangapoua give assurance that when the batteries are erected and in full work the reefs in these districts will prove remunerative. At the Thames, ground that has lain unoccupied for years is again being taken up and rigorously prospected, and there is reason to believe that payable quartz will be found in the reefs.

The new battery at Marototo, and the Cassell works at Karangahake, will add to the Ohinemuri returns.

The reefs opened in the Ferguson Syndicate's Mine, at Waiorongomai, give every indication of future profitable operations.

I have, &c.,

Geo. Wilson,

The Under-Secretary, Mines Department, Wellington. Inspector of Mines.

Return of Quantity of Quartz crushed, Gold obtained, and Estimated Value of Gold, in the Hauraki Mining District for the Year ending 31st March, 1890.

Name of District.	Quartz.	Specimens and Picked Stone.	Mullock.	Tailings.	Gold.	Value per Ounce.	Total Value.
	Tons cwt. lb.	Tons cwt. lb.	Tons.	Tons.	Oz. dwt. gr.	£ s. d.	£ s. d.
Coromandel	1,690 0 0	0 2 76	..	..	6,707 18 7	2 16 2	18,837 15 0
Thames	31,155 16 0	2 7 77	29,595	7,856	33,816 14 8	2 12 6	88,763 15 6
Ohinemuri	4,773 0 0	..	..	..	6,382 0 0	1 7 6	8,615 14 0
"	*	..	..	..	..	..	†3,000 0 0
Te Aroha	4,894 0 0	..	..	..	20,416 0 0	0 11 6	11,739 4 0
Totals	42,512 16 0	2 10 41	29,595	7,856	67,322 12 15	..	130,961 8 6

* Quantity not ascertained. † Ore exported.

N.B.—The above returns show the quantity of melted gold. The average value of gold per ounce is greatly reduced in Ohinemuri and Te Aroha districts on account of the quantity of silver, which was formerly lost, but is now saved by improved processes recently adopted.

No. 5.

Mr. Warden Allen to the Under-Secretary of Mines.

Sir,— Blenheim, 23rd May, 1890.

I have the honour to forward you my annual report of the Marlborough goldfields under my charge for the year ended 31st March, 1890. My returns have been previously forwarded. I do not think that there is any decrease in the number of miners employed upon this goldfield for the past year; neither can I report any great improvement in the progress of this district.

Alluvial Workings.

The only portion of my district that requires notice as far as alluvial workings are concerned is Cullen's Valley. In this gorge a large quantity of creditable work has been done, almost exclusively in the creek claims, and many of these claims are now yielding fair returns. Many of the claims have lately been paying good dividends, and the money has certainly been well earned. The miners have had an exceptionally fine season for their work. During the past year some 6,000oz. or 7,000oz. of gold have been—if I may use the term—exported from this gully, the greater part of it from the creek claims. The higher terrace-ground has been very little worked. When the creek claims are nearly worked out a great deal of this terrace-ground will pay for sluicing.

On Cullen's freehold land, known as Cullen's Flat, some good work has been done, but at present with unsatisfactory results. Holders of claims on this flat are, however, very sanguine of success.

In the Waiau Valley district solitary miners, or parties of miners, are working in the various valleys, some of them obtaining fair wages; but nothing has been done requiring special notice.

In the Wakamarina district the remarks concerning Waiau Valley will apply. Possibly I should mention the Gorge River Claim. This company have done good substantial work on their claim in the shape of head and tail dams. Good pumping machinery has been placed upon the ground, worked by steam, quite sufficient to keep the claim clear of water in ordinary weather. One paddock has been taken out, but the returns from the washdrift were not satisfactory. This paddock was not taken from the best part of their claim; therefore it cannot be considered a fair sample of what they may expect to find. In the meantime the funds in hand at the disposal of the directors have been "bottomed," and an application will be made for a few months' protection in order to enable the directors to obtain further supplies.

Quartz Claims.

About forty licenses for quartz claims have been issued; about ten or twelve have been withdrawn or cancelled, and no doubt several more will be forfeited or cancelled as soon as the time arrives for paying the second year's rent.

There are only two companies that require notice. The Southern Cross Claim, held by Newth and party, has been partially worked. There are four men employed on the claim. About 170ft. of a cross-cut drive has been completed, and they expect, after driving about 200ft. further, to cut the reef. This reef has been described as about 4ft. thick. The work may be described as testing the ground. The company hold "good specimens."

Messrs. Logan and Turner, on behalf of the companies that they represent, have just completed arrangements for taking over the licenses held by Messrs. Logan, Hill, and Duncan. It is now to be worked as one company. I am informed that the prospects are good enough to warrant the directors placing machinery on the ground, and therefore something like work may at last be looked for. Up to the present time the work done on these licensed holdings taken over by this company is briefly as follows:—

Waikakaho Claim.—Hitherto four men at work on this claim. No. 1 drive, 260ft. on reef; the reef described as from 3ft. to 5ft. thick. No. 2 drive, 180ft.: this is a cross-cut drive to cut reef. Have gone through No. 1 Reef in this level: 4ft. thick, showing good gold.

Kapai Claim.—Two men at work on this claim. Have driven 160ft. Reef described as from 2ft. to 7ft. thick, showing good gold.

Mahakipawa Claim.—Two men at work on this claim. Have driven 180ft. to cut reef. Work done has been testing reefs on these claims. Parties show good specimens.

With regard to all other licensed holdings, some licensees have done as much work as the funds would allow—and this apparently has not extended much further than finding specimens. Others have not done any work on their claims. Whenever inquiries have been made as to the progress of their work, the report has been that they were engaged testing their reef. The Marlborough reefing claims have been described as being still in their "infancy:" this description is no doubt correct, but "reefers" are a weary time "nursing their specimens."

Future Prospects.

I have no reason to alter my opinion formerly given. I believe that Marlborough will yet prove to be as rich in minerals as any other district in New Zealand. We have a large extent of known auriferous country, and no doubt good payable reefs will yet be discovered. The climate is good; we have abundance of wood and water, fairly accessible diggings, and cheap provisions. We require better appliances for carrying on the work, a large addition to our mining capital, the district to be better known, and a large number of the right men in the right place. We do not require any more mining agents or "syndicators," or any addition to our "rich specimens."

A few tracks for opening up the back country would be a great boon. Miners evidently appear to consider that the greater part or the whole of the goldfields revenue now handed over to the local bodies should be expended within the goldfields district.

Messrs. Logan and Turner inform me that the company they now represent intend in a short time to have machinery at work upon their claims. If this speculation turn out well we shall soon have a large increase to our mining population.

I enclose you a comparative return of revenue: it shows a decrease, but this is in the items "miners' rights" and "survey fees."

I have, &c.,

The Under-Secretary, Mines Department, Wellington. J. Allen, Warden.

Statement showing the Gold Revenue collected in the Marlborough District for the Years ending 31st March, 1889, and 31st March, 1890.

——	Miners' Rights.	Rents.	Registration.	Fees and Fines.	Other Receipts.	Total.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
31st March, 1889 ...	295 0 0	261 8 6	12 9 0	17 12 0	342 12 6	929 7 0
31st March, 1890 ...	125 0 0	312 14 8	17 2 0	36 1 0	63 13 0	554 10 8

Licensed holdings issued: Year ending 31st March, 1889, 34; 31st March, 1890, 5.

No. 6.

Mr. Warden GIBBS to the UNDER-SECRETARY of MINES.

SIR,— Warden's Office, Collingwood, 31st March, 1890.

I have the honour herewith to transmit, together with my annual report, statistics of this goldfield for the past year.

Although I have little actual progress to report in the mining operations of these districts during the past year, there has been much extra ground taken up, of which, if only a fair average proportion is got into work, my successor will have a substantial progress to report next year.

In the old alluvial workings there has been a fair amount of gold obtained during the year.

In the Johnston's United (the only claim in which machinery is at work) there has been a decided improvement in the yield of gold during a portion of the year.

In the numerous holdings of the Red Hill Gold-mining Company (Limited) there has been little work done. The water-race, which is an excellent piece of work so far as it goes, is still incomplete, having a long distance yet to be constructed before it reaches the machine-site. At present it terminates at the old Richmond Hill Claim, which lies in its course. This is an alluvial claim from which during many years much gold has been obtained by some four or five different parties. The Red Hill Company, through one of their managers, obtained an extended claim of one acre adjoining the ground of the late proprietor of this old claim, and the company, having obtained a transfer of this block, commenced sluicing with their large head of water, causing many complaints from the adjoining claimholder, which were eventually settled by the company buying him out, since when the company are employing a few men at sluicing the joint claims, and I have no doubt are getting good gold. In the Red Hill Mine proper some prospecting is being done in following some of the quartz leaders, which, although small, have a fair show for gold. This company still hold a large aggregate area of ground (see my report of last year) on which little or no work has been done.

There have been taken up during the past year on the Aorere River two prospecting claims of the maximum area, some ten miles apart, and four special claims of an average of one mile each along the course of the river, all for dredging purposes, and there seems little doubt, from the supposed and partially-known richness of the river-bed, that if the bottom is not too rough the results will be payable. There has also been taken up at the Parapara another block of 100 acres, and granted as a special claim for hydraulic sluicing purposes. This block was very carefully prospected before application, but up to the present no actual work has been done since it was granted. At the same locality the hæmatite-paint works are still continuing a regular output of that article.

So far as the nature and number of the applications are any indication, there are signs of some activity, but I regret to have to report that the holders of these large claims are very slow in starting to work.

In the sub-district of Takaka there are about the same number of men at work as there have been for years past, all at alluvial working.

In the Motueka or Mount Arthur locality there are a few men still working during the summer months.

Coal.—The Wallsend Mine at Ferntown, Collingwood, continues its regular output. In this mine the seam or seams have lately shown a decided improvement, and there are hopes of an increased output.

I have, &c.,

The Under-Secretary, Mines Department, Wellington. WM. GIBBS, Warden.

No. 7.

Mr. Warden GREENFIELD to the UNDER-SECRETARY of MINES.

SIR,— Warden's Office, Nelson, 9th June, 1890.

In forwarding the annual returns for the Wangapeka and Baton districts of the Karamea Goldfield for the year ended 31st March, 1890, I have the honour to inform you that I have very little to report, especially as I have been frequently absent from the district during the year, engaged on other important duties, including those of Warden and Resident Magistrate of the Otago goldfields. In so far as I have been able to ascertain, and as the returns show, there has been very little improvement or increase in gold-mining in the Wangapeka or Baton districts during the year. This may in some measure be due to the unusually long drought experienced during the summer months, which was unfavourable to gold-mining. The only new feature I have to report is the discovery of a gold-bearing quartz reef in the Baton district; but whether it will prove payable or not remains to be seen. Steps are being taken to have the stone properly and thoroughly tested, and the result will probably be known at an early dete.

"THE MINING ACT, 1886."

With regard to the above Act I think it right to call attention to the provisions of section 60, which gives the Wardens power to grant small areas for agricultural, horticultural, or dairy purposes. While Acting-Warden of the Otago goldfields, several applications under this section came before me for small areas (50 acres) within the boundaries of runs held under licenses granted by the Otago Land Board. These applications were made in consequence of an opinion given by Mr. Justice

Williams that the Warden had power to grant occupation licenses under section 60 within the boundaries of licensed runs. Several of these applications were for portions of the runholder's home paddocks and cultivations, and were of course refused. Other applications were also refused, as the applicants held licensed country elsewhere, and it was held that the Act was intended to encourage miners and others to settle on the land and cultivate small areas, and not to give additional land to those already in possession of large areas. Dummyism was also attempted, but without success.

My reason for calling attention to the operation of this section is that it is, I think, doubtful if it was the intention of the Legislature that section 60 should apply to Crown lands held under license: that it does so apply is due to the interpretation of "Crown lands" in "The Mining Act, 1886," which was clearly intended to apply to land required for mining only, as it is defined "to include all lands of the Crown occupied under any license or lease for depasturing or agricultural purposes," and it would be absurd to suppose that land held under agricultural lease could be taken from the lessee and granted as an occupation license under section 60 to some one else. Some amendment therefore appears to be necessary, defining what lands may be licensed under the section referred to, and prohibiting owners or occupiers of land over a certain area from acquiring additional land under the Mining Act contrary to the spirit and intention of the Land Act.

The regulations with regard to rent appear also to require amendment, as the minimum is fixed at 1s. per acre and the maximum at 2s., and if any portion of the land should be resumed for mining purposes a reduction in the rent is to be made at the rate of 2s. per acre; so that if a licensee holds 50 acres at 1s. per acre, and 25 acres thereof should be resumed, he would hold the remaining 25 acres rent-free. This surely could not have been intended, and should be rectified, as it tends to prevent licenses being granted at the minimum rental.

I have, &c.,

ALFRED GREENFIELD, Warden.

The Under-Secretary, Mines Department, Wellington.

No. 8.

Mr. Warden BIRD to the UNDER-SECRETARY of MINES.

SIR,— Warden's Office, Westport, 24th May, 1890.

I have the honour to forward herewith the statistical returns for the year ending the 31st March, 1890, and also a report on the Karamea District generally

But little alteration has taken place in mining matters during the past year, but the unprecedented fine weather has proved a great drawback to the majority of alluvial miners, many of them not having made half-time, I believe; which fact has caused a large decrease in the return of gold.

The most important claim in this part of the district is

The Fairmaid Gold-mining Company (Limited).—This company was formed to work auriferous land at Addison's Flat by means of hydraulic sluicing. About £8,000 has been expended in works and purchase of mining- and water-rights. Sluicing was commenced in July, 1889, and since that date gold worth about £2,500 has been produced. The year has been an exceptionally dry one, so that but little work has been done since October last. The works consist of a dam enclosing a water-area of about 17 acres at a level of 300ft. above the claim. This reservoir is supplied by a water-race, capable of carrying forty heads of water, from a creek distant about four miles. The water is led from the reservoir to the claim by an open race and a line of 18½in.-diameter wrought-iron pipes. No fall was obtainable for the tailings, hence the "wash" is lifted by means of a hydraulic elevator some 37ft., when it passes over plush-tables having a spread of 120ft. The works give employment to eight men.

The Caroline Terrace Gold-mining Company (Limited).—This company was formed to work an auriferous-cement lead situated on the elevated terrace to the east of the Charleston Road, about four miles and a half from Westport. The works now in course of construction consist of a water-race, three miles long, to convey water to the claim, and a mill to grind the cement and save the gold. The cement is to be ground and passed over copper amalgamated plates and plush-tables. It is intended to treat 100 to 150 tons of cement daily, and, as an assay of the cement gave in some cases over 6dwt. of gold to the ton, the venture should be a good one. It is intended to commence work in August next. The machinery is now in course of construction by the Anchor Foundry, Nelson.

The Daydawn Special Claim, held by Messrs. Mace and Bassett, has been in full swing when water was available, with, I understand, very satisfactory results. Prospecting has been carried on at the Great Republic Mine, and also at the Beaconsfield; but I am sorry to say the results are not very encouraging, although in the latter mine a small reef has been struck, and from some of the stone a fair prospect of gold has been obtained.

The venture of the Fairdown Gold-mining Company has, I am sorry to say, been unsuccessful, and I am informed an application is about to be made to wind up the company.

The attempt to float a company in London to work the Mokihinui leases failed; but I understand it is the intention of some of the shareholders, more especially those of the Red Queen Quartz-mining Company, to recommence prospecting—with, I think, a strong probability of success. With the fact that 1,560 tons of quartz from the Red Queen Mine yielded an average of 29dwt. to the ton, and that very little outlay is required to put things in order at the mine; with improved

communication; having also in view the probable extension of the railway from Ngakawhau to Mokihinui, and anticipated reduction in cost of crushing, I think the directors may be hopeful of better things in the future.

A large number of special claims and licensed holdings were granted during the year, but a large percentage of them have been cancelled for non-payment of rent.

Nothing new has transpired in the Charleston sub-district, but I think the population remains about the same as last year. I believe the miners of this district have suffered more than any others through the great scarcity of water already mentioned.

LYELL SUB-DISTRICT.

Since my last report no new discoveries have been made, and nothing fraught with importance to this district has happened, unless, indeed, it be the starting again of the United Alpine Company's battery upon stone, the produce of this mine. Contrary to expectations at the time of my last report, success has not as yet attended the efforts of the said company to find the reef in the No. 7 level of their mine. To particularise with regard to the work performed in this mine during the year, I might mention that, owing to the non-success of the operations in the level above referred to, work was discontinued therein for a time, and an uprise started to connect with a winze which was being sunk on the stone underfoot in No. 6 level. This uprise was carried up a distance of 164ft., when the reef was struck; a connection was then made with the winze, which had been sunk a distance of 185ft., and an intermediate level driven north and south from the top of the uprise. The south level is 84ft. in length, and the reef from 10ft. to 12ft. wide the whole way, and very hard and clean. In the north level, which has been driven a distance of 90ft., there is 20ft. of stone showing at the present time. The yield from the crushings up to the present has been at the rate of between 11dwt. and 12dwt. per ton of quartz, but it is anticipated that this will shortly increase. The shareholders have now every hope that in a short time they will be amply recouped for the many heavy calls asked of them, and that monthly dividends will be the order of the day for some years to come.

There is little calling for special mention in the case of the other mines. There are two men at work in the Captain Cook, and some stone has, I believe, been met with. A fresh start has been made in the United Italy, and contracts have been let with a view of picking up in a lower level some rich stone worked in the northern end of the mine some years ago, but which gave out. A portion of this mine is held on tribute, and a crushing therefrom is in process of being taken out. The last crushing, concluded shortly before Christmas, yielded at the rate of about 4½oz. per ton. At the Owen everything is very quiet. The Makatu has had two or three crushings, but apparently there is no continuity about the stone. Nothing much appears to have been done during the year towards opening up and proving the silver-lodes said to exist in this district. A company named the Wellington and Silverstream Gold- and Silver-mining Company was in process of registration a short time since, so that something may possibly be heard of shortly in the direction indicated.

There is no change to report in the matter of alluvial mining in either this or the Murchison district.

Quite a number of dredging claims have been taken up both on the Buller and Matakitaki Rivers. With the exception of Messrs. Hutton and party's dredge, which has been at work for some time near Fern Flat with very payable results, I believe no machinery has as yet been placed on any of these claims. I may, however, state that I am led to believe that a company has been formed to work a portion of the Matakitaki. I have, &c.,

The Under-Secretary, Mines Department, Wellington. FRANK BIRD, Warden.

No. 9.

Mr. Warden BIRD to the UNDER-SECRETARY of MINES.

SIR,— Warden's Office, Reefton, 22nd May, 1890.

I forward to you herewith statistical returns for the year ended 31st March last. I also furnish you with a short account of some of the works carried out in the district during the same period, together with such other information as may be of interest.

Comparing the past year with the previous one, I find that the calls have been less by £11,387 8s. 4d., the dividends greater by £1,562 10s. The dividends have been less than the calls by £9,281 6s. 8d. Although the amount of quartz crushed for the last twelve months is in excess of the previous year by 3,830 tons, yet the yield has been less by 883oz., and consequently the value of the gold obtained is less by £3,044 5s. 11d. The yield of alluvial gold is less by 1,425oz., and less in value by £5,549 3s. 4d. The recent drought, nearly suspending, as it did, crushing and sluicing operations for a considerable time, will to a great extent account for the smaller returns for the year.

From the opening of the district to the 31st March last 466,914 tons of quartz have been crushed, from which 360,676oz. of gold have been obtained, valued at £1,400,136, out of which dividends to the extent of £457,781 have been declared. The yield of alluvial gold has been about 98,670oz., valued at £359,919. The total gold-production is 459,346oz., valued at £1,760,055.

I attach a list showing the names of the majority of claims in the district, the calls made and dividends declared, &c., by them during the year.

Name of Company.	Calls made.	Dividends declared.	Stone crushed.	Yield.	Value.
	£ s. d.	£	Tons.	Oz.	£ s. d.
Keep It Dark	...	6,500	5,757	2,538	9,899 0 0
Globe	...	4,950	8,274	4,041	15,962 0 0
No. 2 South Keep It Dark... ...	1,200 0 0	600	420	356	1,389 0 0
Supreme...	1,983 6 8	...	...	...	...
Eureka Extended	100 0 0	...	...	...	...
General Gordon	50 0 0	...	...	...	...
Fiery Cross Extended	1,612 10 0	...	1,522	1,000	3,953 17 9
Royal	500 0 0	...	...	...	...
Wealth of Nations	812 10 0	...	Tailings	206	797 18 4
			85	27	104 9 2
Argosy	187 10 0	...	...	...	...
Chicago	50 0 0	...	...	...	...
Empress...	650 0 0	...	...	...	...
Hard to Find	600 0 0	...	...	...	...
Inglewood	...	1,200	2,300	1,329	5,109 0 0
Londonderry	50 0 0	...	...	...	...
Lone Hand	50 0 0	...	...	...	...
Merrijigs...	600 0 0	...	...	...	...
Reform	...	...	70	50	194 0 0
Maori Chief	100 0 0	...	...	...	...
Murray Creek	416 13 4	...	...	...	...
Inkerman	1,250 0 0	2,000	1,658	2,195	8,641 2 0
Just in Time	466 13 4	...	...	...	...
Resolution	100 0 0	...	...	...	...
Inangahua Low-level Tunnel ...	450 0 0	...	...	...	...
Reward	200 0 0	...	...	...	...
Nil Desperandum	479 3 4	...	297	252	992 4 11
Hercules...	400 0 0	...	32	58	224 11 9
Homeward Bound	300 0 0	...	...	..	...
Venus Extended	800 0	...	70	30	110 17 9
Gallant	1,200 0 0	...	...	...	...
Happy Valley	600 0 0	...	127	29	110 19 1
Golden Lead	300 0 0	...	100	22	84 0 1
Triumph...	400 0 0	...	...	...	...
National	600 0 0	...	...	...	...
Sir Francis Drake...	1,900 0 0	...	2,119	426	1,543 8 0
O.K.	100 0 0	...	...	...	...
Edinburgh	100 0 0	...	...	...	...
Welcome	600 0 0	...	249	731	2,880 18 0
Golden Treasure	1,200 0 0	...	*750	377	1,475 0 0
Specimen Hill	1,336 6 8	...	...	...	...
Progress	...	...	*5,000	1,649	6,559 6 1
Mount Morgan	50 0 0	...	...	...	...
Alexandra	200 0 0	...	...	...	...
All Nations	400 0 0	...	...	...	...
Prima Donna	200 0 0	...	...	...	...
Multum in Parvo	100 0 0	...	...	...	...
Lone Star	1,400 0 0	...	*200	42	164 12 0
Big River	1,700 0 0	...	*700	350	1,363 10 8
Scotia	1,100 0 0	3,000	593	1,272	5,016 16 6
United Devonshire	224 3 4	...	...	...	...
Guide	100 0 0	...	...	...	...
New Britannia	312 10 0	...	..	...	...
Energy	...	...	2,071	800	3,100 0 0
	27,531 6 8	18,250	32,394	17,780	69,676 12 1
Alluvial gold	...	...	...	2,715	10,314 15 2
				20,495	79,991 7 3

* In these cases the tonnage is only given approximately.

Following the course I have hitherto adopted, I now give an account of the operations of some of the mines.

Devil's Creek.

Globe.—The operations of the company during the year have been attended with moderate success. On the eastern reef the winze was sunk from No. 1 to No. 2 levels, a depth of 50ft. A drive was taken in about 150ft. on No. 2 level to strike this reef. A large body of stone was struck, but this has not yet been operated upon. The main shaft has been sunk from No. 2 level to No. 3, a depth of about 110ft., and the reef was obtained on driving a cross-cut 24ft. to the west. The reef has been driven on 90ft.—viz., 60ft. to the west and 30ft. to the east. A large body of stone is to be seen in both drives, showing good gold. There is still about two years' work on the eastern block on No. 2 level, but, the stone in No. 3 level having been found to be of a superior quality, work has been discontinued for the present on No. 2 level, and the work of opening up and crushing stone from No. 3 level is now being carried on. As showing the quality of the stone in No. 3 level, 711 tons of stone has been crushed therefrom during the month of April, yielding 652oz. of gold, enabling the directors to declare a dividend of 1s., which represents £1,800. A winding-engine has been erected at the mine, enabling the work to be carried on much more expeditiously. The erection of the concentrators has been completed, but they have only been a short time at work. About 3 tons of pyrites is obtained from these per week, containing, according to assay-tests, 4oz. per ton, whilst the clean tailings (after the pyrites have been separated from them) contain 8dwt. to the ton. It was claimed that these machines would save a fair percentage of free gold; but actual experience proves to the contrary. The tailings being operated upon are conveyed from the battery to the concentrators direct. From the starting of this claim the company have crushed 33,349 tons of stone for a yield of 16,538oz. of gold, the value of which is £65,015, out of which £18,000 have been given in dividends. From present indications this mine is likely to give dividends for some considerable time.

Progress.—At the date of last report the western reef had just been struck. The reef was driven on for a distance of about 100ft., and was opened up and stone stoped out and sent to the battery, which, after many vexatious delays, started crushing. Up to the present time the stone crushed has been obtained chiefly from this reef. The winze on the eastern reef was sunk another 100ft., making the total depth 200ft., and at the same time the main level was driven about 350ft., to connect the eastern and western reefs. The eastern reef has now been driven on about 140ft., and there is now 9ft. of stone in the face showing fair gold. The stone crushed from the western reef was not as good as might reasonably have been expected, judging from the crushing of the stone taken from the winze in sinking. On stoping out this reef a horse of mullock made its appearance and continued up for some distance, and while it lasted crushings were rather poor. More recent crushings have been taken from the eastern block, and show a considerable improvement, and would point to better results henceforth. An aerial tramway is to be erected to connect the battery with the coal-mine. The company has during the year crushed about 5,000 tons for a yield of 1,649oz. of gold, of the value of £6,559 6s. 1d.

Murray Creek.

Keep It Dark.—On the completion of the winding-shaft sunk from No. 3 level, the work of driving for the reef was commenced. Having intersected the middle block, which was only 30ft. in length, it was stoped up 40ft. The eastern reef was struck, opened out, and stoped up 50ft. The western reef was intersected in due course and driven on for 90ft. The first stope is now being taken out of this block. The crushings have latterly been very poor. The north block, from which good returns have heretofore been obtained, has not up to the present time been found on this level: it is, however, being driven for, and the drive is now in 40ft. With the striking of this block a return of prosperity for the company may be looked for. During the year 5,757 tons has been crushed, yielding 2,538oz. of gold, valued at £9,899; out of which dividends have been declared to the extent of £6,500. The total output of the mine is 102,825 tons of stone, from which 56,451oz. of gold has been obtained, the value of which is £219,606, returning £106,583 in dividends.

Wealth of Nations.—This mine has been steadily prospecting for years, and has now got to a depth of 200ft. below the battery-level, or 700ft. below where the quartz was found on the surface. The present workings are confined to the lowest level, which has been driven a distance of 770ft. from the main shaft. About two months ago quartz was met with, and has been driven on for a distance of 60ft., and still continues in the face of the drive. The reef averages 5ft. in width. A parcel of 100 tons has been taken from the reef and crushed, and proves to be payable. A tunnel has been driven 450ft. on the battery-level in the direction of this reef, which it is believed extends upwards. This, if proved to be correct, will open up a block of stone 200ft. in depth. This reef is supposed to be a new make of stone, or second formation, and in no way connected with the reefs on the higher levels, which have not, so far, been traced down. If this should prove to be the case it will be a matter of considerable importance to the district, as indicating a greater permanence, and should be an encouragement for other companies to prospect at greater depths on the working-out of surface-blocks. As very little opening-up work has to be done, it is expected that in a few months the company will again be raising quartz to keep their machinery employed. They have every facility for crushing, having a twenty-head battery and eight berdans, the latter being worked steadily in grinding tailings obtained from past crushings. From the surface-block the company obtained £35,100 in dividends and gold to the value of £110,267 2s. 5d.

Hercules.—This claim was formerly known as the Nil Desperandum, the capital of which company becoming exhausted, it was re-formed under the above title. Some very good stone was obtained, yielding nearly 2oz. to the ton; but, unfortunately, this was of small extent, the average for the whole of the crushings being about 18dwt. The main shaft is now being sunk from the No. 6 level. It is proposed to sink it 125ft., of which 50ft. has already been sunk.

Energy.—The party of miners who had this mine on tribute have now purchased it from the owners. They have crushed during the year 2,071 tons of quartz, obtaining about 800oz. of gold, worth £3,100.

Inglewood.—Stoping out stone has been continued, and 2,300 tons has been crushed during the year, from which 1,329oz. of gold has been obtained. The gold is valued at £5,100, and the shareholders have received out of this £1,200 in dividends. Some months' work still remains on this level.

Venus.—A winze was sunk 115ft. below No. 3 level, and it was expected that the reef would be struck in this at a depth of 25ft.; but, not having found it, it was decided, after sinking 70ft. without meeting with success, to put in a cross-cut. In this the reef was struck after driving 28ft. to the east. The sinking of the winze was then continued to a depth of 115ft. The stone struck in the 70ft. level was followed by a winze to a depth of 40ft. The work of making a connection between the 70ft. and 115ft. levels is now in progress, and on completion the mine will be opened up. The reef is small, but shows fair gold. The western reef, from No. 2 level upwards, has been let on tribute for a term of two years.

Golden Treasure.—About the first work undertaken was to clear out the old Band of Hope tunnel, about 700ft. in length, and also the winze. Several hundred tons of stone left by the Band of Hope Company were stoped, but it did not prove payable. A winze was sunk 150ft. at the end of the tunnel, and a large body of stone is being driven on; but this is not considered payable. Work has recently been started on the old Golden Treasure battery-level, and stone considered by some to be the north block has been struck. The stone is about 3ft. wide. The north block in years past yielded about 2oz. to the ton.

Merrijigs.

Inkerman.—The work done in this mine for the past twelve months has been the extension of the level north and south from the winze at the 76ft. level. The north end was driven 260ft. At 240ft. the reef became small, leaving only a trace. The reef was driven on south 120ft.: at 90ft. the reef cut out. All the ground above the level has been stoped out up to the surface. Some quartz being found on the surface north of the winze, a tunnel was driven into a spur of the hill for about 80ft., but the stone found was small and poor. About six months ago a main shaft was started at about 45ft. south of the winze. This shaft has been sunk to a depth of 225ft., which will give 150ft. of backs to No. 1 level. A winze has also been sunk 145ft. from No. 1 level, the reef being carried down the whole distance without a break. The stone averages 5ft. in width, and yielded on No. 1 at the rate of 26dwt. per ton. A drive is now being made from the main shaft at a deeper level to connect with the bottom of the winze, which has been sunk from No. 1 level, and the connection is daily expected. On the connection being made crushing would commence within a fortnight.

Scotia.—Stone has been taken from the level which had just been opened at the date of my last report. From this level 593 tons of stone was obtained, which yielded 1,272oz. of gold, or at the rate of over 2oz. per ton. Dividends to the extent of £3,000 were declared. The work of further opening up the mine was taken in hand, and a winze was sunk from No. 1 level, from about the centre of the block, to a depth of 80ft. After sinking 25ft. the stone ran out. Prospecting for the reef was carried on for a considerable time, and recently, in driving into the foot-wall in the winze at a depth of 45ft., the reef was again picked up. The stone is about 1ft. thick, and shows fair gold. It is now the intention of the company to cut into the foot-wall 30ft. lower down.

Golden Lead, O.K., and Merrijigs.—I made mention in my last report of a peculiar formation, being a conglomerate of sandstone and quartz leaders, found in these claims. A fair amount of work has been done on this formation with a view of proving its extent and value. Recently, in order to test the value of the stuff, 100 tons of it, taken indiscriminately from the heap at the mouth of the tunnel, and obtained from all parts of the Golden Lead, was put through the battery, and yielded about 4½dwt. per ton. This, in the face of private tests, was at the time looked upon as disappointing; but, as the quantity seems illimitable, with large crushing-power it should be remunerative. Another crushing is now being taken out, and, being selected, better results are looked for. A parcel of the stuff from the Merrijigs is being taken out to be crushed. The quartz leaders in this claim seem to be larger. A project has been mooted for all the claims in this locality to combine in laying down a light railway from the mines to the Inangahua River, a distance of about two miles and a half, and there to erect a powerful crushing plant; but nothing has yet been decided upon.

Big River.

Big River.—The main level has been extended 250ft., and a rise put up to the surface of 145ft. It is now the intention of the company to sink a main shaft 200ft. in depth, from the east end or face of the main tunnel, to be worked by a water-wheel. The rise will act as a rope-way, landing the cages in the tunnel. When this shaft is sunk it will only be 200ft. east of the last block of stone worked, and 200ft. west of the rich block of stone in the level of the old workings, and upon which a winze has been sunk from this level for a depth of 110ft. This work will necessarily take a considerable time.

Boatman's.

Welcome.—The principal work of the year has been in prospecting between Nos. 6 and 7 levels, which has been attended with very indifferent results. The reef is still found to be in very broken country. Stone is found in detached blocks along the line of reefing-country for 600ft. to 700ft., and runs in narrow seams rich in gold; but it is much broken up by hard sandstone bars which cross the course of the reef. This class of country first showed itself in the No. 6 level, and has continued down to No. 9, which is the lowest level yet opened in the mine. A consider-

able amount of driving, sinking, and cross-cutting has been done during the year between Nos. 6 and 7 levels without finding a defined lode. A winze has been sunk to a depth of 70ft., following a run of very good stone below No. 7 level. Preparations are now being made for hauling the stone from this winze by means of a wire-rope to be worked by the engine in No. 6 level. The No. 7 level is being extended northward for the purpose of making a connection between the Welcome and Homeward Bound workings, the cost of which is equally divided between the two companies.

Fiery Cross.—At the south end of the mine a winding-shaft has been sunk to a depth of 150ft. below the 450ft. level, and a level driven from the bottom of the shaft 250ft. south. A winze has also been sunk the same depth on the reef. The principal work beyond the opening-out of this block has been the stoping-out of quartz, which up to the present time has proved poorer than the last block taken out above the level. In the north end of the mine a considerable amount of prospecting has been done. Two winzes have been sunk to a depth of 60ft., and 100ft. has been driven in prospecting for the north block which gave out on the 650ft. level. The battery is now constantly employed in crushing stone from the south block.

General.

It will be understood that the work done has not been confined simply to those mines which I have mentioned, but more or less work has been done in nearly all the claims mentioned in the list at the beginning of this report.

I made mention in a previous report of the small attention that had been given by companies to the saving and treatment of tailings. As indicating the importance of this matter, I may state that a Christchurch firm, representing an American syndicate, recently offered the Globe Company 5s. per ton for their stack of tailings, amounting to about 20,000 tons. This would represent the heap as worth £5,000, or over 27 per cent. of the dividends declared by the company. Assuming, for the sake of argument, the whole of the tailings resulting from crushings in the district to be of equal value to those from the Globe, I find that there has been 466,914 tons of quartz crushed, representing an equal tonnage of tailings. Say that out of this quantity 100,000 tons has been saved and treated, this would leave a loss of 366,914 tons, which, at only 5s. per ton, would amount to £91,728, or about one-fifth of the total amount of dividends declared. It is only reasonable to suppose that any firm offering 5s. per ton expect to make a profit. Add this profit to the above-mentioned sum of £91,728, and some idea may be formed of the loss the district has sustained.

I have to thank managers of companies for much valuable information and kind assistance.

The current year opens with fair prospects.

I have, &c.,

Frank Bird, Warden.

The Under-Secretary, Mines Department, Wellington.

No. 10.

Mr. Warden Keddell to the Under-Secretary of Mines.

Sir,— Warden's Office, Greymouth, 2nd July, 1890.

I have the honour to forward my general report of the portion of the Westland Mining District under my supervision. The statistical returns called for by you have been sent to you by Mr. Barton, who has explained that I was then prevented by illness from completing them by the addition of this report.

Arnold, Notown, Dunganville, and Barrytown.

No change of any note has taken place in this sub-district. At Notown an effort has been made to test the lower strata of the creek and flat, but the party, who had acquired a special claim for this purpose, was not fortunate in the first shaft put down.

Another party, with the same object, is about to take up a special claim on the Arnold Flat. The population remains about the same. The Midland Railway works have attracted some of those not settled on remunerative claims, but their absence is not likely to be permanent.

Blackball.

This sub-district continues to be steadily worked, and returns are satisfactory. Moonlight attracted a good deal of attention about the end of last year—November—and a number of special claims were applied for near Garden Gully. They were opposed, and the Warden's Court at Ahaura was occupied for many sittings inquiring into these applications, and objections on the ground of the land being too rich to be granted in large areas; one—a test case—went to appeal, but was arranged between the parties on terms. As is frequently the case, now that the excitement is over, the ground does not show any evidence of being valuable enough to warrant the amount of litigation.

New River and Paroa.

The claims reported last year as having been taken up at large cost of survey and construction of water-races, have not made so much progress as I hoped to have been now able to report. The principal drawback to the effectual working of these claims, which border the sea-coast, is the want of fall, and for successful hydraulic sluicing fall is an important element. There is undoubtedly very rich dirt in quantity found in these claims, and if they were located on a terrace, and the same amount of water available, they would yield a handsome return to their owners.

Dredging.—I regret much that the dredging claim of the Paroa Company, taken up by Messrs. Byrne and Brown, which was noticed in my last report, has not yet proved a success. Twelve months ago Mr. S. Brown designed a dredging-plant which, as a model, had received the unqualified

approval of all who had examined it—indeed, so much so that more of the same kind of machinery had been ordered for the workings of other special claims owned by English capitalists; but, unfortunately, when completed and worked it was found to be unsuitable for the heavy drift which constitutes our sea-beaches, and the powerful centrifugal pump, which was the main feature in the plant, was unable to work. Its power was too great, and it would draw up anything within its radius; and the heavy stones it brought with such velocity caused too much wear and tear. The company soon realised this, and at once resolved to return to the bucket-and-ladder dredge system, and accordingly remodelled their machine. This was done with comparatively little delay, and the new machine started to work. After about a month's run a washing-up took place, the result of which has never been made public. I learn, however, that the punt on which the machinery is erected has not been found substantial enough to stand the heavy strain, and no work has been done for the last month or so. This failure, so far, is much to be deplored.

Up to the present no dredging-plant has been successful in this district, or that portion of the mining district south of Hokitika. The machinery has been approved, and success has always been confidently looked for, but when it has been put to a practical test it has been a failure. The only test the public will hear of is the amount of gold obtained. On a large special claim, say of 50 acres, portions must be known to be more auriferous than the rest, and it would be better for the furtherance of the dredging industry if the machine's first efforts were employed on those portions of the claim which have been prospected and found to contain a payable quantity of gold. The most perfect arrangements of dredging machinery and gold-saving tables must be damned if employed on barren ground.

A number of special-claim holders are anxiously waiting for a successful trial of these dredges that have been so long before the public. It is no satisfaction to know that the Welman dredges have been so successful at Waipapa Beach; they have not proved so down south on this coast. It is said and generally believed that the beach at Waipapa is more suitable, and differs materially from the coarse and heavy drift and boulders prevailing here. Capital is not wanting in the colony and in England to assist us in working these beach claims; and a great impetus would be given to this branch of mining here if any of the dredges between Okarito and Barrytown would prove itself able to accomplish its work.

The Greymouth Company (English) are working hard at the construction of their plant at the North Beach, at the mouth of the River Grey. It is expected to be finished in about a month or two. The two engines—of twenty-five and fifteen horse-power—have been locally made at the Despatch Foundry, Greymouth. Captain Parker, the manager, who brings a large experience to help the work, is superintending it personally. This company first intended following on the lines of Mr. S. Brown's machine, but, fortunately, had not advanced far when its imperfections were discovered; and the machine now under construction is on the bucket-dredge principle.

One of the drawbacks to the Paroa machine was, I am informed, the accumulation of the tailings. This must be provided for: a machine lifting 50 to 100 tons of water and shingle per hour must deposit a large quantity of spoil in a day. I think it will be found necessary to lift the tailings to a sufficient height to allow them to be carried away through a long tail-race far beyond their present and, of course, their future workings, and, in cases of claims on the beach, conveyed below low-water mark.

The claims on the North Beach—Taylor's and Webb's—have been working, but with no result worthy of special mention.

Kumara.

This sub-district, where the most important hydraulic workings are carried on, has not produced so much gold this year. This is, however, easily accounted for. First, the winter of last year was unusually dry, and in the spring the rainfall was abnormally light, and from this cause the returns of gold for the first three quarters of the financial year throughout the district have been below corresponding times; but at Kumara it unfortunately happened that just as water was available—about the middle of December—an accident occurred to the sludge-channel—the original—which collapsed, and the water broke through into No. 3 Channel, then being constructed, nearly causing the death of the sub-contractors, who were working in it. Their lives were miraculously preserved, and their rescue was the subject of general congratulation—so much so that the miners overlooked for a day or two that the accident which had occurred, though not so disastrous in result as it might have been, was serious enough, as it prevented the working and the washing-up of all the claims served by the sludge-channel until repairs could be effected. This meant enforced idleness for about two more months. This matter, which was the subject of a Royal Commission, has been fully gone into, and only needs a cursory notice here. The repairs have been made, and the new Channel No. 3 is being constructed, and the miners have been since steadily at work.

A Mining Association has been formed amongst the miners here, the members and officers duly elected at public meetings. On an application for a licensed holding at Kumara about three months ago the association objected to its being granted because, amongst other reasons, the holder of a licensed holding who disregards the conditions of his license can only be attacked by an objector, who has to deposit £15 under Rule 23, and then, if successful, he cannot be declared the owner if he desired, but the ground has to be sold at auction, at which any person may bid, and only then after a month or two's delay; and if the licensee should appeal against the forfeiture, the objector's £15 may remain locked up for three or four months. On the other hand, if the ground be held under a certificate as an extended claim, and the claim in the same way liable to forfeiture, a miner can make a complaint for a few shillings in the Warden's Court, and can ask in the prayer of the same that on forfeiture he may be declared the first applicant. This is the existing state of the law. "The Gold-mining Districts Act, 1873," from which the forfeiture-of-licenses sections are taken, provided for the Inspector's taking steps to enforce the conditions and to make forfeitures: in

the present Act all these sections have been excised, and the only process by which a licensed holding (or special claim) can be attacked is that referred to by the Mining Association. The licensed holding in question was only for 6 acres and 2 perches, and 6 acres could be held as an extended claim. In all cases under "The Goldfields Act, 1866," and "The Mines Act, 1877" (excepting as regards gold-mining leases), the chief incentive to miners to keep their neighbours up to the conditions of their tenure was that they could obtain possession of the claims or privileges which the others had forfeited by neglect or non-use.

All the claims appear to be doing fairly well, and there is the same demand for mining rights, &c. As soon as the promised extension of the Government water-race is completed more claims will be occupied.

WAIMEA AND STAFFORD.

Mining has continued steady in this portion of the district. There has been a slight falling-off of applications and less contentious business at the Courts, and no new ground broken this year, but on the whole I think things are about the same as last year.

The Wheel of Fortune and the Kelly's Terrace companies have gone into liquidation. The success met with by the tributers in the last-named did not last long. The new owner is hopeful of picking up the lead. The Teremakau Quartz-mining Company at the Taipo Ridge have now, I am informed, got their crushing-plant in position, and will soon start crushing.

At Greenstone the large sluicing company is still at work, but have not sufficiently advanced yet to make returns. The Chinese are about the same in number, and are steadily at work up the Greenstone and at Westbrook.

I have, &c.,

JACKSON KEDDELL, Warden.

The Under-Secretary, Mines Department, Wellington.

No. 11.

Mr. Warden MACFARLANE to the UNDER-SECRETARY of MINES.

SIR,— Warden's Office, Hokitika.

I have the honour to forward herewith the usual statistical returns and annual report on the mining district under my charge for the year ending 31st March, 1890.

Owing to a rearrangement of Warden's boundaries during the past year, this district, and the sub-districts of Ross, Okarito, and Jackson's Bay, have now for boundaries the provincial district line running from Big Bay in the south, and the Arahura River on the north—covering a coast-line of some two hundred miles.

HOKITIKA.

In the northern division of this district no marked alteration has taken place in mining during the year. The usual number of men are at work in the gullies and terraces about the Arahura, Blue Spur, Hauhau, and Kanieri, and about the same amount of gold has been won as was obtained the previous year. Prospecting by a company for dredging purposes has been carried on in the bed of the Arahura River, and is likely to result in a dredge being put to work. Attempts have also been made of a similar kind on the Hokitika River, opposite the Kanieri, where good prospects have been obtained. This is held by a company, who, should future prospecting warrant, propose erecting a powerful bucket-dredge to work their claim.

Hydraulic sluicing on a large scale is carried on by the Humphrey's Gully United Gold-mining Company (Limited) in the Arahura Valley. This company are the holders of valuable concessions in the shape of large auriferous areas, water-races, dams, and tailings-sites; but so far shareholders have not yet reaped the reward they merit. The claim has been let on tribute for some time. The total yield of gold for this year is valued at £2,611 18s. This compares favourably with the yield for the previous year, but after paying cost of maintenance, management, and other incidental expenses, and deducting amount retained by tributers, there is not enough left to enable the directors to declare a dividend. This unsatisfactory state of affairs is said to be due to a want of sufficient water. I learn from a reliable source that from £15,000 to £20,000 is still required to complete the water-supply for working this claim at a profit to the shareholders: however, this company, like many others, find their capital expended and the work unfinished. Endeavours have been made to overcome this difficulty by "unloading," and offering liberal terms to capitalists acquainted with ventures of this kind, but so far without success. This property is well worth the consideration of capitalists, and if properly handled would very likely prove a profitable investment: held and worked as it is at present, it can benefit only the few men actually employed; the shareholders receive nothing but the annual report and balance-sheet. This cannot be satisfactory, and the sooner a new departure is taken, the better it will be for all concerned.

Kanieri Lake Water-race.—During the past year Owens and party—to whom the grant of the property was made—have transferred their rights to a registered company, the Kanieri Water-race and Mining Company (Limited). The ground which it is intended to work first is situated at Kanieri Forks, five miles and a half from the lake, the source of their water-supply. Of this distance three miles of the old race is utilised, and two miles and a half of a diversion have to be constructed. The company has completed the necessary repairs to the three miles of the old race, and has a large portion of the diversion finished, and before the end of the year it is expected the claim will be in full work. For the purpose of working the ground at the Forks the company is only taking half the water which the old race can carry; but they have now secured eight miles more of the same, with the intention of bringing the remaining water to other localities. No doubt the development of this enterprise, with the magnificent and permanent water-supply at command, will have a most important influence over mining interests in the neighbourhood of Hokitika.

A quiet but persistent rush has set in to what is known as Buck Creek Terrace. This is a continuation of the Woodstock, Brighton, and Rimu Terraces. The claims taken up extend along the face of this terrace to the south a distance of from two and a half to three miles, and indications point to the opening-up of an immense area of payable auriferous drift, admirably adapted for hydraulic sluicing. At the Rimu end, where some of the claims have been worked for fifteen years, tunnels have been driven into the terrace 1,400ft., and others are preparing to go still further. As a rule the gold is distributed through the whole of the driftal wash, which varies from 8ft. to 40ft. in depth, although in some claims richer runs have been found, yielding as much as £10 per week per man. The value of the general run of wash in the claims is put down by the miners as being equal to from ¼dwt. to ½dwt. to the load. Already over one hundred men are at work on this terrace, but water is the great want; and applications are still being made even in face of the fact that only about five hours' water per week is available.

Last year a considerable rush took place to the low ground in front of the north-west portion of the same line of terrace, and one of the most promising ventures in this locality is now being carried on by Mr. James Craig, the owner of the land through which a valuable lead of gold has been traced a distance of 60 chains. Substantial tunnels, 900ft. long, tramways, water-races, and dams have been constructed at a cost of £1,000 for the proper working of the claim, at which from twenty to thirty men will be permanently employed. I understand that this ground has been thoroughly prospected, and from the data obtained the results cannot be otherwise than satisfactory. This lead is an old beach-lead, running under the terrace, into which a great many tunnels have been driven, most of which are on payable wash.

There is no question as to the immense area of auriferous wash available for hydraulic sluicing; and the natural facilities for getting rid of tailings could not be better, the bottom on which the drift rests being a soft clay sandstone, over 100ft. above the level of the flat below. To provide sufficient water for this is beyond the reach of the ordinary working-miner, or even of a combined number of the same, although I believe they are quite willing to contribute labour to the end in view; but the initiative, and the bulk of the means, must come from some other quarter. . . .

Ross Sub-district.

This district shows little sign of recovery from the depression and inaction that has characterized it for some time back. In the back gullies and terraces the ordinary workings are being carried on with about the same results as last year; but here, as elsewhere, the undertakings entered into by the large companies are, comparatively speaking, at a standstill. In most cases we find capital expended, or nearly so, and work still unfinished—plant insufficient to overcome difficulties, &c. This applies more particularly to the Ross United Gold-mining Company (Limited). This company, with a capital of £150,000, acquired at a large outlay the greater portion of the auriferous flat country from Ross Flat to the ocean-beach, upon which they have expended up to date £97,000, the balance of the capital being mainly absorbed in the purchase, by paid-up shares, of certain interests that threatened to interfere with the ordinary operations of the company. After encountering considerable difficulties in opening out the claim at the deepest level—380ft.—they were enabled to work in the wash-dirt for six weeks, taking out in that time 614oz. of gold; the water then became too heavy for the pumping machinery, necessitating the discontinuance of work until more powerful machinery could be obtained. I need not point out that the suspension of work by a company such as this, where over a hundred men were employed, has told disastrously on the town and district of Ross; and it is to be hoped that the directors will in some way be able to raise the extra capital required to successfully resume operations. That this company has a valuable property is well known, even if they only worked to the 380ft. level; but it is the opinion of many that the heaviest deposits of gold will be found on still lower levels. Experience gained in this and other colonies points to this: that it is at or near the junction of the various tributaries and on the bed-rock that we may look for the best gold—*e.g.*, as occurring within my own experience at Ballarat, what was known as the "Jeweller's Shop," on the flat, was found at or near the junction of three celebrated gullies—viz., Canadian, Prince Regent, and Sailors' Gullies—and there the best gold was found, on or near the bed-rock. In Ross Flat somewhat similar conditions obtain: there we have Donnelly's, Jones's, and German Gullies, that have for ages been pouring their burdens of auriferous *débris*—derived from the weathering and crumbling-away of the Mount Greenland ranges—into the great auriferous-drift stream coming from the north that at this point has been deflected seaward by the spurs and outliers of the Greenland Range: and it is fairly reasonable to suppose that, when tested by sinking to the bottom, the results will be equally satisfactory. Since the suspension of the underground work mining has been carried on, above the level of the drainage tunnel, at the elevators, where the ground is sluiced by hydraulic giant nozzles to a depth of from 46ft. to 80ft. from the surface, the tailings being lifted by powerful elevators. A similar plant is in work at the Prince of Wales, Donohue's. These plants are let to private parties of miners, who keep them in repair and pay to the company 35 per cent. of the gross yield of gold. There are also some ten parties working the old ground on the flat at tributes of 10, 15, and 20 per cent. of their gross earnings. The proceeds from these are sufficient to defray all charges for mine-management, maintenance of water-races, and administration, and to leave a small margin of profit to the company. As the richest ground lies below the level of the present workings, there is no doubt that when the deep levels have been drained, the greater part, if not the whole, of the area of the company's property would be occupied on the tribute system. An expenditure of £20,000, it is estimated, would put the claim in working-order, but up to date the directors have not succeeded in arranging for such a desirable end.

The Mont d'Or Gold-mining and Water-race Company (Limited), with which is incorporated the Greenland Company's claim, is now one of the largest and best-paying sluicing claims on the Coast, the sum of £3,600 having been divided amongst the shareholders during the year, represent-

ing 33⅓ per cent. on the paid-up capital of the company; and but for the exceptionally dry season this amount would have been doubled. The various quartz claims about Cedar Creek and Donnelly's that were so prominently before the public a year ago have not yet shown to advantage. The batteries put up by the William Tell and the Donnelly's Creek companies have been crushing for some time, but the returns are disappointing. Further prospecting is being done with the view of striking better stone; in the meantime calls are still being made, in place of dividends being declared.

Prospecting is being carried on about Mount Rangitata, where prospects of gold and silver, of varying values, have been found in the country rock (granite), as well as in the veins and lodes. Of the numerous dredging claims taken up in this district, a number have been cancelled for non-payment of rent; others have been and are being prospected by boring, but there is no sign of machinery being put on any of them. This may be due to the fact that the machines already constructed have not been sufficiently tried to enable an opinion to be formed as to which is the most suitable machine for this kind of work.

Okarito Sub-district.

With the exception of those connected with the dredging claims, the numbers employed in mining are about the same as last year, but with a considerable increase in the quantity of gold as the result of their labours. A couple of small rushes took place during the year, one on the terraces about Omaroa Creek, where four parties hold extended claims. The workings are about 400ft. above sea-level, but the nature and disposition of the wash show it to be the remains of what was at one time a beach-lead. A great deal of the sand is strongly cemented, and requires burning and pounding before the gold can be extracted. Some of this cement is said to go 6oz. to the ton. So far, work is confined to the four claims, but careful prospecting on the same level will no doubt lead to the discovery of other portions of the same run. The other rush was on the Okarito River, where a few parties are on payable gold on the banks of the river. Several parties are said to be on payable gold on the Wateroa River, about seven miles above the road. Near the mouth of the gorge on Cook's River a number of men are at work on payable gold, and on the beach, north and south, the usual numbers are at work. In this district, also, a number of special claims have been cancelled for non-payment of rent, &c., and in some instances the abandoned ground has been reapplied-for by other parties.

Dredging Claims.

Three-mile Beach.—The Welman Dredge ordered by the English company—the New Zealand Beaches (Limited)—for this claim is now, after many unforeseen delays, almost completed, and it is anticipated dredging will be commenced during May or June. This plant is the largest yet designed for New Zealand, the pipes being 13in. diameter and the engine of twenty-five-horse power nominal. The gold-saving tables have a spread of 80ft., with a superficial area of 800 square feet; and, with the experience gained of the capabilities of the Welman dredges at Waipapa and the Saltwater, it is estimated by the company that 100 tons of solid material may be successfully treated per hour. As this plant will have the advantage of being set to work on ground which has been proved, the result of the company's operations will be watched with great interest. Mr. Brooke-Smith, the energetic manager for the Beaches Company, in answer to questions relative to the depths bored by him—states that his bores have in no instance exceeded 30ft. in depth, his object not being geological research, but the acquisition of payable dredging claims, and that he did not consider it necessary to bore to any greater depth than the material could be lifted by the dredge. The object of boring was merely to ascertain the quantity of gold in the ground; so that gold at greater depths is still a question of speculation and conjecture. The amount of information obtained by Mr. Brooke-Smith of the formation of the beaches—and which he has kindly placed at my disposal—has been considerable, as the following figures will indicate: 424 holes have been bored to an aggregate depth of 6,664ft., from which 4,288 prospects were taken, weighing 34,500lb. The material from the bore-holes was carefully washed, and a record kept of the quantity found in each prospect, as well as particulars of the nature of the various strata passed through; also noting where permanent or rock bottom was touched. The success or otherwise of this company on the Three-mile will no doubt govern their actions relative to the best methods of working the other beaches held by them at Gillespie and elsewhere.

The Welman dredge on the Saltwater, although said to be finished some months ago, has done so little work, and that in such a fashion, as to give no idea of what the beach is capable of producing, nor even any idea of what machines of this kind can do, or how far they are suited for this sort of work. I have been unable to obtain any information from the company as to the actual number of cubic yards dredged, the time taken, and the gold won; or, in fact, any information bearing upon the working of machines of this class. This is to be regretted, as the best method of working our beaches is still a moot point. Knowledge of this sort, gained by experience, would be a great public gain, and no loss to the company furnishing it. I have therefore, with the exception of the data kindly placed at my disposal by Mr. Brooke-Smith, of the English Beaches Company (Limited), on this subject, to depend on notes made from personal observation, and information obtained from reliable and capable parties, other than the Saltwater, Five-mile, and Gillespie's Beach Companies, for information pointing to the most efficient and economical methods of working our beaches. The dredge at the Saltwater, under efficient management, is guaranteed to deliver and deal with 60 tons of solid matter per hour. Whether it can do so or not I am not prepared to say: that it is not doing so will be apparent to any one visiting the claim. But to obtain the best results from machines of this kind, men must be specially trained for certain parts of the work; but, once the material is delivered by the pump, then the ordinary experienced miner comes in. I am informed that in neither case have the company in their employ men experienced in mining

or in working the nozzle: in proof of this, the quantity of stuff is not delivered. The construction of the tables is so faulty, and the tables so badly looked after, that Mr. Guthrie, the manager of the Fairmaid Company at Addison's Flat, and the patentee of the tables, who visited the claim last week, after prospecting the tailings from the machine, stated that the amount of gold lost, and that could be saved, would pay for running the machine, and that anything approaching scientific method, or even ordinary knowledge, in working the claim, is conspicuous by its absence. This is not only unfair to the machine, the gold-saving appliances, the claim, and the shareholders, but it is detrimental to every undertaking of the kind on the Coast, as tending to the discouragement of people embarking in similar ventures. Fairly payable dredging-ground, with rich patches, is said to have been found all the way down the lagoon; and this, under efficient management and a competent staff, should prove a profitable undertaking to the shareholders. During the past year the Five-mile Company have, by boring a portion of their ground, proved its value, and, having acquired the right to the Alpine Lake Water-race, they are having it surveyed and reported on by Mr. Smyth. This is a valuable water-right, the lake having an area of 168 acres. It is proposed to raise the present outlet 8ft. This supply, with the pressure obtainable (310ft.), would enable the company to work their claim by Perry's patent to very great advantage; but from a report laid before the company by Mr. Wright I understand they purpose using the water for generating electrical power, as well as for washing with. Perry's patent has proved such a pronounced success wherever tried that I think the shareholders would be wise in giving it a trial before proceeding to experiment in any other direction. With the water-power under the above pressure, they could do the work of two such dredges as they have at the Saltwater, and at half the cost, and without experiencing any difficulty in the disposal of their tailings—a most important point in beach-dredging. At Gillespie's Beach, where a series of bores were put down, a large area of rich sand was found at a level never before reached; and from extensive workings of the top sand thrown back by the diggers in the early days of the Coast very excellent prospects were obtained. I have heard incidentally that this company have under construction a powerful Von Schmidt dredge, and that the material for building the punts and pontoons is expected daily. Here, as elsewhere when the sand is much above the water-level, the profitable disposal of the tailings will be the main difficulty: this must necessarily follow where the sand-pumps are used. Their best practical lift being under 15ft. vertical, by the time the tailings leave the tables so much fall is lost that unless a second lift is provided it will be impossible to store the tailings behind the machine. The Von Schmidt dredge is another experiment in the same direction as the Welman, and it remains to be seen whether this machine will meet our requirements, and solve the difficulty of putting through large quantities of wash, and at the same time saving the gold. Sceace and party are extending their race to the north of the old workings, where payable gold has been found in new ground north of the company's claim. This beach, from the knowledge gained by boring, is likely to engage the attention of other companies at an early date, and I have reason to think their confidence will not be misplaced.

Jackson's Bay Sub-district.

Nothing new has been opened during the year. Bullock Creek, and the beaches along the coast, carry about the usual number of men. A series of bores were put down on the Arawata Beach by the holders of one of the special claims; but the quantity of wash obtained would not warrant the putting-up dredging machinery, consequently this and the adjoining claim have been abandoned, and have since been cancelled. A series of bores will be put down on the Haast beaches as soon as arrangements are completed, with, it is to be hoped, better results. Very little prospecting was done last summer. Mr. Douglas was up the Waipaia for a few weeks, but was driven back by the snow. He is now out on the main range, on the watershed between the headwaters of the Turnbull, Waiototo, Blue, Young, and Wilkin Rivers, with Mr. Mueller, Chief Surveyor of Westland, and party; and, as their line of travel crosses the great mineral belts running along near the divide, they may have something to say on their return about the country passed over. Mr. Pauline, who met with an accident in December last, was unable to carry out his intention of being at Big Bay in January. I learn that he is now there; but, having lost the summer, he is now confining his operations to the ranges near the coast, and will wait his opportunity to get further inland, the block of country between the Red Hill and the Greenstone Saddle being still unexplored. Early in December Mr. Kelly, the representative of a large Sydney firm engaged in the nickel and chrome trade in New Caledonia, paid a visit to Cascade Valley and Olivine Ranges, in the interests of his firm. He said the chrome was of the best quality, but that the distance from Jackson's Bay (the port of shipment)—about thirty miles—was a bar to the profitable working of the ore at present. The awaruite, a nickeliferous alloy found in the gravels of the Gorge and other rivers, was an interesting and valuable discovery if some easy method was found of separating it from its surroundings. Overland communication between Lake Wakatipu and the coast at Jackson's Bay is not yet practicable, except on foot. The unfinished portion should be looked to, so that it could be made available for driving stock to and from Otago; facilities would also be given to prospecting, and a new tourist route opened to the travelling public. In the magnificence of its mountain, lake, and river scenery, the number and magnitude of its glaciers, this route is unequalled, and requires only a decent horse-track and sufficient accommodation to make it one of the most favoured routes of travel in the colony. Numerous inquiries have from time to time been made about flax in south Westland; however, nothing definite has yet been done. The successful establishment of this industry would be a boon to the settlers, as providing occasional employment for their families, and bringing cash into circulation. Crops have been wonderfully good, especially potatoes, this year, and, with occasional work on road and other contracts, the settlers get along fairly well.

Since the removal of the Resident Magistrate and Warden to Hokitika, considerable dissatisfaction is expressed and inconvenience incurred at the delay in appointing some one to attend to the

duties of the Clerk to the Resident Magistrate's and Warden's Courts, Receiver of Gold Revenue and Mining Registrar, District Land Officer, Registrar of Births, Deaths, and Marriages, and Postmaster, at Jackson's Bay. With the exception of the post-office, the duties attached to the above have heretofore been discharged by the Resident Magistrate: but his removal to Hokitika renders this impracticable, his visits to the Bay being only quarterly; hence the necessity for a resident officer. The wants of the settlers south have been fairly well attended to by the Government s.s. "Hinemoa" and the subsidised steamer "Waipara;" but a material alteration is required in the rates of back-freight to enable settlers to send their surplus produce and stock to market. A special clause in the conditions is required in this direction if the subsidised boat is to be of the benefit to settlers contemplated by the Government.

I have, &c.,
D. Macfarlane, Warden.

The Under-Secretary, Mines Department, Wellington.

No. 12.

Mr. Warden Stratford to the Under-Secretary of Mines.

Sir,— Oamaru, 16th June, 1890.

The statistics for the Maerewhenua Mining District for the year ending the 31st of March, 1890, having already been sent to you, I have the honour to add a general report on the field.

We have had an unprecedentedly dry season, which has greatly retarded mining operations, as the work is purely alluvial, and depending on water-supply. The Otakaike and Maerewhenua Rivers have been lower during this period than for many years past, and, as there have not been any freshets, the tailings and *débris* have accumulated and partly blocked the tail-races.

I have again to call your attention to the fact that, until the Maerewhenua River is proclaimed a watercourse for the receipt of tailings, no improvement can be expected in the mining industry. I am aware of the obstacle to the proclamation—viz., that the freeholds on the banks of the river were granted before the year 1873, and cannot be resumed by the Governor without the consent of the grantees; but I have reason to believe the owners could be approached, and the land purchased on reasonable terms. There can be no question as to the great and permanent advantage to be gained in opening up the Maerewhenua River as a sludge-channel from Livingstone to Waitaki. Private enterprise would soon bring twenty-five to thirty heads of water on to the field, and the mining population would increase from seventy to three hundred working-men. The gold is there in payable quantities for sluicing, and, notwithstanding all the obstacles to the progress of mining, the population has not diminished. It is true a few were attracted by the Nenthorne rush; but they have returned to their old quarters long since. I have granted about 40 acres in claims, one large water-race, to carry six heads fourteen miles, and about 200 acres for occupation, during the year.

I can only reiterate my recommendation of 1889, and add to it a suggestion that the River Maerewhenua be surveyed, showing on a plan all the encumbrances (in the way of freeholds) to a free and unlimited discharge of tailings, the acreage of the impediments, and their estimated value. With this data the Waitaki County Council might see its way, if assisted by the Government, to find the means to purchase the freeholds, and remove the only obstacle to the progress of mining and the settlement of a permanent population of about four or five hundred.

I have, &c.,
H. A. Stratford, Warden.

The Under-Secretary, Mines Department, Wellington.

No. 13.

Mr. Warden Revell to the Under-Secretary of Mines.

Sir,— Warden's Office, Lawrence, 30th April, 1890.

I have the honour to forward herewith the statistical returns for the twelve months ending the 31st March, 1890, and to submit the following general report on that portion of the Otago Mining District under my supervision during the same period:—

Tuapeka Sub-district.

Mining matters in this part of the district show rather a falling-off, for since the Blue Spur claims were sold to the Blue Spur and Gabriel's Gully Consolidated Gold Company there has been a falling-off in working. During the past year the Consolidated Gold Company have made only a slight return over and above actual working-expenses. There are rumours of this company being wound up, and some attempt made to start the works on a better principle with a new company. Most of the original shareholders have left the Blue Spur and gone to other places, seeking employment, as they could not obtain work from the Consolidated Company.

The claims at the head of Munro's Gully continue to yield fair returns whenever the water is available. Several parties of Europeans and Chinese continue working on the low flats along Munro's Gully and on the Tuapeka River above its junction with Munro's Gully, making average wages. In the lower portion of Gabriel's Gully the European and Chinese hold extended and ordinary claims, yielding average returns.

At Weatherstone's Flat a few Europeans and Chinese are working extended and ordinary claims on the flat and along the side of the river on old worked ground, and also on the mining reserve along the Tuapeka Creek to its junction with the Clutha River. These are doing fairly well. Four claims, comprising 274 acres, have been applied for at Beaumont, but at present are awaiting survey before being granted.

At Waitahuna there is nothing of importance to report. There are about eighty Europeans and fifty Chinese employed in mining pursuits. The Chinese are principally employed on the low flats adjoining the river, and are making small wages. Some of the Europeans up the gully hold valuable claims, yielding good dividends. At Table Hill two quartz claims, containing about 60 acres, have been taken up, showing fair prospects. The owners are busy constructing water-races and other works in connection with their claims.

At Manuka Creek, Adams Flat, and Glenore about thirty Europeans, and the same number of Chinese, are employed, making small wages. During the summer months they generally go out harvesting, and when the work gets slack they return to mining pursuits again. A prospecting river-claim of two miles was granted to a party on the Tokomairiro River at Glenore, which has since been abandoned, and a similar claim has been applied for by another party. There are about six men employed working on the Canada Reefs, reported to be making small wages.

Waipori Sub-district.

A considerable revival has taken place in the mining industries in this part of the district during the past year. The special claim of 293 acres granted to Messrs. Hazlett and party has commenced work with a large dredge, erected on the ground at a cost of from £3,000 to £4,000. The prospects obtained are reported to be quite up to the expectations of the owners. There are four other large special claims on this flat also to be worked by dredging, but as yet they have not got to work. In quartz-mining licensed holdings have been granted to Gare and party, Lawson and party, Robertson and party, and Knight and party. Gare and party have got into working-order, and their claim is yielding very good prospects.

Messrs. Campbell and party hold a prospecting area of 300 acres to search for antimony, and are endeavouring to float a company in London to work the same. There are about six men prospecting for scheelite at present, in consequence of the price offered by a London company—viz., £22 per ton delivered in Dunedin.

O'Brien and party, who have been so successful in working their claim in the Deep Lead, have sold their interest at a very good figure to the Amalgamated Waipori Deep Lead Gold-mining Company (Limited). This company is now actively employed working the ground on an extensive scale.

Tapanui Sub-district.

Mining operations in this part of the district are carried out on a very small scale. A few Chinese are working in the Scrubby Terraces, making ordinary wages. They hold two water-races in the locality, which supply them with water.

At Waikaka the special claim of 180 acres was abandoned, as the company found it was unsuitable for dredging purposes. The Europeans and Chinese continue working on and about the Little Waikaka, making ordinary wages. One or two extended claims have also been taken up near Waikaka, which the occupiers hope will turn out remunerative.

Waikaia Sub-district.

Mining matters in this part of the district are much the same as last year. A fair share of gold has been obtained from the workings in Hospital Hill, but the ground is beginning to be worked out. The Chinese in this locality are doing a good deal of prospecting, whilst others continue working their claims at Welshman's and Moffatt's Gullies. The special claim taken up just below Moffatt's Gully, on the flat, has been abandoned after sinking two holes about 35ft. and being driven out by water. Jones and party have been working on a nine-acre claim up the Winding Creek for a syndicate in Invercargill, but so far with indifferent success.

There are a few Europeans at work on Gow's Creek, making fair wages; and the same also applies to Growlers' Creek and Piano Flat. Some fifteen licensed holdings and special claims have been taken up during the year, containing 433 acres; but, with the exception of four quartz claims and a claim on the flat at Nokomai, none of the others have started to work.

Messrs. Conliffe and Dwyer have obtained very good prospects out of their extended claim at the Upper Gorge of the Nokomai. The Chinese in the same locality are also making fair wages.

Tenders have been called for the formation of a water-race from Steeples Creek to the Scrubby Terraces, opposite Waikaia Township, which would command a large area of auriferous ground, and prove a great boon to the mining community. Already claims have been applied for in anticipation of the race being constructed.

The revenue received in the Warden's department shows a considerable increase, the amount received being £356 13s., as against £195 for the previous year.

Roxburgh Sub-district.

Having been placed in charge of this portion of the district, to relieve Mr. Warden Wood, in June last, I have to report that the population is estimated at 1,576 Europeans and 58 Chinese. The several claimholders are busy working their claims, or engaged bringing in large water-races in connection therewith. Some of these water-races are very extensive, varying from ten to sixty miles in length.

The principal claims at work are the Island Block Company, yielding from 80oz. to 120oz. per week, and the Hercules Company, at Roxburgh, yielding from 100oz. to 140oz. per week. Other large claims are held in different places, but no work has been done in some of them, as the parties are engaged constructing water-races in connection therewith from Dismal Swamp, the Taieri River, and other localities. Moody and Uren have an extended claim on the bank of the river, about four miles above Roxburgh, which is yielding over £12 per week.

There are eight dredges on the river, some of which are earning fair wages. Pringle and party, Bennett and party, Valentine and party, and Brazil and party are reputed as doing well with their dredges. The Dunedin Gold-dredging Company have one steam and one ordinary dredge at work, making fair wages with the former.

The Chinese are principally working on the Waikaia Saddle, making average wages.

In conclusion I have to attach the following returns: viz., estimated yield of gold; estimated population; together with return of the number of miners' rights, licenses, registrations, &c., issued at the local Courts; and also a return of the cases heard, and revenue collected.

I have, &c.,

The Under-Secretary, Mines Department, Wellington. W. H. Revell, Warden.

Return of Miners' Rights, Water Licenses, Registrations, &c., issued during the Twelve Months ending 31st March, 1890.

Nature of Right issued.	Lawrence.	Waikaia.	Tapanui.	Roxburgh.	Total.
Miners' rights	819	345	19	274	1,457
Miners' rights consolidated	1	4	2	...	7
Business licenses, at £3 (yearly)	1	2	...	...	3
" £1 10s. (half-yearly) ...	...	4	...	...	4
Water-race licenses, at 5s.	34	28	1	25	88
" 2s. 6d.	78	36	3	47	164
Registrations, at 20s.	1	...	...	...	1
" 10s.	18	...	...	...	18
" 5s.	10	...	...	...	10
" 1s.	344	245	7	146	742
Applications for special claims	12	10	...	12	34
Special claims granted	7	10	...	7	24
Applications for licensed holdings	11	7	2	2	22
Licensed holdings granted	11	7	...	2	20
Applications for mineral licenses	...	...	...	...	...
Mineral licenses granted	...	...	...	...	...
Applications for occupation licenses	3	1	...	7	11
Occupation licenses granted	1	...	...	6	7
Mining applications	239	235	4	109	587

Return of Revenue collected during the Twelve Months ending 31st March, 1890.

——	Lawrence.	Waikaia.	Tapanui.	Roxburgh.	Totals.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Warden's department ...	1,158 1 4	356 13 0	13 5 6	534 3 6	2,062 3 4
Deferred-payment rents ...	650 0 2	15 16 6	...	210 12 7	876 9 3
Resident Magistrate's Courts (goldfields)	289 6 6	112 16 0	92 7 9	47 0 0	541 10 3
Licensing-fees	17 6 0	6 6 0	1 17 0	5 12 0	31 1 0
Totals	2,114 14 0	491 11 6	107 10 3	797 8 1	3,511 3 10

Return of Cases heard in the Resident Magistrate's and Warden's Courts, and Revenue collected, during the Year ending 31st March, 1890.

——	Civil.	Criminal.	Warden's.	Totals.	Revenue, including Licensing-fees.
					£ s. d.
Lawrence	140	131	24	295	318 8 6
Waikaia	54	54	11	119	132 8 0
Tapanui	59	34	...	93	107 10 3
Roxburgh	40	26	11	77	52 12 0
Outside goldfields—					
Milton	24	35	...	59	75 18 0
Balclutha	91	38	...	129	102 1 6
Kaitangata	14	22	...	36	26 17 0
Clinton	46	30	...	76	46 8 0
Gore	286	62	...	348	212 8 0
Mataura	...	8	...	8	3 13 0
Totals	754	440	46	1,240	1,078 4 3

RETURN of the ESTIMATED POPULATION for the Twelve Months ending 31st March, 1890.

	European.	Chinese.
Tuapeka District	5,400	500
Milton	4,600	65
Balclutha	3,700	..
Tapanui	1,686	64
Gore	3,200	60
Mataura	800	...
Waikaia...	1,030	200
Roxburgh	1,579	55
Clinton	1,561	...
Kaitangata	1,119	...
Totals	24,675	944

Showing a total of 25,619 souls.

ESTIMATED YIELD of GOLD for the Year ending 31st March, 1890.

	Oz.
Tuapeka District	11,100
Waikaia	6,000
Tapanui	1,600
Roxburgh	3,800
Totals	22,500

No. 14.

Mr. Warden DALGLEISH to the UNDER-SECRETARY of MINES.

SIR,— Warden's Office, Naseby, 31st May, 1890.

Herewith I have the honour to transmit the annual reports, and the usual statistical returns for the Dunstan, Wakatipu, and Mount Ida Districts, for the year ending 31st March, 1890.

Clyde and Alexandra.—Although nothing of any special consequence has transpired here during the year in mining matters, I am pleased to be able to report that no reduction in the numbers employed in mining pursuits has taken place, nor do I think the quantity of gold obtained has fallen below the average of the last few years. The two current-wheel dredges are still working on the Clutha River, half-way betwen Clyde and Alexandra, and I am given to understand that in both cases profitable results are being achieved. The Welman dredge which last year was lying at the bottom of the Manuherikia River, has been raised, and the machinery found to be but little the worse for its eighteen months' submersion. No effort has yet been made to refit it, but I am informed that the company in England has taken steps to increase its capital, and that a representative is on the way to the colony to take charge of the property with a view to an early resumption of operations.

Bald Hill Flat.—Quite a stir in mining has been going on in this locality during the past six months. Several new water-races have been applied for from Gorge Creek, and a general rush to clear out and repair the old races has been made. Three licensed holdings have been taken up for hydraulic sluicing, and a company is now being formed to work Little Bald Hill, a portion of Mr. John Butler's freehold. It has always been the opinion of experienced miners that this locality is rich in gold deposits, and I feel assured that, now the miners have determined upon superseding the primitive methods of working the ground, hitherto so persistently adhered to, by introducing more modern appliances, a considerable increase in the yield of gold, and population, will ensue.

Tinker's.—The claims in this locality continue to yield remunerative returns. In the early part of last year quite a rush took place, and about a dozen licensed holdings and special claims were applied for, embracing the whole of the ground under the range from Devonshire Gully to Dry-bread. This was consequent upon the sinking of a shaft to test the granite-wash, a deposit which until recently had been taken for the bottom. The shaft was sunk to a depth considerably over 200ft., and excellent prospects were obtained all the way down, sometimes reaching to as much as 6gr. to the dish. In consequence, however, of the scarcity of water, the great depth, and other difficulties surrounding the working of the ground, most of the applications have been withdrawn, and only those taken up which were applied for by parties holding the water and occupying the frontage claims. The find is looked upon as a very valuable one, and has proved this part of the field to be practically inexhaustible.

Mr. John Ewing has completed his water-race from Thompson's Creek, and, although a short one, the rough character of the country through which it was constructed necessitated an expenditure approaching £6,000. The race is constructed to carry twenty heads of water, and will command all the ground from Tinker's with a pressure equal to 500ft. He has not yet commenced sluicing operations, and I fear will not be able to do so until spring, water being so very scarce, and none now available for this race. The syndicate which undertook to float the Tinker's mining property upon the London market on or before the 31st December last failed to do so within the time. I have heard no expressions of regret at the failure. During the last twelve months water has been most anxiously sought for, and apparently every available drop taken up. Never since the opening of the goldfields, I think, has it been of greater value than at the present time. To give some idea of the high estimation in which it is held in this part of the district, I may

mention that a few weeks ago the two "Excel" water-races, one holding the first right to seven heads of water and the other the fifth right for a similar quantity out of Thompson's Creek, realised at auction the enormous sum of £10,800 sterling, the Undaunted Company, holding six-fifteenths of the property, being the purchasers.

Black's, or Ophir.—Mining here has not been as prosperous as I could wish for some time. Green's Reef is now unworked, and the Ophir Company, from which so much was expected, had such a disappointing return from the first crushing that I fear no further efforts will be made. The Ophir Waterworks and Hydraulic Sluicing Company has already gone into liquidation without making an attempt to bring in the water from the Manuherikia River. There are a few men, however, doing fairly well, but the absence of water limits their labours very much.

Black's No. 3.—The Ida Valley Deep Lead Gold-mining Company, under the management of Mr. Eckberg, have been energetically prospecting their property during the last twelve months. Four shafts have been bottomed on the solid rock, varying in depth from 180ft. to 217ft. The seams of running drift met with rendered the undertaking both difficult and dangerous, and much sympathy is felt for the company in its failure to strike payable gold. As the capital of the company is nearly exhausted, I am afraid this will add another to the many unsuccessful attempts to win the supposed rich deposits of gold in the Ida Valley Deep Lead.

Bannockburn.—The work here being almost entirely sluicing, the effects of the exceptionally hard winter and succeeding dry summer have been most severely felt. During ordinary seasons over twenty heads is the usual supply brought in, while for a considerable time past only some six heads have been available, the consequence being that a number of claims had to be protected and others only partially worked.

The bringing-up of the main channel enables the holders of claims in the deep ground now to work their holdings.

Paterson and party have now been nearly two years in bringing up a deep tail-race from the Kawarau River to some deep ground at the foot of Pipeclay Gully: they have already expended some £2,000 in the undertaking, and expect to be some months yet before they get to the ground. McLellan and party have also gone to considerable expense in bringing in water to their claim at Slaughteryard Hill, and in the construction of dams, &c.; but, again, the shortness of water prevents them getting on. Their claim is well known to be thoroughly payable for sluicing operations, from tests obtained some time ago by tunnelling. On the Carrick Range there are a few parties remuneratively employed in alluvial workings; and in quartz-mining Lawrence and party, who have a lease on the old Caledonian reef, are believed to have a very valuable property. They have succeeded in tracing the reef for a considerable distance, with a body of stone from 2ft. to 4ft. in thickness, and carrying very payable gold. They have erected a serviceable little crushing plant of four heads of stampers, driven by a Pelton wheel. The machine is a self-feeder, and will easily put through from 25 to 30 tons per week. The Star of the East Company have abandoned their claim, and the license has been cancelled, but two or three parties have set in to further prospect the ground.

Nevis.—Even this portion of the district, with its usual splendid and almost inexhaustible supply of water, has been affected by the long drought. Several special claims have been taken up, which are intended to be worked on the hydraulic system. There is little doubt that there is a very large extent of payable ground at the Nevis: from Whitton's to the saddle at Upper Nevis there is a large flat, which has been but little prospected, although there are a number of gullies running into it which have been worked and proved to be very payable, and in some instances exceedingly rich. A water-race, to bring in ten heads of water to work the flat I have alluded to on the hydraulic system, is to be brought in by the owners of the special claims. I have great hopes that this will prove to be a very remunerative undertaking. The ground is only from 15ft. to 20ft. deep, with soil and fine gravel down to the wash. One party working at this place have been making wages even by stripping the ground by ordinary barrow-and-shovel work, indicating what good results should be obtained when large quantities of the ground can be dealt with.

Kawarau River.—The claims on the banks of this river are still in some cases turning out well. One or two new claims have been taken up on the west bank, above the gorge, and water is being carried across the river in piping. The owners are hopeful of obtaining good results.

A number of claims have also been taken up in the Roaring Meg, principally by Chinese miners, who have shown great energy and determination in contending with really difficult work at this place. Their pluck has been well rewarded in most cases; one party, I am informed, has for some months past been making from £10 to £25 per week.

The excitement in dredging which took place some months ago has now quieted down somewhat. At that time dredging claims were marked off pretty well all along the Kawarau River, and some on the Clutha. No doubt many of them were so taken up for purely speculative purposes, and were not proceeded with. There are, however, some which I have every reason to believe will be carried on, and, I trust, to a favourable result. Coote and Horn, I am informed, have succeeded in floating their company, and intend to use electricity for working their dredges, the power of the river-current to be utilised for the purpose. It is now beginning to be recognised by the miners that the dredge of the future will have to be worked by steam, or possibly electricity. Kloogh and party are working a current-wheel dredge on the Clutha near Lowburn, with tolerable results, and a special claim has been applied for in the same locality by Kunosin and party, whose intention is to put on a steam-dredge. Some of the party worked at the place in the early days, and profess to know of some very rich ground still unworked.

During last winter the Clutha River was unprecedentedly low, and the consequence was that some very rich patches of gold were obtained, principally by Chinese miners. All of the rivers are now very low again, and there is a strong probability of their being even lower than last winter, and of a correspondingly rich yield being obtained.

Quartz Reef Point, Lowburn, Five-mile Creek, &c.—Little or no alteration is noticeable in these localities, and I am informed that the miners are being fairly well remunerated for their labour; but here, as throughout the whole of Central Otago, the want of water is becoming most seriously felt.

Bendigo.—The Cromwell Company are progressing with the main shaft. It is now, I am informed, 430ft. in depth; it is intended to sink it to 600ft. The company has been working a leader, which has lately widened out from 6in. to 12in. and 18in., and while water was obtainable to work their mill it was paying the expenses of the mine. Water has, however, become so scarce that they will be compelled to resort to steam-power. The old Eureka Claim, now held by McLoughlin and party, promises to be a fairly profitable speculation. They are now erecting a five-head battery, to be driven by an overshot wheel.

Criffel and Fatboys.—Nothing of an unusual character has transpired at either of these places. At the former the prevailing want of water has no doubt affected the usual good return, as, I am informed, only some twenty men could obtain sufficient to keep them going. At Fatboys matters are comparatively at a standstill. The El Dorado Company are persistently pushing on with their tail-race, but have not yet succeeded in striking the deep ground. If the hopes of the company are realised in striking payable ground, there is little doubt that a large number of men will find employment, as there is a large extent of ground that would be available, the formation being very similar to that which has given such splendid returns at Mount Burster and Clarke's.

Queenstown, Arrow, &c.—There is but little of moment to refer to in this part of the district. Almost the only new development has been a boom in special dredging claims. Every available foot of ground has been taken up, applied for, and granted on the Kawarau, Shotover, Arrow, and Cardrona Rivers. Two claims have also been granted at the head of the Dart River, three claims in Bucklerburn, and one each in the Twenty-five-mile and Twelve-mile Creeks respectively. Up till now, however, there is but one dredge at work—that of Sew Hoy and Company, at the Big Beach. It has been working most successfully for several months, and is a dividend-paying concern. I learn the Energetic Company is having three more dredges built, on the most improved principles. One other dredge has been launched to work in the Kawarau River, below the junction of the Shotover. This dredge has not yet passed out of the contractor's hands, consequently nothing has yet been done in the way of gold-saving. There are a dozen other dredges in the course of construction, and if only a proportion of them prove payable there will be twenty or thirty more built with all possible speed; and, as the claims to be operated upon have shown indications of being payably auriferous for dredging, the next annual report will probably be of a more cheerful nature than the present one. As the various companies are each trying to obtain the newest and most approved machinery and the best gold-saving apparatus, there can be little doubt that during the current year there will be a vast improvement in the mechanical and gold-saving portions of the dredges, and that experience and science will solve some of the many problems which have hitherto surrounded the working of dredges as dividend-paying concerns.

Quartz-mining has been thrown very much into the shade through the great amount of attention bestowed upon the dredging claims. There are now but three quartz claims in active operation, and two of these are private companies, the Phœnix and the Sunrise. The only public company is the Gallant Tipperary. In all of these mines the estimated yield per ton is over an ounce. The Invincible Company is in liquidation. The Premier and Tipperary, both at Macetown, are still awaiting a favourable opportunity to be floated on the London market.

Alluvial mining has been almost at a standstill for many months past through the oft-alluded-to drought.

There has been, however, a fair quantity of gold obtained, many of the Chinese miners having been very successful.

There are several very large and costly undertakings nearing completion: Messrs. Davies and Moodie's water-race on to Burke's Terrace, Shotover, entailing a cost of some £10,000; the tunnel of the same enterprising firm at Arrow Falls; Hogan and party's tail-race at Moke Creek, and others, testify still great confidence in the future of the Wakatipu District.

Cardrona Valley.—It is stated that a considerable quantity of the precious metal has been obtained in this locality during the year, a quantity which would have been largely augmented if a larger supply of water had been available.

Mount Ida.

Naseby and Kyeburn.—Perhaps in no place within the Otago Mining District has the unprecedented drought been more keenly felt, and greater disaster shown itself as an attendant: it will suffice if I say that to it is attributable a falling-off of nearly half the annual yield of gold for the district. To give one of many instances which might be quoted, I may mention that one of the leading sluicing companies here during the past thirteen months had only fifteen days' supply of water. It is now recognised by every one that, to prevent as far as possible recurrence of these discouraging delays, it is becoming absolutely necessary that some steps be taken to enable the water-supply to be made more regular to the consumers, and rendered more permanent, by the construction of the long-talked-of and much-needed reservoir at Eweburn. My own appointment to this district is of such recent date, however, that I feel unable to speak on the subject with the amount of certainty and authority that older residents can and do.

I am informed that the extent and richness of auriferous ground between Naseby and Kyeburn commanded by the extension of the Government race is found to far exceed the expectations of the miners there: this would apparently tend to show that a large and permanent field remains to be worked in those subdivisions.

Hamilton's and Sowburn.—In December last portions of the Taieri river-bed and adjacent terraces, near Patearoa ford—in all about 100 acres—were taken up by a number of miners who amalgamated, and jointly prospected the ground with boring-rods and tubes. The depth of auriferous wash was found to average 20ft., and to be of a quartz-drift nature, similar to the drift now being worked at St. Bathan's. The prospects obtained showed a result of from ½dwt. to 1dwt. of gold to the load. This was considered quite ample to justify a more systematic and costly scale of operations, and arrangements have been made with Mr. Welman to put a prospecting plant on the ground, and if the present anticipations are realised further arrangements are to be made for putting on dredges, which, if successful in obtaining payable gold, will be the means of the river-bed and flats being taken up and worked on the dredging principle, and be of incalculable benefit to the district generally. I may add that a Dunedin syndicate has also pegged off a large area on the same river, including part of the Taieri Lake; but they have not yet commenced operations.

Hyde and Macrae's.—There is little fresh to report upon in these places. In connection with the Mareburn or Highlay Reef the legal manager informs me the reef is 7ft. wide at the 150ft. level, and that the stone averages ½oz. to the ton. The company has been compelled to suspend operations on account of the scarcity of water. Several dams have now been constructed, also a platform capable of holding 100 tons of quartz.

A number of dredging claims have been taken up on that portion of the Taieri River in the Hyde subdivision, the prospects obtained being represented as very good. Mr. Esson, representing a Dunedin syndicate, has recently put on a spoon-dredge, and I am informed the results are sufficiently satisfactory to induce his company to purchase a Welman dredge. I understand that several leaseholders on the river purpose renting the spoon-dredge to prospect their claims. The Golden Quarry Reef, at Highlay, has been placed in the hands of Mr. Dixon, who shortly proceeds to the Home-country with the object of floating a company to work it.

Quite a number of reefs have been discovered in the Macrae's subdivision since last year's report, and some of them—notably the Maritana, the Golden Point, and the Orient—have given fair prospects, but want of capital prevents the shareholders proceeding further at present.

Blackstone Hill and Rough Ridge.—The Great Eastern and Progress Companies at Rough Ridge stopped work owing to the companies being under offer to a London syndicate. Through some misunderstanding, however, negotiations lapsed, and the present shareholders, I understand, propose to carry on operations on their own account.

Serpentine.—There is very little stirring at this place. The principal mining operations are being carried on by the Golden Gully United Quartz-mining Company. This company are working their special claim in a very systematic manner. The main adit has been driven 1,154ft., and connected with the surface by a main pass 230ft. The results of last summer's crushing were satisfactory, being at the rate of 1oz. 15dwt. per ton—130 tons of stone yielding 221oz. of gold. The company is now removing the battery from the top of the hill to a site in Long Valley, where work can be more efficiently and economically carried on.

There are a few isolated parties engaged in sluicing operations, but I am not informed of the results. It is believed there is a considerable tract of payable country about the locality, but the extreme severity of the climate acts as a bar to its occupation on a large scale.

Nenthorne.—This last acquisition in the way of a quartz-mining field, about which such very extravagant hopes were entertained last year, has not yet by any means realised those hopes. At the outset of its career the management of many of the claims fell into inexperienced hands, the consequence being that the work was carried on without system, and in not a few cases in an unnecessarily costly manner. The brevity of my visits to the place, and the fact that my time whilst there has been invariably entirely occupied with Court-work, has prevented me from acquiring information relative to the present position of the various mines of a sound and reliable nature, but, generally speaking, I believe work is now being prosecuted in a more business-like way, and in a short time results of a definite character, as to the permanence or otherwise of the field, will be available.

I have, &c.,

S. Mead Dalgleish, Warden.

The Under-Secretary, Mines Department, Wellington.

Summary of Quarterly Returns of Cases and Revenue for the Undermentioned Periods, Clyde and Alexandra.

Quarters.	Cases commenced.	Criminal Cases.	Revenue.	Licensing-fees.	Total.
			£ s. d.	£ s. d.	£ s. d.
To June 30, 1889	5	18	8 5 0	9 1 0	17 6 0
September 30, 1889 ...	22	33	21 3 0	0 12 0	21 15 0
December 31, 1889 ...	14	27	25 2 0	...	25 2 0
March 31, 1890 ...	14	27	94 11 0	...	94 11 0
Total	...	...	...	...	158 14 0

WARDEN'S COURT and GOLDFIELDS REVENUE.

Quarters.	Cases.	Applications.	Revenue, Warden's Court.	Goldfields Revenue.	Total.
			£ s. d.	£ s. d.	£ s. d.
To June 30, 1889	3	28	1 16 6	112 9 6	114 6 0
September 30, 1889 ...	2	18	0 13 0	84 10 0	85 3 0
December 31, 1889 ...	4	23	0 19 0	52 8 6	53 7 6
March 31, 1890 ...	5	42	5 5 0	103 17 9	109 2 9
Total	...	...	...	...	361 19 3

Total estimated population, 1,500.

RETURN of MINERS' RIGHTS, LICENSES and REGISTRATIONS, &c., issued at CLYDE and ALEXANDRA for the Year ending 31st March, 1890.

Miners' rights	337
Consolidated miners' rights	2
Business licenses, at £3	6
" £1 10s.	Nil
Water-race licenses, at 5s.	32
" 2s. 6d.	64
Registration, 1s.	136
Applications for licensed holdings	4
" " granted (50 acres)	2
" special claims	3
" " granted (250 acres)	2
" occupation licenses	12
" " granted (71 acres)	3
Mining applications	111

REVENUE collected for the Twelve Months ended 31st March, 1890.

	£ s. d.
Warden's Court and goldfields revenue	361 19 3
Deferred payment	613 6 9
Resident Magistrate's Court and licensing	158 14 0

NUMBER of CASES disposed of.

Civil	55
Criminal	105
Warden's Court	14
Total	174

No. 15.

Mr. Warden CAREW to the UNDER-SECRETARY of MINES.

SIR,— Warden's Office, Dunedin, 8th May, 1890.

I have the honour to forward herewith the yearly returns for the portions of the Otago Mining District administered at Dunedin. In doing so I may state that the year's transactions call for little or no special remark. At Hindon things remain very much as they were at the date of last year's report. The Mount Hyde Company, then erecting extensive quartz-crushing machinery, has been unfortunate, and the property has fallen into the hands of Messrs. Begg and Co., who intend pushing on with the enterprise, but, for want of water, have been unable as yet to commence crushing. At the small battery in Machine Creek about 200 tons of stone has been crushed during the year, yielding an average of 7½dwt. to the ton. This includes several small crushings for other than the proprietors of the battery.

About the same number of miners are working in various parts of the district as before. On the Barewood Run, the property of the University Council, several promising quartz reefs are being prospected and opened up, trial-crushings from which appear to have yielded satisfactory returns.

On the Waikouaiti River Mining Reserve a few miners are still working, and a number of applications thereat have been dealt with at Dunedin during the year.

A discovery of gold at Coal Island, Preservation Inlet, during the year has induced a number of miners to resort thither, the number there at present being probably fifty or sixty; and applications for water-races, claims, and other rights have been dealt with here rather than elsewhere, as being more convenient for the applicants.

Several applications for mineral prospecting licenses have also been granted over land at Silver Peak, Mount Hyde, and at various places on the west coast of the Otago Provincial District.

I have, &c.,

The Under-Secretary, Mines Department, Wellington. E. H. CAREW, Warden.

No. 16.

Mr. Warden Rawson to the Under-Secretary of Mines.

Sir,— Invercargill, 22nd April, 1890.

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 31st March, 1890:—

Longwood.

The Longwood Sluicing Company (Limited), as seen by the last report of Mr. Warden McCulloch, commenced operations last year by constructing a water-race five miles and a half in length from Cascade Creek, being a continuation of Berndtsen's big water-race, for the purpose of working the old abandoned quartz claim at Longwood by means of ground-sluicing. It was hoped that this enterprise would be the means of opening up a large extent of auriferous country. This company has been steadily at work during the past year, but, owing to the very difficult nature of the ground, less progress has been made than was anticipated. Nevertheless, it is confidently expected that, by persevering in the sluicing as at present carried out, a valuable goldfield will be shortly developed. Shares have been lately sold at from 50 to 60 per cent. premium.

Orepuki.

With respect to the Orepuki Goldfield there is nothing new to report since last year, excepting that water has been exceptionally short this year, and consequently the usual amount of work has not been done. About the same number of miners are still at work on the field. Within the last few months four special claims for sea-beach ground have been granted in Te Waewae Bay, near Orepuki. A prospectus was issued on the 21st of last month preparatory to floating a company to work one of these claims.

Roundhill.

The Roundhill Goldfield, at which operations are carried on by means of ground-sluicing, employs about the same number of miners as usual, but they are getting very much jammed up for want of fall. I visited the mines, and saw that the lower level, in which the richest deposit of gold is found, is most of it sludged up. This sludge is now from 20ft. to 40ft. deep in the gullies. A company is being promoted for the purpose of removing this sludge and at the same time extracting the gold from it, and with the further object of giving access to the lower gold-bearing levels. The promoters have recently arranged to send their secretary to England to float the company.

Coal Island, Preservation Inlet.

A rush has recently set in to Coal Island, Preservation Inlet. There are at the time of writing this report about a hundred and thirty miners there. As far as I have been able to ascertain, between 200oz. and 300oz. of gold has already been obtained from the field. The gold is obtained in shallow ground, at a depth not greater than 10ft. Prospects are reported as fairly good, but large boulders have to be contended with. The gold is rough and nuggety.

Waipapa.

The Waipapa Creek Company (Limited) continue dredging operations. I understand they are still on comparatively poor ground, but expect to get on a well-known gold-lead in three or four weeks. Nevertheless, the quantity of gold saved for last month was equal to about £500 in value. This is the only beach claim in this district at present using a Welman dredge; but four other of these machines are on the way from England. The Lake Brunton Dredging Company, on Waipapa Beach, expect to commence operations in June with assured good results. Steps have been taken to get other claims worked at the mouth of the Waiau River. It is believed that the Welman dredge will inaugurate a new and prosperous era in gold-mining, making it profitable to work ground otherwise unpayable.

I have, &c.,

The Under-Secretary, Mines Department, Wellington. C. E. Rawson, Warden.

No. 17.

Mr. J. Gow, Manager, Waimea-Kumara Water-race and Sludge-channel, to the Under-Secretary of Mines.

Sir,— Kumara, 18th April, 1890.

I have the honour to submit my report on the Waimea-Kumara Water-race and Sludge-channel for the year ending the 31st March, 1890, as follows:—

Waimea Race.

The sales of water for the past year are somewhat less than they were the previous year, and the decline is very gradual. Mining at the Stafford end of the race is almost exclusively confined to the Chinese, who are content to work for less gain than the average European.

Tunnel Terrace, between Goldsborough and Stafford, is the principal mining centre supplied by the race, and, although it is poor ground, not likely to pay more than small wages, the miners are not likely to abandon such claims nowadays, that will take several years to work out. When Tunnel Terrace is worked out there will be sale for all the water now used there, if carried to the north side of the Waimea Creek by a siphon, where the want of water is much felt by the old miners in that locality. At Fox's there are still a few miners comfortably located, working eight or ten claims, and making small wages.

The amount of sales from this race for the year is £1,240 9s. 7d., and the expenditure on maintenance for the same period is £795 7s. 7d., leaving a credit balance of £445 2s. on the year's transactions. The average number of miners supplied with water was ninety-one.

The fluming at Kawhaka has had a thorough overhaul, and during the Christmas holidays many of the longest of the old flume-legs were removed, and new ones of inner heart of red-pine fixed in their stead: all the very long legs in these flumes are now new, which may be considered to give a new lease of life for several years to the Kawhaka flumes. The race throughout is in a good state of repair.

Kumara Race.

Within the past twelvemonths extensive alterations of races have been sanctioned, and subsidised in free water by the Government equal to one-third their estimated cost, and carried out by parties of miners wishing to sluice away the original race-site. These deviations have been made by substituting iron or steel piping—principally the latter—of 30in. diameter, in lieu of the old ditching. By these deviations some large blocks of ground are made available for sluicing purposes, which will require from ten to twelve years to wash away. There are four parties concerned in these deviations, each taking ten heads of water each shift, valued at £1 5s. per day to each party. The main race, which passes through Dillman's, has been cleaned out of the last five years' accumulation of rubbish, and almost reconstructed, at a cost of £125. It had been so long neglected—five years—that it would not carry more than eighteen heads without overflowing. It now carries thirty heads. On the line of the same race, below Dillman's, there are 1,012ft. of 30in. steel piping ready to be laid down parallel with an old flume that is liable to break down any day; and, again, further down, and below J. Leache's deviation of the same race, it has been widened and deepened to carry thirty heads, at a cost of £132 15s. This race, when the 1,012ft. of piping is laid, will be capable of carrying all the water required at the lower end of the field for the next two or three years.

By-washes.—I have just completed a new by-wash at Stockman's Tank, capable of carrying twenty heads, at a cost of £25. I have also overhauled and completed the pipe by-wash from main siphon behind Dillman's to the old by-wash at Dillman's office—where valve is attached—capable of carrying thirty heads from the high-level race, at a cost of £25. Some alterations and improvements in the working of the gates are being made to the old by-wash at Blake's old sawmill, at a cost of £7, where from forty to fifty heads can be turned off in a few minutes' time; and the new Kapitea Hill Race is now available as a by-wash, and is capable of carrying forty heads from the mouth of the sludge-channel head-race. I hold a permit from the chairman of directors of the Long Tunnel Company to use Dawson's Creek, 35 chains down the race, as a by-wash for the forty heads last mentioned; which creek I cleared out for the purpose, at a cost of £12. These by-washes together are more than sufficient to carry all the water from the main Kumara Race when required.

The last deviation made—Palmer and Pascoe's—has removed a great source of danger to several of the large sluicing claims: there the ground has been sluiced away for some distance along on both sides of the race to a depth of over 100ft., and, in consequence of the ground having been previously driven out in the first of Kumara mining, large surface-breaks became a daily occurrence, showing a constant subsidence was going on, endangering the mining plant and men's lives on either side, until I deemed it necessary to stop their water-supply. The filling-in of the cavities in the bottom of the race during the last twelve months has cost about £80.

A few of the first sluicing claims opened on the field are worked out, and three others are nearly so; nevertheless the demand for water at the present time is greater than the supply. I find it just now a most difficult matter to arrange the shifts so as to give all the customers water every day: it cannot always be done, and, notwithstanding this well-known fact, additional claims are still being prepared to take sluicing-water, and applications are made from time to time for gauge-boxes to be put in opposite their claims in readiness. The miners are gradually being convinced of the fact that water is cheaper than labour, and are consequently applying from time to time for additional heads of water to work their claims. Most of the first sluicing claims opened on the Kumara used from five to seven heads only; the same parties now take ten and twelve heads when they can get that quantity, and will not work with less than ten heads. The time is not far distant when not less than fourteen or fifteen heads to each claim will be considered the correct quantity to make the ground pay fair wages; therefore the present sales from the Kumara Race are certain to be maintained for some years to come. The average number of miners supplied with Government water during the year was about 175, and the approximate quantity of gold obtained by them 7,543oz., valued at £28,663 8s. 0d.

Sludge-channel and Tailings-site.

In April last year the tailings-site was completely filled up, and the narrow channel for the river-water nearly closed—so much so that timber protection-work had to be put on its opposite bank to the sludge-channel, to prevent it scouring away beyond the reach of the channel, which was then down to the water-level. After a short stoppage of sluicing operations the channel was raised 4 chains within the tunnel, to a less gradient per chain than it formerly had, and the channel at the lesser gradient was extended out over the old tailings until a small drop was gained, when sluicing was again resumed, and has continued steadily while water was available up to the present time. The length of raised extension, exclusive of branches, is 36 chains, at which point it is just now narrowing the river at the timber protection, where further filling must be stopped within a week. Two new branches are now being constructed to enable the miners to continue working if possible until the new Sludge-channel No. 3 is completed, which work is so far advanced as to admit of it being completed in time, provided it is more energetically advanced by the contractors. The contract time for completion of the 30 chains of tunnel has expired, and the contract for building the channel

and completing it ready for use is let, and partly done. The whole work, by a little energy, could be completed in six weeks from date, at about which time the tailings-site will be again filled up and useless. The new channel will again cover the old tailings-site to a depth of 18ft. and more, in places which should work out a large area of ground, extending over several years.

The amount of channel-fees for the past year was £167 9s. 3d., and the value of gold-dust obtained from the channel for the same time £541 15s. 6d., making a total gain of £709 4s. 9d. The expenditure on maintenance and contingencies amounts to £3,213 15s. 11d., showing a loss of £2,504 11s. 2d. on the channel for the year. There were sixteen parties using the channel at the beginning of the year, and fourteen at the end of the year.

The portion of No. 1 Sludge-channel to be abandoned on completion of No. 3 will be thoroughly cleaned up from its juncture downward, for gold-dust deposited therein. In order to do this completely, an outlet drain will have to be constructed at the mouth of No. 1 Channel tunnel, to take away the drainage-water while No. 3 is working. The channel outside of tunnel and immediately under the tail of No. 3 will be the first to be cleaned up for gold-dust.

I have, &c.,

The Under-Secretary, Mines Department, Wellington. J. Gow, Manager.

No. 18.

Mr. J. McNaughton, Manager, Nelson Creek Water-race, to the Under-Secretary of Mines.

Sir,— Nelson Creek Water-race, Hatters' Terrace, 8th April, 1890.

I have the honour to forward my annual report on the transactions connected with the working of the Nelson Creek Water-race during the year ending the 31st March, 1890.

The revenue derived from sales of water has been £529 18s. 4d., and the expenditure on maintenance £917 10s.

The average number of miners employed in working ground with water from the race during the year has been twenty-seven, and the approximate amount of gold obtained by them during that period has been 846oz., representing the value of £3,235 19s. After deducting from this sum the amount paid for water, it leaves £2,706 0s. 8d. as the total earnings of the miners employed, being £100 4s. 5d. each per annum.

All the upper end of Try Again Terrace is now sluiced away; still, however, there is a large extent of what is deemed to be payable ground at the lower end, which will take some years to work out. On the terraces along No. 3 Creek several parties of miners have started to work the old blocks that were left as unpayable years ago, and, as far as I can ascertain, with very favourable results. Mr. Roche's hydraulic claim in No. 3 Creek has not been working very satisfactorily for some time past, owing to frequent breakages in the pipes and drainage-race. Up to the present this claim has not proved a success; there are, however, good grounds for expecting better returns in future, as the workings are now nearly up to that part of the creek where the ground is known to be payable.

During the past year the large arch bridge across Gow's Creek has been extensively repaired. This bridge was in a dangerous state, as it had subsided about 10in. in the centre. The arches had to be strengthened, the bridge brought back to its proper level, and a great deal of the superstructure renewed. The repairs to this bridge alone caused a loss of one month's sales of water. Several other bridges were also renewed in parts, but these renewals were effected without interfering with the working of the race. A good deal of the boxing on many of the bridges will require renewing during the next twelve months. The decayed timber in the tunnels is being constantly removed and new timber fixed in its stead.

There are several claims that have been opened during the past three months that are likely to be worked profitably for some time to come. There are also several others now being opened on trial-water which I hope soon to see contributing their share to the revenue of the race. Although the known payable ground that the race commands is now getting rather limited, I still feel confident that the estimated returns for the ensuing year will be fully maintained.

Herewith please find tables showing the revenue and expenditure on account of Nelson Creek Water-race, maintained by the Government, from the 1st April, 1889, to the 31st March, 1890; also revenue and expenditure for the first and last six months of the year, the number of men employed by the race, and the approximate amount of gold obtained by them.

I have, &c.,

The Under-Secretary, Mines Department, Wellington. J. McNaughton, Manager.

No. 19.

Mr. D. Doyle, Manager, Argyle Water-race, to the Under-Secretary of Mines.

Sir,— Charleston, 4th April, 1890.

I have the honour to forward my report for the twelve months ending 31st March, 1890, on the working of the Argyle Water-race, and mining generally in this locality.

Argyle Water-race.

The receipts from sales of water do not nearly reach the amount received last year, owing principally to the dry season and shortness of water in Government dam. I estimate the loss from this source at nearly £300 on the year's working. The expenditure on maintenance is in excess of last

year, owing to new timbering, which had to be done in both supply-races and main race. The main race had to be thoroughly renewed, and, being now in good repair, should last for many years with only a slight annual expenditure for planking and battens. During the dry weather, in addition to repairing and timbering races, the tunnels were overhauled. The rimu slabbing in them is showing decay, and will require to be renewed shortly, but the birch slabbing is still quite sound. The outside supply-races are in very good repair, all the bracing on the trestles carrying the flume are being renewed with black-birch. The north supply-race has been extended 13 chains, putting 40ft. of fluming across a gully, and there still remains about 25 chains to be done. The reservoir has been gradually lowering for the last four years, and in July last it ran down below level of channel, since when we have only had two full months' supply of water. There is a heavy drain out of the reservoir to Gregory and Horner, who have been getting over three heads per day, or a total amount worth £124.

GENERAL.

The ground about Candlelight Flat is fast getting worked out. The principal claims now working are two sluicing claims, one of which takes water from Government dam. There are three crushing-batteries, of four head stamps each, driven by a water-wheel, two of which take their water from Government.

On Argyle Terrace there has been no work done for the past five years, all available ground being worked out. Two gullies leading from the terrace are, however, working. In Argyle Gully Enright and party are making good wages working tailings, but have been greatly retarded for want of water, only being able to work forty-three days in the last six months. It will take some years to work their claim out. In Ballarat Creek Weir Bros. are working the head of the gully on the hydraulic-elevating principle, and have lately been improving their plant by extending their piping 1,000ft. towards Government race, thereby increasing their head by about 80ft. They have also suffered from want of water. On Sardine Terrace Dwyer and party have been doing a lot of heavy and unremunerative work during the last eighteen months, bringing a tail-race up to work a lead running through the back of their lease. This is now turning out well, and repaying them for their labour. There is a large quantity of cement in their claim, and they intend to erect a battery to crush it. The Dublin City Claim is in full working-order. Their wheel and battery of four head stamps work very well. The wheel is built to drive twelve heads altogether, with an increase of water-power. I consider this and Weir Bros.' the two best gold-yielding claims in the district. In Victoria Gully is another tailings claim which is paying its owner very handsome returns. There are several other claims working in the flat between Back Lead and township turning out very well—notably, Warren and party and Walsh and party. There is also one crushing-battery erected this year, and another in course of erection. This will make five crushing-plants in this locality, with every likelihood of others being erected shortly, as there is a large area of cement which will pay ordinary wages for years to come. The great drawback to the district is the want of water, and unless some additional supply is brought in I fear the growing population will not remain, as gold-mining is the only industry carried on here. There is a large area of country at the back of Charleston which has never been thoroughly prospected, owing to the want of tracks to pack provisions, &c. I have no doubt, when this country—which extends from the watershed of the Little Grey on one side to the Buller River watershed on the other—is opened up, there will be other minerals besides gold discovered. Coal is also known to exist in the locality.

I have, &c.,

The Under-Secretary, Mines Department, Wellington.

D. DOYLE, Manager.

No. 20.

The Chairman, Mount Ida Water-race Trust, to the Hon. the MINISTER of MINES.

SIR,— 31st December, 1889.

I have the honour, in compliance with section 25 of "The Mount Ida Water-race Trust Act, 1876," to forward the annual report and balance-sheet for the year ended 31st December, 1889.

The spring and summer months of the year 1889 will be long remembered by miners as the driest ever experienced since gold was first discovered in central Otago, and the yield of gold has in consequence decreased by about one-half that of ordinary years. This prolonged drought has reduced the revenue of the Trust by nearly £300 under last year's receipts, though that year (1888) was also exceptionally dry. The Trust has, to enable it to continue operations, retrenched its expenditure all it possibly could do, and put the maintenance-men upon half-pay for several months until water was available, and in several instances small reductions in wages have been made. The expenditure last year amounted to £1,687 15s. 6d. (which included about £400 of extraordinary expenses), while this year it is £598 12s. 10d. less. Notwithstanding the reductions referred to, the year closed with a deficiency of £74 3s. 11d. The severe frosts of last winter, succeeded by a dry spring and summer, so reduced the quantity of water brought in that the cash received from sales was insufficient to carry on with, and the Trust was compelled to appeal to the Government for a loan of £200, the half of which was granted on the condition of its being repaid in March, 1890. The continuous drought which has since prevailed has not placed the Trust in a position to meet the loan, or even to pay working-expenses, which are two months in arrear.

Notwithstanding all the causes which have operated against the financial non-success of the Trust in the past year, it is confident that with an ordinary season it will be able to redeem all its obligations. The demand for water still continues, large areas of payable sluicing-ground are waiting to be operated on, and all that is required to make the work a success is a steady and continuous supply of water.

The construction of the reservoir at the Eweburn to conserve the storm-water would place the Trust in a position to give a full supply of water to miners for eleven weeks at a time when the weather is most favourable for sluicing, and at the driest time of the year. As the construction of this reservoir was a part of the original scheme of water-supply to this field, the Trust would earnestly urge upon the Government its construction, which would largely increase the water-supply, employ an additional number of men, and greatly augment the revenue of the Trust.

I have, &c.,
WM. GUFFIE,
Chairman, Mount Ida Water-Race Trust.

The Hon. the Minister of Mines, Wellington.

BALANCE-SHEET of the MOUNT IDA WATER-RACE TRUST for the Year ended 31st December, 1889.

Receipts.	£	s.	d.	*Expenditure.*	£	s.	d.
To Balance at bank, 1st January, 1889 ..	0	3	0	By Maintenance, head-race	383	10	0
Amount received on account of water-sales	785	9	9	Extra labour on ditto	12	12	0
Gold from channel	129	6	0	Cleaning head-race and extension ..	75	1	0
Government loan	100	0	0	Maintenance, channel	140	0	0
Balance, unpaid cheques £126 2 5				Extension of head- and flushing-races..	15	11	0
Overbanked .. 0 0 5				Washing up channel	106	13	0
126 2 10				Timber, carpenters' and blacksmiths' work, tools, and sundry expenses ..	59	18	0
Balance at bank, 31st December, 1889 .. .. 51 18 11				Construction of culvert	6	15	0
	74	3	11	General management	245	17	6
				Printing and stationery	6	17	9
				Clerk's salary	15	0	0
				Office-rent	16	17	0
				Law-costs	3	3	0
				Petty cash	1	7	5
	£1,089	2	8		£1,089	2	8

Statement of Water-sales.

	£	s.	d.		£	s.	d.
To Amount owing for water, 31st Dec., 1888	1,330	12	10	By Cash received for water during 1889 ..	785	9	9
Water sold during 1889	801	1	0	Owing for water on 31st December, 1899..	1,346	4	1
	£2,131	13	10		£2,131	13	10

W. GUFFIE,
N. P. HJORRING,
JAMES MITCHELL,
} Members of the Mount Ida Water-race Trust.

APPENDIX I.

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, 1889.

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.	£
Coromandel ..	158 0 0	1 10 0	0 5 0	124 10 0	0 11 0	13 1 0	4 1 0	301 18 0
Te Aroha ..	38 0 0	12 0 0	0 10 0	1,338 12 9	9 9 0	15 4 0	70 12 3	1,484 8 0
Thames and Ohinemuri	283 5 0	258 0 0	63 15 0	1,299 6 10	15 19 0	26 4 0	809 6 6	2,755 16 4
Totals ..	479 5 0	271 10 0	64 10 0	2,762 9 7	25 19 0	54 9 0	883 19 9	4,542 2 4
NELSON.								
Collingwood ..	39 0 0	3 0 0	15 12 6	170 15 0	14 12 0	5 17 0	23 15 10	272 12 4
Westport ..	108 5 0	9 0 0	19 17 6	733 5 0	14 5 0	9 2 0	301 14 0	1,195 8 6
Charleston ..	75 10 0	..	16 5 6	83 6 0	13 9 0	4 4 0	6 9 6	199 4 0
Ahaura ..	227 11 0	14 10 0	31 15 0	295 0 0	45 6 0	32 16 0	53 17 0	700 15 0
Reefton ..	192 15 0	171 10 0	22 0 0	1,400 15 0	15 10 0	13 2 4	264 7 9	2,080 0 1
Wangapeka* ..	18 15 0	..	1 15 0	15 0 0	1 14 0	..	7 14 6	44 18 6
Lyell	49 15 0	3 0 0	5 17 6	225 10 0	2 12 0	0 5 0	10 2 6	297 2 0
Motueka ..	3 0 0	..	0 10 0	..	0 4 0	..	0 7 0	4 1 0
Murchison and Owen's	59 15 0	7 10 0	16 15 0	175 10 0	4 2 0	4 7 0	196 13 0	464 12 0
Totals ..	774 6 0	208 10 0	130 8 0	3,099 1 0	111 14 0	69 13 4	865 1 1	5,258 13 5
MARLBOROUGH.								
Havelock ..	128 5 0	5 10 0	11 0 0	432 10 2	18 18 0	36 0 0	342 3 0	974 6 2
WESTLAND.								
Hokitika and Kanieri	152 0 0	7 10 0	21 2 6	57 10 0	11 1 0	8 16 0	65 19 2	323 18 8
Greymouth ..	269 5 0	18 5 0	13 0 0	322 0 6	41 19 0	24 15 0	29 10 8	718 15 2
Ross	31 10 0	0 10 0	7 15 0	372 0 0	2 17 0	3 7 0	45 6 4	463 5 4
Stafford ..	61 5 0	4 10 0	13 12 6	215 5 0	5 13 0	4 8 0	78 16 6	383 10 0
Kumara ..	213 0 0	20 10 0	8 2 6	141 17 6	22 6 0	17 15 0	14 7 6	437 18 6
Jackson's Bay ..	3 5 0	..	..	..	..	..	2 0 0	5 5 0
Goldsborough ..	48 5 0	0 10 0	22 10 0	..	8 1 0	0 10 0	6 3 0	85 19 0
Okarito ..	22 5 0	8 0 0	5 0 0	394 4 0	1 4 0	..	18 5 0	448 0 0
Totals ..	800 15 0	59 15 0	91 2 6	1,502 17 0	93 1 0	59 11 0	260 8 2	2,867 9 8
OTAGO.								
Black's ..	71 0 0	2 5 0	13 15 0	184 15 0	7 2 0	6 5 6	42 2 3	327 4 9
Tapanui ..	8 5 0	..	0 17 6	..	0 9 0	..	0 1 6	9 12 6
Hindon ..	57 16 0	6 0 0	1 17 6	25 0 0	0 19 0	..	44 2 2	135 14 8
Naseby ..	260 15 0	169 10 0	58 12 6	1,433 12 6	34 13 0	27 12 0	5 9 0	1,990 4 0
Roxburgh ..	66 0 0	1 0 0	14 10 0	242 18 6	7 19 0	7 9 6	145 2 0	484 19 0
Alexandra .. / Clyde	84 15 0	15 15 0	15 17 6	79 12 6	6 14 0	6 2 6	48 19 0	256 15 6
Pembroke ..	34 0 0	3 0 0	1 15 0	1 15 0	0 18 0	0 18 0	0 2 0	42 8 0
Cromwell ..	148 0 0	16 15 0	24 2 6	273 16 6	24 3 0	9 13 0	82 1 0	578 11 0
Queenstown ..	125 16 0	13 15 0	21 10 0	718 12 11	17 16 0	20 11 0	240 18 6	1,158 19 5
Arrowtown ..	97 10 0	3 0 0	15 5 0	411 2 0	17 1 0	22 0 0	42 13 9	608 11 9
Lawrence ..	210 10 0	5 15 0	24 12 6	630 19 0	31 0 0	10 15 0	105 19 8	1,019 11 2
Waikaia ..	100 5 0	10 0 0	13 2 6	184 0 0	12 0 0	11 17 0	0 19 6	332 4 0
Orepuki, Longwood and Riverton	146 1 0	22 15 0	16 15 0	140 14 0	17 2 0	24 4 0	21 15 0	389 6 0
Maerewhenua ..	29 0 0	..	6 7 6	10 2 0	5 11 0	2 8 0	0 4 0	53 12 6
Wyndham ..	14 0 0	0 4 0	3 2 6	142 10 0	1 15 0	5 6 0	3 7 0	170 4 6
Totals ..	1,453 13 0	269 14 0	232 2 6	4,479 9 11	185 2 0	155 1 6	783 15 10	7,558 18 9
Grand Totals ..	3,636 4 0	814 19 0	529 3 0	12,276 7 8	434 14 0	374 14 10	3,135 7 10	21,201 10 4

* Last year's return.

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, 1890.

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 ..	49 0 0	..	..	95 10 0	2 6 0	0 10 0	..	147 6 0
Te Aroha ..	1 15 0	..	..	146 5 0	1 13 0	..	0 1 0	149 14 0
Thames and Ohinemuri	76 0 0	36 5 0	9 0 0	439 7 6	2 5 0	0 14 0	145 2 6	708 14 0
Puhipuhi ..	41 0 0	7 10 0	..	272 10 0	0 1 0	..	..	321 1 0
Totals ..	167 15 0	43 15 0	9 0 0	953 12 6	6 5 0	1 4 0	145 3 6	1,326 15 0
NELSON.								
Motueka ..	3 10 0	..	..	..	..	..	..	3 10 0
Collingwood ..	11 15 0	..	3 10 0	6 15 0	3 4 0	3 5 0	58 19 6	87 8 6
Westport ..	42 15 0	..	2 12 6	118 0 0	3 9 0	0 16 0	70 2 6	237 15 0
Charleston ..	18 16 0	..	5 5 0	31 2 0	3 0 0	0 10 0	1 19 0	60 12 0
Ahaura	57 10 0	5 10 0	11 2 6	45 0 0	12 17 0	4 2 0	63 1 0	199 2 6
Reefton	101 0 0	57 0 0	5 5 0	164 5 0	1 7 0	..	129 16 3	458 13 3
Wangapeka* ..	7 15 0	..	1 15 0	..	0 9 0	..	5 5 6	15 4 6
Lyell	12 0 0	..	1 5 0	60 5 0	0 13 0	..	0 9 0	74 12 0
Murchison and Owen's	43 10 0	..	3 2 6	49 10 0	1 6 0	..	1 0 6	98 9 0
Totals ..	298 11 0	62 10 0	33 17 6	474 17 0	26 5 0	8 13 0	330 13 3	1,235 6 9
MARLBOROUGH.								
Havelock ..	22 5 0	1 10 0	1 10 0	124 16 4	3 0 0	6 19 0	1 3 6	161 3 10
WESTLAND.								
Hokitika and Kanieri	40 5 0	6 0 0	4 15 0	..	3 16 0	1 19 0	2 3 6	58 18 6
Greymouth ..	62 15 0	0 15 0	8 10 0	16 14 0	7 5 0	4 1 0	16 8 6	116 8 6
Ross	13 0 0	..	1 2 6	94 10 0	0 19 0	0 8 0	2 15 6	113 5 0
Stafford	16 0 0	0 10 0	2 0 0	8 15 0	0 15 0	1 13 0	2 18 0	32 11 0
Okarito	5 15 0	3 0 0	1 5 0	38 7 0	0 10 0	..	1 1 0	49 18 0
Kumara ..	69 5 0	..	1 17 6	106 12 6	5 18 0	3 19 0	4 16 0	192 8 0
Goldsborough ..	16 0 0	0 5 0	3 5 0	..	1 4 0	0 16 0	0 18 0	22 8 0
Jackson's Bay ..	2 0 0	..	0 5 0	..	0 1 0	..	..	2 6 0
Totals ..	225 0 0	10 10 0	23 0 0	264 18 6	20 8 0	12 16 0	31 0 6	587 13 0
OTAGO.								
Black's	16 15 0	..	1 7 6	..	1 8 0	1 19 0	26 15 0	48 4 6
Tapanui ..	0 5 0	..	..	..	..	0 4 0	4 7 0	4 16 0
Hindon	18 0 0	0 5 0	1 0 0	..	0 15 0	0 16 0	6 9 0	27 5 0
Naseby	52 15 0	27 0 0	10 17 6	166 17 9	6 14 0	3 18 0	1 16 0	269 18 3
Alexandra } Clyde .. } ..	25 5 0	3 5 0	4 15 0	48 19 0	2 5 0	5 4 0	1 8 0	91 1 0
Roxburgh ..	16 10 0	..	3 2 6	137 6 6	1 17 0	2 12 0	0 10 0	161 18 0
Cromwell ..	47 0 0	..	5 12 6	79 10 3	5 17 0	1 5 0	1 5 6	140 10 3
Queenstown ..	19 15 0	3 5 0	3 10 0	179 8 9	3 12 0	0 12 0	9 16 0	219 18 9
Arrowtown ..	23 10 0	0 15 0	3 5 0	69 16 8	3 2 0	0 11 0	0 11 6	101 11 2
Lawrence ..	49 15 0	1 5 0	5 12 6	345 10 8	3 7 0	2 7 0	0 4 6	408 1 8
Waikaia ..	17 15 0	7 10 0	1 7 6	29 0 0	2 13 0	3 4 0	..	61 9 6
Orepuki, Longwood, and Riverton	26 10 0	4 10 0	2 17 6	29 12 0	2 4 0	0 15 0	0 3 0	66 11 6
Pembroke ..	5 15 0	..	..	..	0 5 0	..	..	6 0 0
Maerewhenua ..	5 15 0	..	0 17 6	7 10 0	1 13 0	3 10 0	0 12 0	19 17 6
Wyndham ..	3 0 0	..	0 15 0	68 10 0	1 0 0	0 2 0	3 0 0	76 7 0
Totals ..	328 5 0	47 15 0	45 0 0	1,162 1 7	36 12 0	26 19 0	56 17 6	1,703 10 1
Grand Totals ..	1,041 16 0	166 0 0	112 7 6	2,980 5 11	92 10 0	56 11 0	564 18 3	5,014 8 8

* Last year's returns.

T. H. HAMER,
Accountant.

No. 3.

COMPARATIVE RETURN of REVENUE derived from the GOLDFIELDS in the several DISTRICTS of NEW ZEALAND during the Years 1888 and 1889, 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 1888	763	54	104	5,991	44	41	448	3,065	10,510
Year 1889	479	272	65	2,762	26	54	884	2,852	7,394
Increase	..	218	..	..	..	13	436	..	..
Decrease	284	..	39	3,229	18	..	..	213	3,116
WELLINGTON—									
Year 1888	..	..	..	..	..	..	3	..	3
Year 1889	..	..	..	..	..	..	..	..	..
Increase	..	..	..	..	..	..	..	..	..
Decrease	..	..	..	..	..	..	3	..	3
NELSON—									
Year 1888	703	417	142	3,505	109	51	1,377	3,826	10,130
Year 1889	774	209	130	3,099	112	70	865	3,970	9,229
Increase	71	..	..	..	3	19	..	144	..
Decrease	..	208	12	406	..	..	512	..	901
MARLBOROUGH—									
Year 1888	278	18	6	68	10	13	25	100	518
Year 1889	128	6	11	433	19	36	342	519	1,494
Increase	..	..	5	365	9	23	317	419	976
Decrease	150	12	..	..	..	..	..	..	..
WESTLAND—									
Year 1888	853	47	144	1,297	85	53	440	6,805	9,724
Year 1889	801	60	91	1,503	93	60	260	6,911	9,779
Increase	..	13	..	206	8	7	..	106	55
Decrease	52	..	53	..	..	..	180	..	..
OTAGO—									
Year 1888	1,344	114	245	3,502	192	146	868	6,961	13,372
Year 1889	1,454	270	232	4,479	185	155	784	6,510	14,069
Increase	110	156	..	977	..	9	..	..	697
Decrease	..	..	13	..	7	..	84	451	..
Total Increase	..	167	..	..	..	71	..	5	..
Total Decrease	305	..	112	2,087	5	..	26	..	2,292

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 1887 and 1888, and the Quarters ending 31st March, 1889 and 1890 respectively, showing the INCREASE or DECREASE in respect of each District.

District.	Years 1888 and 1889.				Quarters ending 31st March, 1889, and 31st March, 1890.			
	1888.	1889.	Increase.	Decrease.	1889.	1890.	Increase.	Decrease.
AUCKLAND.	£	£	£	£	£	£	£	£
Coromandel	418	302	..	116	113	147	34	..
Te Aroha	2,186	1,484	..	702	374	150	..	224
Thames	4,839	2,756	..	2,083	960	709	..	251
Puhipuhi	..	..	..	..	..	321	321	..
NELSON.								
Motueka	5	4	..	1	2	3	1	..
Collingwood	246	273	27	..	60	87	27	..
Westport	1,432	1,195	..	237	170	238	68	..
Charleston	248	199	..	49	56	61	5	..
Ahaura	455	701	246	..	93	199	106	..
Reefton	3,006	2,080	..	926	385	459	74	..
Wangapeka	45	45	..	..	15	15	..	..
Lyell	262	297	35	..	69	75	6	..
Notown	..	..	..	..	..	..	..	..
Murchison and Owen's ..	605	465	..	140	305	98	..	207
MARLBOROUGH.								
Havelock	418	974	556	..	581	161	..	420
WESTLAND.								
Hokitika .. / Kanieri ..	242	324	82	..	85	59	..	26
Greymouth	856	719	..	137	117	116	..	1
Ross	713	463	..	250	222	113	..	109
Stafford	241	384	143	..	108	33	..	75
Okarito	254	448	194	..	71	50	..	21
Greenstone	..	..	..	..	52	..	..	52
Kumara	493	438	..	55	155	192	37	..
Jackson's Bay	20	5	..	15	4	2	..	2
Goldsborough	98	86	..	12	27	22	..	5
OTAGO.								
Hindon	296	136	..	160	15	27	12	..
Naseby and Black's ..	1,367	2,317	950	..	243	318	75	..
St. Bathan's	..	..	..	..	..	..	..	..
Alexandra	184	257	..	159	56	91	29	..
Clyde	232				6			
Roxburgh	312	485	173	..	177	162	..	15
Cromwell	463	579	116	..	121	141	20	..
Arrowtown	736	609	..	127	146	102	..	44
Queenstown	1,391	1,159	..	232	370	220	..	150
Pembroke	55	42	..	13	10	6	..	4
Lawrence	741	1,020	279	..	231	408	177	..
Waikaia	220	332	112	..	38	61	23	..
Tapanui	6	10	4	..	91	5	..	86
Orepuki and Longwood ..	342	389	47	..	100	67	..	33
Maerewhenua	67	54	..	13	5	20	15	..
Wyndham	..	170	170	..	..	76	76	..
WELLINGTON.								
Wellington	3	..	..	3	2	..	..	2
CANTERBURY.								
Christchurch	..	..	..	..	..	..	..	..
Totals	23,497	21,201	3,134	5,430	5,635	5,014	1,106	1,727
Net decrease ..	..	..	..	2,296	..	..	..	621

T. H. HAMER,
Accountant.

No. 5.

RETURN of GOLD DUTY credited to LOCAL BODIES for the Year ended 31st December, 1889, and Quarter ended 31st March, 1890.

Local Body.	For the Year ended 31st December, 1889.	For the Quarter ended 31st March, 1890.
COUNTIES—	£ s. d.	£ s. d.
Bruce	12 1 2	2 4 2
Buller	1,083 5 11	283 14 8
Clutha..	3 15 8	2 0 0
Collingwood	281 5 9	120 7 8
Coromandel	254 6 6	285 0 4
Fiord	1 16 0	4 16 0
Grey	3,058 2 5	636 10 0
Inangahua	2,561 15 9	483 0 9
Lake	1,199 1 10	375 19 4
Marlborough	519 2 2	373 19 6
Maniototo	922 4 4	284 17 10
Ohinemuri	269 6 8	28 7 0
Piako	37 16 5	25 11 0
Sounds	0 2 0	..
Southland	501 15 4	125 9 9
Stewart's Island	..	0 6 6
Taieri	22 17 8	18 11 2
Thames	966 8 11	178 17 3
Tuapeka	1,298 3 9	467 17 11
Vincent	1,589 1 8	579 7 3
Waihemo	87 1 2	37 7 6
Waikouaiti	86 14 6	49 2 11
Waimea	13 17 8	12 3 6
Waitaki	170 7 3	44 4 4
Wallace	574 13 2	177 19 3
Westland	2,918 3 4	819 0 10
BOROUGHS—		
Alexandra South	39 2 2	5 5 0
Brunnerton	6 0 0	0 11 5
Hokitika	87 3 8	1 5 4
Kumara	389 12 1	45 16 9
Naseby	0 19 3	..
Ross	451 19 5	61 12 6
Te Aroha	1 0 0	..
Thames	1,323 6 5	262 15 5
Totals	20,762 10 0	5,794 9 10

Treasury, 6th May, 1890.

JAS. B. HEYWOOD,
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, 1889.

PRODUCE OF THE GOLDFIELDS IN		DURING THE QUARTER ENDED 31ST DEC., 1889.		ENTERED FOR EXPORTATION TO THE 30TH SEPT., 1889.		TOTAL ENTERED FOR EXPORTATION FROM NEW ZEALAND TO THE 31ST DEC., 1889.	
County or Borough.	District.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
		Oz.	£	Oz.	£	Oz.	£
County of Coromandel	Auckland	1,573	6,292				
" Thames		1,971	7,885				
" Ohinemuri		1,581	6,315				
" Piako		207	748				
Borough of Thames		4,094	16,363				
		9,426	37,603	1,598,186	5,959,110	1,607,612	5,996,713
County of Hutt	Wellington	..	..	188	706	188	706
County of Marlborough	Marlborough	664	2,656	60,198	232,145	60,862	234,801
County of Collingwood	Nelson	533	2,132	1,650,660	6,548,257	1,651,193	6,550,389
County of Buller	West Coast	1,650	6,601				
" Inangahua		5,553	22,228				
" Grey		6,676	26,702				
" Westland		6,659	26,637				
Borough of Brunnerton		28	112				
" Kumara		469	1,878				
" Hokitika		13	53				
" Ross		813	3,249				
		21,861	87,460	3,562,719	14,150,978	3,584,580	14,238,438
	Canterbury	..	..	24	96	24	96
County of Taieri	Otago	69	278				
" Tuapeka		6,048	24,037				
" Vincent		5,712	22,684				
" Maniototo		2,659	10,700				
" Waihemo		438	1,758				
" Waikouaiti		673	2,692				
" Waitaki		951	3,804				
" Bruce		48	190				
" Lake		4,395	17,439				
" Wallace		2,000	7,980				
" Southland		1,917	7,666				
County unknown		33	132				
Borough of Alexandra		149	602				
		25,092	99,962	4,695,453	18,530,990	4,720,545	18,630,952
	Unknown	..	..	24	96	24	96
Totals		57,576	229,813	11,567,452	45,422,378	11,625,028	45,652,191

Department of Trade and Customs,
Wellington, 20th January, 1890.

H. S. McKELLAR,
Secretary and Inspector.

No. 7.

RETURN of the QUANTITY and VALUE of GOLD ENTERED for DUTY for EXPORTATION from NEW ZEALAND for the YEARS ended 31st DECEMBER, 1888 and 1889.

PRODUCE OF THE GOLDFIELDS IN THE DISTRICT OF	DURING THE QUARTER ENDED—				TOTALS FOR YEAR 1889.		TOTALS FOR YEAR 1888.	
	31st March, 1889.	30th June, 1889.	30th September, 1889.	31st December, 1889.	Quantity.	Value.	Quantity.	Value.
	Oz.	Oz.	Oz.	Oz.	Oz.	£	Oz.	£
Auckland	6,413	3,317	9,499	9,426	28,655	113,191	35,223	139,556
Marlborough	1,777	2,644	104	664	5,189	20,167	699	2,547
Nelson	985	350	1,384	533	3,252	12,310	3,027	11,320
West Coast	30,026	20,830	28,979	21,861	101,696	406,451	100,139	400,405
Otago	21,190	17,196	941	25,092	64,419	256,430	62,107	247,142
Unknown	..	..	..	..	..	..	24	96
Totals for 1889	60,391	44,337	40,907	57,576	203,211	808,549	..	..
Totals for 1888	52,708	49,552	53,891	45,068	..	..	201,219	801,066

Department of Trade and Customs,
Wellington, 20th January, 1890.

H. S. McKELLAR,
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, 1890.

PRODUCE OF THE GOLDFIELDS IN		DURING THE QUARTER ENDED 31ST MARCH, 1890.		ENTERED FOR EXPORTATION TO THE 31ST DEC., 1890.		TOTAL ENTERED FOR EXPORTATION FROM NEW ZEALAND TO THE 31ST MARCH, 1890.	
County or Borough.	District.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
		Oz.	£	Oz.	£	Oz.	£
County of Coromandel	Auckland	1,930	7,623				
" Thames		3,648	13,719				
" Ohinemuri		243	970				
" Piako		192	770				
Borough of Thames		3,693	14,451				
		9,706	37,553	1,607,612	5,996,713	1,617,318	6,034,246
County of Hutt	Wellington	..	..	188	706	188	706
County of Marlborough	Marlborough	3,740	14,953	60,862	234,801	64,602	249,754
County of Waimea	Nelson	122	453				
" Collingwood		1,204	4,510				
		1,326	4,963	1,651,193	6,550,389	1,652,519	6,555,352
County of Buller	West Coast	2,837	11,333				
" Inangahua		4,830	19,320				
" Grey		6,363	25,452				
" Westland		7,273	29,092				
Borough of Brunnerton		6	24				
" Kumara		458	1,832				
" Hokitika		13	52				
" Ross		616	2,464				
		22,396	89,569	3,584,580	14,238,438	3,606,976	14,328,007
	Canterbury	..	..	24	96	24	96
County of Taieri	Otago	186	744				
" Tuapeka		4,679	18,833				
" Vincent		5,794	23,276				
" Maniototo		2,848	11,488				
" Waihemo		373	1,492				
" Waikouaiti		491	1,964				
" Waitaki		445	1,780				
" Bruce		22	88				
" Lake		3,760	15,140				
" Wallace		1,780	7,120				
" Fiord		48	192				
" Clutha		20	80				
" Southland		1,255	5,020				
" Stewart Isld.		3	12				
County unknown		15	43				
Borough of Alexandra		53	212				
		21,772	87,484	4,720,545	18,630,952	4,742,317	18,718,436
	Unknown	..	..	24	96	24	96
Totals		58,940	234,502	11,625,028	45,652,191	11,683,968	45,886,693

Department of Trade and Customs,
Wellington, 18th April, 1890.

H. S. McKELLAR,
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, 1890, and 31st MARCH, 1889.

DISTRICT OF	QUARTER ENDED 31ST MARCH, 1890.		QUARTER ENDED 31ST MARCH, 1889.	
	Quantity.	Value.	Quantity.	Value.
	Oz.	£	Oz.	£
Auckland	9,706	37,533	6,413	25,398
Marlborough	3,740	14,953	1,777	6,838
Nelson	1,326	4,963	985	3,680
West Coast	22,396	89,569	30,026	120,065
Otago	21,772	87,484	21,190	83,896
Totals	58,940	234,502	60,391	239,877

Department of Trade and Customs,
Wellington, 18th April, 1890.

H. S. McKELLAR,
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, 1890.

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 10s. to £3 1s. 6d.	8s. to 14s.	..	..
	South Hauraki	£2 10s. to £3 10s.	5s. to 8s.	£3	40in.
	Ohinemuri	£2 10s. to £3 10s.	5s. to 8s.	£3	40in.
	Te Aroha	2 14 0	10s. to 12s.	..	..
MARLBORO—	Pelorus and Wairau ..	3 15 3	..	..	..
NELSON—	Wangapeka	£3 to £3 15s.	..	..	..
	Charleston	3 17 0	..	£2 15s.	40in. for 9 hours.
	Inangahua	£3 16s. to £3 18s. 9d.	8s. to 10s.	..	..
	Collingwood	3 13 0	..	..	..
	Westport	£3 12s. to £3 17s.	..	..	..
	Murchison	3 15 0	..	£3	..
	Lyell	3 15 0	12s.	..	..
WESTLAND—	Hokitika and Kanieri) Waimea .. ..) ..	3 16 0	..	£1 10s. to £3	40in.
	Totara and Ross	3 16 0	15s.	£1 10s.	40in.
	Stafford	3 16 6	..	£1 10s.	40in.
	Greymouth	3 16 6	..	£3	..
	Kumara	3 16 0	..	£2 10s.	Or £1 per day for 40in. sup.
	Ahaura	3 16 0	..	..	..
	Okarito	3 16 0	..	£1	..
	Jackson's Bay	3 16 0	..	..	..
OTAGO—	Hindon	3 15 0	10s.	..	..
	Tuapeka	3 15 0	..	£1 4s. to £1 10s.	For 8 hours.
	Dunstan	..	..	..	..
	Longwood	3 8 6	..	£1	40in.
	Orepuki and Roundhill ..	3 16 6	..	£1	40in.
	Arrow (Wakatipu Goldfield) and Queenstown	3 15 0	12s. 6d. to 15s.	..	..
	Mount Ida	3 15 0	£1	£1	16in. by 1in.
	Macrae's, Hyde	..	..	..	..
	Hamilton, Serpentine ..	..	..	..	..
	Maerewhenua	..	..	..	..
	Cromwell	3 15 0	..	£1 10s.	..
	Waikaia	£3 10s. to £3 15s.	..	10s.	For 60 hours.
	Tapanui	3 15 0	..	..	..
	Wyndham	3 15 0	..	..	..
	Roxburgh	3 15 0	..	..	..
	Clyde and Alexandra ..	3 15 0	15s.	..	..
	Black's	3 15 0	15s.	£2 to £4	Per 60 inches.

No. 11.

TABLE showing the NUMBER of GOLD-MINING COMPANIES REGISTERED under "The Mining Companies Limited Liability Act, 1865," and Amending Acts, the Joint-stock Companies Act, and "The Mining Companies Act, 1886," upon 31st March, 1899.

Mining District.	Under "Mining Companies Limited Liability Act, 1865," and Amending Acts.			Under Joint-stock Act.			Under "Mining Companies Act, 1872."		
	No.	Nominal Capital.	Paid-up Capital.	No.	Nominal Capital.	Paid-up Capital.	No.	Nominal Capital.	Paid-up Capital.
AUCKLAND—		£	£		£	£		£	£ s. d.
Te Aroha	2	220,000	177,456¼	..	..	..	2	95,000	31,493 8 0
MARLBOROUGH	..	..	..	..	..	..	2	10,500	1,300 10 0
NELSON—									
Westport	..	..	..	..	..	..	9	215,137	36,031 8 4
Lyell	2	48,000	20,900	..	..	..	5	126,000	81,758 6 8
Owen	..	..	..	3	47,000	766	1	6,000	1,085 0 0
Inangahua	..	..	..	2	15,000	4,191	61	1,019,750	310,681 1 6
	2	48,000	20,900	5	62,000	4,951	76	1,366,887	429,555 16 6
WESTLAND—									
Hokitika and Kanieri ..	..	..	..	1	150,000	137,620	..	..	..
Stafford	1	12,000	5,437	..	..	..	6	36,600	9,145 0 0
Ross	15	228,000	161,250	..	..	..	10	90,000	20,386 0 0
Kumara	1	16,000	7,433	..	..	..	1	7,000	2,300 0 0
	17	256,000	174,120	1	150,000	137,620	17	133,600	31,831 0 0
OTAGO—									
Cromwell	2	137,000	3,500	..	..	..	..	..	..
Dunstan	..	..	..	..	..	..	5	38,225	19,388 12 0
Lawrence	6	52,300	31,042	..	..	..	..	..	..
Mount Ida ..	..	..	..	..	..	..	13	177,000	48,288 0 0
Orepuki and Longwood	..	..	..	..	..	..	2	2,750	2,250 0 0
Totals ..	8	189,300	34,542	..	..	..	20	217,975	69,926 12 0

No. 12.

RETURN showing the AVERAGE PRICES of PROVISIONS and LIVE STOCK for the Year ending 31st March, 1890.

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	2/–3/	6/6	24/
South Hauraki	94/	25/–28/	1½	1/–1/2	/10	/7–/9	2/	11/	4/6	7	10/–15/	5–50	10/–15/	20/–60/	4	4	6	3	3	1	3½	2/–3/	6/–7/6	25/–30/
Te Aroha	90/	25/–30/	3–3½	/6–1/6	/9	/8	2/	11/6–14/	4/–5/	40/–150/	5/	2–20	8/–14/	10/–50/	1½–4	2½–4	4	3½–4	3–4	1½–2	3–5	1/3–3/	6/	10/–35/
MARLBOROUGH—																								
Queen Charlotte Sound																								
Pelorus ..	100/120	25/	8	1/	/9	/6	1/9	12/	2/–3/	1–6	5/–20/	1–30	5/–15/	5/–60/	2–4	3–6	3–6	6	3	2	3–4	2/6	6/	15/
Wairau ..																								
Baton	..	..	..	..	..	..	..	..	...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sherry and Tadmor ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
NELSON—																								
Wangapeka	..	..	..	/8	/8	/7	2/	15/–18/	..	3	..	10–15	5/–9/	8/–10/	4	3	5	..	5	2	5	2/6–3/	6/	..
Collingwood	100/	25/	2	1/	/7	/8	2/	15/	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	4	8	6	4	2	4	3/6	7/6	20/
Lyell	120/	26/	3	1/3	1/3	/9	1/6–2/	16/	7/6	5	5/	10–15	12/	30/	4	3½–4	6	6	3½	3	4¼	2/6–3/	6/–7/	18/
Murchison	135/	32/	2½	1/	1/	/8	2/	18/	8/6	90/	..	6–25	10/	20/–25/	4	4	5	..	3½	2	4½	2/6–3/	6/6–7/	15/
Westport	..	25/	8	1/3	1/2	/8	2/	12/	5/	6	..	5–50	14/	50/	6	6	6	6	4	2	5	2/6	7/	20/
Charleston	130/	26/	2	1/6	1/3	/8	1/9–2/	13/–15/	5/6	9	15/	20–30	16/	30/	6	6	8	6	5	1	5	2/6–3/6	5/6–8/	16/
Ahaura	150/	25/	2	1/3	1/	/9	1/6	12/6	5/	60/–150/	20/	7–25	3/–13/	15/–100/	4	4	8	6	4	2	4	2/–3/	6/	15/
WESTLAND—																								
Stafford	100/	24/	2	1/6	1/3	1/	1/3	14/	4/6	6	20/	10–40	15/	40/–120/	6	6	6½	6	4	2	6	3/	6/6	15/
Waimea ..	100/	25/	1½	1/6–2/	1/6	1/	2/	15/–20/	4/6	5–10	15/	10–20	15/–20/	20/–60/	6–8	6	8	6	4	1½	5	2/6	6/–7/	25/
Hokitika and Kanieri																								
Ross	110/	24/6	1½	1/	1/	/9	1/6	14/	6/	4–10	5/	10–20	12/	40/–50/	5	5	6	6	4	1½	4	2/	6/	20/–30/
Okarito	60/	39/	4	1/6	1/3	/10	2/	15/	7/	6	15/	12	20/	30/	5	5	8	8	6	6	6	2/6	6/	19/
Kumara	120/	23/6	2	1/6	1/	1/	1/8	20/	6/	8–12	20/	10–30	15/–18/	40/–100/	5	5	8	6	3	2	5	3/	6/–8/	22/
Greymouth	90/–110/	24/–36/	2	1/6–2/	1/8-1/9	1/–1/3	1/6–2/	12/–15/	6/–6/6	6–9	10/–20/	7–50	12/–20/	15/–100/	5–6	5–6	6–8	6	3–4	2	4–6	2/6–3/6	6/–7/	15/–35/
Jackson's Bay	..	30/	..	1/	1/	1/	1/6	15/–18/	5/	2–6	..	5–15	20/	20/–100/	3–4	6	6	6	4	2	4–6	2/–2/6	5/6–6/6	..
OTAGO—																								
Hindon	95/–150/	25/	1½	1/2	1/	/9	1/6	14/–20/	4/	3–6	..	8–30	10/	..	6	5	6	4	3	2	4–6	3/	6/6	..
Tuapeka	80/–160/	28/	1½	1/	/10	/8	1/6	12/	4/	6	..	8–20	2/–12/	5/–50/	6	5	5	3	3	1	3½	2/	5/6–7/	20/–30/
Tapanui	90/	24/	1½	/10	/9	/6	2/	9/	3/6	5–8	..	2–20	3/–8/	10/–60/	6	5	6	3	4	1	4	2/6	6/	18/
Cromwell	100/–120/	27/	2	1/3-1/6	1/–1/3	/10	1/9	11/	3/6–4/	3–10	..	5–40	4/–15/	..	5–6	4½–6	5–6	6	4½–5	2–3	4–5	2/–3/	6/	From 15/
Clyde ..	120/	26/–30/	2	1/6	1/3	/8	1/9	13/	5/	50/–130/	..	4–30	3/–12/	15/–80/	5	4	8	5	4	2	4½	2/6	7/	18/–30/
Alexandra ..																								
Roxburgh	120/	30/	2	1/3	1/	/8	1/9	12/	4/6	4–10	..	7–25	3/–12/	90/	4	4	8	6	4	2	4	2/6	7/	18/
Black's	120/	26/–30/	2	1/6	1/3	/8	1/9	13/	4/6	50/–130	..	5–30	3/–10/	15/–80/	5	4	8	6	4	2	4½	2/6	6/	18/
Queenstown	110/	28/	2	1/3	1/	/9	2/	12/	2/2	5–10	..	10–30	3/–10/	20/–100/	6	4	7	6	3	2	4–5	2/–3/	6/	16/–30/
Wyndham	80/	36/	3½	/10	/10	/6	2/	12/	3/6	4	..	8	7/	15/	4	3	6	4	3	1½	3½	2/6	5/6–7/	30/
Arrow (Wakatipu Goldfield)	120/	30/	2	1/3	1/	/9	2/	12/	2/2	5–10	..	5–15	3/–10/	20/–100/	6	4	7	6	3	2	4–5	2/–3/	6/	16/–30/
Mount Ida	90/–120/	27/	1¾–2	1/3	1/3	/10	2/	25/	3/3	..	15/	..	..	..	6	4	8	4	5	2	4	2/9	6/–7/	16/
Nenthorne	90/	24/	2	1/3	1/	/8	1/9	10/	3/6	3	..	15	9/	..	5	4	6	4	4	..	4½	2/6	6/	16/
Waikaia	140/	25/–29/	2	1/1	/10	/9	2/	13/6	3/	3–6	..	6–20	4/–10/	15/–25/	5	4	7	4	5	2	5	3/6	6/	20/–28/
Orepuki and Longwood ..	100/	25/	1½	/7	/6	/6	2/	14/	3/6	4–6	20/	5–20	5/–10/	30/–50/	6	4	6	3	5	1	3½	1/8–3/	6/	20/

No. 13.

TABLE showing the AVERAGE RATE of WAGES per WEEK for the Year ending 31st March, 1890.

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	£4 to £8	£3 to £5	£2 8/ to £3	2 8 0	£2 10/ to £3	£2 8/ to £3	2 8 0	2 2 0	..	..	2 2 0	10/ to 15/
South Hauraki	£4 to £6	1 0 0	£4 to £6	£3 to £3 12	3 0 0	2 8 0	3 0 0	2 14 0	£2 2/ to £2 8/	1 16 0	10/ to 30/	..	£1 5/ to £1 10/	7/ to 12/
MARLBOROUGH—														
Wairau ..	..	1 0 0	3 15 0	3 6 0	2 14 0	2 8 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 2/ to £2 8/	2 2 0	..	..	£1 to £1 10	8/ to 15/
Inangahua	7 0 0	£1 to £3	£5 10/ 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 0 0	20/
Charleston	..	..	4 10 0	..	..	..	3 0 0	3 0 0	3 0 0	3 0 0	1 0 0	..	1 0 0	10/
Westport	..	1 0 0	5 0 0	5 0 0	3 0 0	2 14 0	3 0 0	3 0 0	3 0 0	3 0 0	5/ to 20/	15/ to 20/	15/ to 20/	5/ to 15/
Lyell	..	10/ to £2 10/	6 0 0	6 0 0	..	..	4 15 0	4 4 0	3 3 0	3 0 0	2 10 0	..	1 5 0	15/
Ahaura	..	..	4 0 0	..	..	..	3 12 0	3 12 0	3 0 0	£1 5/ to £3	..	..	£1 5/ to £1 10/	8/ to £1
Murchison	..	3 0 0	£5 to £6	..	..	..	3 0 0	3 12 0	3 0 0	2 8 0	0 15 0	1 15 0	1 5 0	8/ to 12/
WESTLAND—														
Waimea and Stafford ..	..	3 10 0	3 10 0	..	..	..	3 10 0	3 10 0	3 0 0	3 0 0	2 0 0	2 10 0	2 10 0	20/
Hokitika and Kanieri ..	£4 to £6	1 0 0	£4 to £5	5 0 0	4 0 0	3 0 0	4 0 0	4 0 0	3 0 0	3 0 0	1 10 0	1 10 0	1 10 0	10/ to £1
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	4 10 0	2 0 0	4 10 0	..	4 0 0	..	4 0 0	4 0 0	3 0 0	3 0 0	1 5 0	1 5 0	£1 10/ to £2	10/ to £1
Greymouth	..	1 0 0	£4 to £6	£4 to £5	£3 to £3 10/	50/ to 70/	£3 to £3 10/	10/ to 14/	3 0 0	£2 2/ to £3	10/ to 15/	£1 to £1 10/	£1 10/ to £2	7/ to 15/
Okarito and 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	2 10 0	15/ to 20/	..	1 5 0	15/
OTAGO—														
Hindon	4 0 0	..	3 0 0	6 0 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 0 0	3 0 0	2 8 0	2 2 0	10/ to 15/	15/ to £1	1 0 0	8/ to 10/
Cromwell	5 0 0	1 0 0	5 0 0	3 10 0	3 0 0	£2 10/ to £3	3 10 0	3 12 0	£2 8/ to £3	£2 8/ to £2 14/	10/ to £1	£1 5/ to £2	£1 to £1 5/	10/ to £1
Clyde	4 0 0	0 10 6	4 0 0	3 10 0	3 0 0	2 10 0	3 10 0	3 10 0	2 14 0	2 2 0	0 10 0	1 10 0	£1 to £1 5/	7/ to 15/
Alexandra ..														
Roxburgh	5 0 0	1 1 0	4 10 0	3 0 0	2 8 0	2 0 0	3 10 0	3 10 0	2 14 0	2 2 0	0 10 0	1 10 0	£1 to £1 10/	10/ to 15/
Black's	5 0 0	1 0 0	4 0 0	3 10 0	3 0 0	2 2 0	3 10 0	3 10 0	2 14 0	2 2 0	10/ to £1	1 10 0	£1 to £1 5/	8/ to 15/
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 ..	..	£40 p. ann.	3 0 0	..	2 10 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 10 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/
Nenthorne	..	1 10 0	4 0 0	..	3 12 0	..	3 12 0	3 12 0	3 12 0	3 0 0	0 15 0	..	1 0 0	12/
Wyndham	3 0 0	1 10 0	..	2 0 0	3 0 0	..	2 10 0	2 15 0	2 14 0	2 5 0	10/6 to 15/	..	1 16 0	7/6 to 10/

* Perannum.

No. 14.

NUMBER of MACHINES employed in ALLUVIAL and QUARTZ-MINING, and the VALUE thereof, for the Year ending 31st March, 1890.

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, pumping, &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 ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	7	190	6	55	3	..	..	..	..	20,000
South Hauraki ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	30	803	21	443	19	..	18	47	343	67,500
Te Aroha ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	220	2	60	10	..	..	..	40	52,000
Totals ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	37	1,213	29	558	32	..	18	47	383	139,500
MARLBOROUGH—																								
Wairau ..)	2	16	..	..	..	80	1	..	13	..	..	..	..	..	..	..	..	..	..	..	..	..	..	900
Pelorus ..)																								
NELSON—																								
Sherry and Tadmor	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Baton	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Wangapeka ..	..	..	..	..	..	105	2	2	12	..	..	..	..	..	..	..	1	4	1	..	..	..	..	250
Collingwood ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	25	3	..	1	..	..	..	..	3,800
Inangahua ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	18	363	19	315	16	2	3	..	64	139,730
Charleston ..	..	..	..	..	..	80	4	70	..	..	50	..	26	..	..	..	..	..	..	..	..	..	..	3,000
Lyell	..	..	..	..	..	30	..	30	..	..	..	..	..	..	..	..	6	63	2	..	..	..	..	16,000
Murchison ..	..	..	..	..	..	80	..	22	..	1	..	..	..	..	..	..	2	20	..	..	..	..	..	10,500
Westport	..	..	..	7	..	61	6	35	..	1	..	..	..	..	..	..	3	25	3	..	..	..	..	12,000
Ahaura	1	15	..	..	..	1,460	4	500	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9,500
Totals ..	1	15	..	7	..	1,816	16	659	12	2	50	..	26	..	20	388	34	427	23	2	3	..	64	194,780
WESTLAND—																								
Stafford	..	..	..	1	3	3,000	3	400	3	..	6	..	..	..	1	65	1	..	..	..	..	..	..	13,000
Ross	..	..	..	..	..	60	..	40	..	..	2	..	..	..	..	..	2	15	2	..	..	..	..	16,000
Hokitika and Kanieri	1	6	..	..	39	280	..	135	..	1	15	..	..	..	..	..	..	..	..	..	..	..	..	5,000
Greymouth ..	7	93	..	..	..	2,700	2	900	50	2	30	..	..	10	..	..	..	..	..	..	..	..	..	15,500
Kumara	..	..	..	7	20	160	4	95	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3,000
Okarito	2	45	..	..	..	70	2	1	12	2	20	..	..	2	..	..	..	..	..	..	..	..	..	7,500
Totals ..	10	144	..	8	62	6,270	11	1,571	65	5	73	..	..	12	1	65	3	15	2	..	..	..	..	60,000
OTAGO—																								
Tapanui	..	..	..	..	..	20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	20
Hindon	..	..	..	..	..	20	..	2	..	..	..	..	..	..	2	60	4	20	2	..	..	..	..	8,000
Tuapeka ..	..	..	..	..	..	500	15	11	30	2	..	..	75	..	..	..	2	10	1	..	..	..	..	10,000
Cromwell ..	..	..	..	..	..	300	..	140	2	1	..	..	..	..	2	24	6	30	4	1	..	..	..	30,000
Black's	1	12	1	2	2	600	5	5,970	7	..	..	1	..	..	..	..	2	14	..	..	..	..	..	45,000
Clyde, Alexandra	..	..	..	2	1	300	5	3,000	3	2	..	2	..	..	..	..	3	18	1	..	..	..	..	15,600
Roxburgh ..	..	..	..	..	1	550	3	3,000	7	8	..	1	..	..	..	..	..	..	..	..	..	..	..	36,150
Orepuki and Longwood	2	30	..	..	..	550	1	160	..	..	..	..	..	..	..	..	1	2	1	..	..	..	..	2,500
Waikaia (Switzer's)	1	5	..	..	..	506	6	54	5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4,000
Arrow	..	..	..	..	..	300	..	60	..	..	..	..	..	..	1	4	4	37	3	..	..	..	..	14,500
Queenstown ..	..	..	..	..	..	400	..	50	..	1	..	..	..	..	1	8	7	100	..	..	..	..	..	30,000
Naseby	..	..	..	..	..	200	..	85	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,750
Kyeburn and Clarke's	..	..	..	..	..	70	..	20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	500
Hamilton's and Sowburn	..	..	..	..	..	70	..	25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	450
Hyde and Fullerton's	..	..	..	..	..	15	..	10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	200
Macrae's, Strath-Taieri, and Shag Valley	..	..	..	..	..	50	..	15	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	150
Maerewhenua ..	..	..	..	..	..	65	..	30	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	690
Serpentine ..	..	..	..	..	..	20	..	5	..	..	..	..	..	..	..	..	1	5	1	..	..	..	..	600
St. Bathan's, Ida Valley, and other localities	..	..	..	..	..	60	..	40	..	..	..	..	..	..	..	..	1	10	..	..	..	..	..	2,500
Nenthorne ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	70	..	20	1	2	1	..	..	11,000
Totals ..	4	47	1	4	4	4,596	35	12,677	54	14	..	4	75	..	11	166	31	266	14	3	1	..	..	213,610

SUMMARY.

Auckland	..	..	..	..	..	..	..	..	..	..	..	..	..	..	37	1,213	29	558	32	..	18	47	383	139,500
Marlborough ..	2	16	..	..	..	80	1	..	13	..	..	..	..	..	..	..	..	..	..	..	..	..	..	900
Nelson	1	15	..	7	..	1,816	16	659	12	2	50	..	26	..	20	388	34	427	23	2	3	..	64	194,780
Westland	10	144	..	8	62	6,270	11	1,571	65	5	73	..	..	12	1	65	3	15	2	..	..	..	..	60,000
Otago	4	47	1	4	4	4,596	35	12,677	54	14	..	4	75	..	11	166	31	266	14	3	1	..	..	213,610
Totals ..	17	222	1	19	66	12,762	63	14,907	144	21	123	4	101	12	69	1,832	97	1,266	71	5	22	47	447	608,790

No. 15.

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, 1890.

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 ..	9	3½	22	1,450	..	..	1	50	..	..	..	..	1,500
Hauraki South ..	21	23	125	80,000	1	10	5	450	1	600	..	..	81,060
Te Aroha ..	6	5¾	21	8,200	..	..	..	..	..	..	..	..	8,200
Totals ..	36	32¼	168	89,650	1	10	6	500	1	600	..	..	90,760
MARLBOROUGH—													
Pelorus	74	70	134	14,000	55	2,500	21	500	15	350	..	..	17,350
NELSON—													
Wangapeka ..	37	75½	193	58,537	16	160	8	..	..	..	..	..	58,697
Collingwood ..	81	75	200	8,000	40	500	50	1,500	..	..	..	..	10,000
Inangahua ..	180	141	1,439	40,198	368	23,333	430	15,254	..	..	..	..	78,785
Charleston ..	200	100	200	20,000	220	8,500	450	11,000	1	3,000	80	3,000	45,500
Westport ..	145	226	1,078	16,500	86	8,600	155	5,200	..	..	..	..	30,300
Lyell	35	25¾	156	5,694	10	353	22	1,246	..	..	..	..	7,293
Murchison ..	95	96½	387	7,720	31	1,048	33	1,024	..	..	..	..	9,792
Ahaura	560	582½	1,909	98,342	593	66,760	557	16,907	..	..	..	..	182,009
Totals ..	1,333	1,322½	5,562	254,991	1,364	109,254	1,705	52,131	1	3,000	80	3,000	422,376
WESTLAND—													
Hokitika & Kanieri	259	141	260	16,000	203	1,560	154	1,300	..	..	48	420	19,280
Ross	120	90	200	20,000	150	1,200	50	1,000	20	1,300	50	600	24,100
Kumara ..	196	110	400	25,000	187	15,500	60	4,500	11	7,000	50	800	52,800
Greymouth ..	980	800	1,191	49,000	684	8,500	670	7,200	..	..	40	900	65,600
Jackson's Bay ..	6	6½	16	800	2	300	..	..	..	..	..	..	1,100
Okarito	40	40½	249	2,261	21	120	12	240	..	..	..	..	2,621
Stafford.. ..	750	400	1,000	20,000	600	12,000	600	9,000	50	2,500	600	2,000	45,500
Totals ..	2,351	1,588	3,316	133,061	1,847	39,180	1,546	23,240	81	10,800	783	4,720	211,001
OTAGO—													
Hindon	36	44	71	4,222	15	657	34	950	..	..	50	200	6,029
Tuapeka ..	248	706	1,290	14,120	339	5,090	242	4,840	..	..	..	..	24,050
Tapanui ..	4	21	6	600	1	20	1	20	..	..	..	..	640
Clyde & Alexandra	126	473	453	33,110	85	11,500	55	3,500	..	..	..	..	48,110
Black's	109	486	463	43,704	90	1,750	63	9,500	*	..	†	..	54,954
Arrow	100	200	250	15,000	200	5,000	30	1,500	30	*	20	200	21,700
Roxburgh ..	117	284	730	28,400	90	9,070	55	3,650	1	800	..	..	41,920
Cromwell ..	253	789	926	78,900	272	7,460	92	1,636	..	..	..	..	87,996
Waikaia ..	143	358	531	15,285	280	3,335	154	3,659	..	..	38	275	12,554
Orepuki and Longwood	240	270	545	16,000	115	5,500	120	1,500	..	..	130	2,400	25,400
Wyndham ..	15	9½	60	2,000	9	650	14	1,016	..	..	..	..	3,666
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	31	106	80	5,500	..	..	..	..	..	..	..	..	5,500
Hyde & Fullerton's	18	90	64	10,150	..	..	..	..	..	..	..	..	10,150
Macrae's, Strath-Taieri, and Shag Valley	30	48	55	4,100	..	..	..	..	..	..	..	..	4,100
Nenthorne ..	1	1½	..	50	..	..	..	..	..	..	..	..	50
Serpentine ..	36	88	93	5,000	..	..	..	..	..	..	..	..	5,000
Maerewhenua ..	21	175	49	15,500	21	986	26	1,875	..	..	..	..	18,361
St. Bathan's and Ida Valley	96	320	350	32,400	..	..	..	..	..	..	..	..	32,400
Totals ..	1,894	5,259	7,139	445,341	1,668	56,018	926	35,346	42	1,350	238	3,075	541,130

SUMMARY.

Auckland	36	32¼	168	89,650	1	10	6	500	1	600	..	..	90,760
Marlborough ..	74	70	134	14,000	55	2,500	21	500	15	350	..	..	17,350
Nelson	1,333	1,322½	5,562	254,991	1,364	109,254	1,705	52,131	1	3,000	80	3,000	422,376
Westland	2,351	1,588	3,316	133,061	1,847	39,180	1,546	23,240	81	10,800	783	4,720	211,001
Otago	1,894	5,259	7,139	445,341	1,668	56,018	926	35,346	42	1,350	238	3,075	541,130
Totals ..	5,688	8,271½	16,319	937,043	4,935	206,962	4,204	111,717	140	16,100	1,101	10,795	1,282,617

* Included in dams. † Included in tail-races.

No. 16.

RETURN showing the REVENUE and EXPENDITURE on account of CONSTRUCTED WATER-RACES maintained by the Government, from 1st April to 30th September, 1889, and from 1st October, 1889, to 31st March, 1890.

Name of Race.	1st April to 30th September, 1889.			1st October, 1889, to 31st March, 1890.			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 ..	267 11 8	267 11 8	450 19 0	262 6 8	262 6 8	466 11 4	..
Waimea-Kumara ..	2,790 14 8	3,126 14 4	959 2 10	3,492 2 5	1,913 4 6	1,260 18 0	141 10 8
Kumara Sludge-chan'l	340 13 10	174 11 5	1,716 6 11	346 8 10	..	1,497 9 0	..
Argyle, Charleston ..	177 19 5	177 19 5	221 11 1	148 11 5	148 11 5	201 17 0	..
Mikonui	25 0 0	..	..	25 0 0	..	..	..
Totals ..	3,601 19 7	3,746 16 10	3,347 19 10	4,274 9 4	2,324 2 7	3,426 15 4	141 10 8

No. 17.

RETURN of CASES in the WARDENS' COURTS, and COSTS AWARDED, for the Year ending 31st March, 1890.

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	25	..	..	18 18 0	
South Hauraki	125	941 16 1	471 15 1	123 6 0	
Te Aroha	4	53 17 6	53 17 6	3 14 0	
MARLBOROUGH	24	141 2 6	38 0 0	42 12 0	22
NELSON—					
Collingwood	2	197 4 0	193 9 0	4 0 0	
Inangahua	13	322 10 0	302 10 0	11 4 6	
Lyell	3	40 10 0	32 10 0	4 16 0	
Westport	8	10 0 0	..	11 14 0	
Charleston	6	50 0 0	25 0 0	1 16 0	
Ahaura	18	133 17 1	127 10 0	41 4 0	
Murchison	1	..	..	..	
WESTLAND—					
Kumara	16	65 0 0	..	19 7 0	
Greymouth	15	172 9 2	80 11 2	95 11 0	
Hokitika and Kanieri ..	13	40 0 0	8 8 0	18 10 0	
Waimea					
Stafford	26	91 0 0	..	8 14 0	
Jackson's Bay	..	..	..	..	
Ross	7	11 0 0	..	7 18 0	2
OTAGO—					
Tapanui	..	..	..	..	
Hindon	..	..	..	..	
Tuapeka	9	25 0 0	2 0 0	12 5 0	
Cromwell	9	110 0 0	1 0 0	6 17 0	1
Roxburgh	10	57 0 0	..	11 2 0	
Black's	15	..	..	8 15 0	
Clyde and Alexandra	14	26 10 0	0 10 0	9 19 6	
Waikaia	11	205 10 0	..	35 14 0	
Orepuki and Longwood	31	63 13 4	13 0 0	30 7 4	6
Arrow (Wakatipu Goldfield) ..	..	..	..	..	
Queenstown	..	..	..	..	
Mount Ida	19	549 11 8	150 7 8	36 14 0	9
Maerewhenua	..	..	..	..	
Wyndham	2	..	..	5 0 0	
Totals	426	3,307 11 4	1,500 8 5	569 18 4	40

Mines Department, 1st June, 1890.

H. J. H. ELIOTT,
Under-Secretary of Mines.

No. 18.

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.	Rental per Annum	Mining District.	No.	Gross Acreage.	Rental per Annum.
		A. R. P.	£ s. d.			A. R. P.	£ s. d.
AUCKLAND—				AUCKLAND—			
Hauraki North ..	..	..	..	Hauraki, Ohinemuri	68	3,510 1 2	263 5 0
Hauraki South ..	..	..	..				
Te Aroha ..	27	749 0 34	377 1 9				
MARLBOROUGH—							
Wairau and Pelorus	37	1,711 1 23	476 2 9				
NELSON—				NELSON—			
Collingwood ..	14	175 0 38	124 15 0	Collingwood ..	..	..	..
Inangahua ..	62	885 3 26	925 0 0	Inangahua ..	3	114 1 0	11 12 0
Charleston ..	10	63 0 0	72 0 0	Charleston ..	6	61 0 19	5 10 0
Ahaura	14	602 0 0	312 10 0	Westport ..	8	84 0 4	82 0 0
Westport.. ..	10	749 1 29	77 6 6	Lyell	4	75 1 24	7 12 0
Lyell	6	76 2 1	79 0 0	Murchison ..	8	666 3 31	67 19 0
Murchison ..	1	15 2 6	16 0 0	Ahaura	3	234 1 10	23 12 0
Owen's	..	..	..	Hokitika & Kanieri	2	90 0 0	4 10 0
WESTLAND—							
Jackson's Bay ..	..	..	..				
Okarito	21	1,190 0 0	297 10 0				
Hokitika and Kanieri	2	25 0 0	15 0 0				
Kumara	19	616 0 0	240 10 0				
Stafford and Goldsborough	18	693 0 0	239 0 0	WESTLAND—			
Greymouth ..	30	1,203 1 36	288 5 0	Greymouth ..	9	383 1 29	38 12 6
Ross	48	2,000 0 0	650 0 0	Kumara	3	158 2 13	19 17 6
				Ross	1	12 0 0	1 10 0
OTAGO—							
Waikaia	15	433 0 39	218 0 0				
Cromwell ..	..	..	..				
Hindon	14	323 0 0	173 0 0				
Tuapeka	51	1,796 2 9	873 17 6				
Black's	14	414 2 1	213 10 0	OTAGO—			
Clyde, Alexandra, and Roxburgh	35	1,220 3 33	435 15 0	Cromwell ..	20	2,681 0 11	333 4 6
				Black's	3	94 1 18	12 2 6
Naseby, St. Bathans, and Nenthorne	136	3,021 0 15	1,581 0 0	Clyde, Alexandra, and Roxburgh	9	1,871 2 19	233 17 6
Arrow (Wakatipu Goldfield)	..	..	..	Mount Ida District	..	..	..
				Arrow (Wakatipu Goldfield)	14	798 3 35	100 5 0
Queenstown ..	..	..	..	Queenstown ..	21	337 3 39	43 10 0
Maerewhenua ..	13	241 2 16	29 12 0	Naseby	16	2,116 0 23	260 8 6
Tapanui	..	..	..				
Totals ..	597	18,206 2 26	7,714 15 6	Totals ..	198	13,290 1 37	1,509 8 0

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, 31st March, 1890.

I have the honour, in compliance with section 59 of "The Coal-mines Act, 1886," to forward my annual report, for the information of the Hon. the Minister of Mines, on the coal-mines in the North Island—namely, Kawakawa, Kamo, Whauwhau, Waikato, Taupiri Extended, Taupiri Reserve, and Miranda.

Kawakawa District.

Kawakawa Mine.—The whole of the workings in this mine are confined to taking out the pillars. The boundary of the whole of the workable coal has been reached, and nothing but a portion of the pillars now remains to be taken out. The company have been making some arrangements with the Natives to work a block of land near Waiomio, but there is still some matter in dispute which is not settled. The whole of the coal in the pillars is being won, and the roof kept up by crib-work. Every care is taken to timber the ground securely, and the ventilation, although a little sluggish in some of the faces, is in the main very good.

Owing to heavy rains, and the broken character of the strata between the surface and the coal, the mine was flooded out from the 1st August to the 24th September. The pumps, which are two 12in. lifts and an 8in. Tangye, were not able to contend with the large influx of water.

On the 13th of July a young man, James Rouse, got his leg broken through riding on the top of a water-skip, which is used in wet weather to haul water up the main incline, so as to assist the pumps to keep it down. Strict orders were issued by the manager that no one was to ride on these skips; but these orders were disobeyed, and the man got thrown off the skip and broke his leg. On the 25th August another youth, Sidney Hansen, met with a slight accident through a similar cause, and was dismissed from the works. The water was heavy at the time of my visit in October last, and kept two 12in. pumps, with 6ft. stroke, working ten strokes per minute, and also the 8in. Tangye, constantly going to keep it down.

The most of the pillars in the lower workings are taken out, and in about twelve months the mine will be worked out. A daily-record book is kept, and the provisions of the Act fairly complied with. There were seventy-three men employed below ground, and seventeen men on the surface, and the output of coal for last year was 27,000 tons.

Whangarei District.

2. *Kamo Mine.*—The ventilation in this mine is very defective, but the company are engaged in the construction of a new air-shaft, which was down to the depth of 170ft. on my last visit of inspection. The shaft is 9ft. by 6ft. in the clear, and close-timbered. On sinking this shaft a small seam of asbestos was found; but the asbestos is not of good quality—it would be very suitable for a covering for steam-pipes and steam-boilers. The shaft will have to go down to a depth of about 220ft. before it cuts the coal.

The coal in the upper workings is very soft and friable, and requires no explosive to be used in bringing it down; but the coal from the bottom workings is much harder, and also freer from sulphur. It should make fair steaming-coal if firebars were made specially for its consumption. There is plenty of room for improvement in the underground workings to reduce the cost of landing the coal on the surface. At present the main roads are tortuous, and each man brings the skip from his face to the shaft. Everything is done by manual labour and in a roundabout form. On both the upper and lower seams the workings are to the rise, and the dip or inclination the seams are lying at is very favourable for a good system of underground haulage.

A daily-record book is kept, and the plan of the workings kept posted up. There were thirty-three men below ground and seven men on the surface, exclusive of six men that were employed in sinking the new air-shaft; and the output of coal from the mine for the year was 12,014 tons.

3. *Whauwhau Mine.*—This mine is about worked out. There are only a few small blocks of coal that can be got at. There had been ten men employed previous to my visit, but they were to be reduced to six. The ventilation was very defective at the place where the workings were carried on, but one of the bords was expected to break through into an old level in the course of the next day, which would give plenty of air. The coal here is only about 2ft. thick. Indeed, it may be said that all the coal that can be won remuneratively is taken out. No daily-record book was kept, nor was there any plan of the workings; but in other respects the provisions of the Act were fairly complied with.

Mr. J. Love, the former manager and part proprietor, met with an accident on the 27th of January, 1889, by getting his arm jammed in the winding-barrel of the drum, and it had to be amputated. His arm seemed to be getting on well, but he was supposed to have been injured internally, and died six weeks after the accident. There is no blame due to any one. He acted in a careless manner when he met with the accident. It seems that the winding-barrel that hauled

the coal from the dip was not set at right-angles to the line of haulage, and Mr. Love was using a hammer-handle to keep the rope in its place on the barrel, and the rope caught his arm in such a manner that it brought up the engine and stopped the winding, and, as there was no one alongside, he was held for a considerable time in this position before it was known that anything was the matter.

The output of coal from this mine during last year was 3,300 tons.

WAIKATO DISTRICT.

4. *Waikato Mine.*—There was no work being carried on in this mine at the time of my visit. It seems that the men only work as orders are received for coal, which has to be freshly hewn when wanted, as it will not stand exposure to the atmosphere without crumbling to pieces. The plan of the underground workings was made up to date, and showed some of the pillars to be only 8ft. thick. On remonstrating with the manager, Mr. John H. Garrett, about leaving the pillars so small, he stated that the bords were started on different lines than those he gave. There were only two pillars of this thickness; the rest of the pillars were of a good width. There is fairly good ventilation in the mine, although there is not yet a defined connection, so that the whole of the air passes into a return air-way and is carried to the upcast shaft. The workings were only commenced about eighteen months ago, so that they are not extensive yet, and are all confined to bords and main headings. The average number of men employed when at work is twenty men below ground and eight men on the surface. The manager's record-book was only written up once a week, but the deputy kept a daily-record book at the mine. The output of coal for the last year was 8,733 tons and 145 tons of slack.

5. *Taupiri Extended Mine.*—The whole of the workings in this mine since my previous visit have been confined to taking out pillars. Some of the workings were not carried on with safety, and I had to give written notice to the manager that the men must be withdrawn from one portion of the mine, as they were working in a very dangerous place. On my next visit I learned that the men had only left this place a few hours before the ground came in from the surface. On my second visit I had to complain of a similar place, which the manager promised to have secured with timber at once. This company has since given up the old workings.

A new shaft has been sunk to a depth of 180ft. on the property lately purchased by the company. The upper portion of the shaft, which was sunk through quicksand, is lined with cast-iron cylinders 10ft. in diameter; but in sinking these cylinders through the sand they went about 9in. out of plumb, and some of the segments got cracked in forcing down, so that rings had to be put on the inside, which have reduced the internal diameter to 9ft. 6in. Below the cast-iron cylinder the shaft is lined with bricks—14in. lining. On my last visit the buntings were being put in their places. They are spaced 7ft. apart, and let into the brickwork 1ft. at each end, the buntings being 12in. by 6in. next the pump compartment, and 9in. by 6in. on the other side. In the place where the iron cylinder is out of plumb, the buntings are placed 4ft. apart; and in the cast-iron cylinder the ends are supported by a wrought-iron bracket bolted to the cylinder in addition to the ends resting on the flange-joints. The guides are to be of 4in. by 3in., and there are to be two cages, fitted with safety-catches and hooks.

The winding-engine has two cylinders 18in. in diameter, with 4ft. stroke, with cast bed-plate set on the top of a wooden sole-piece, and bolted to a brickwork-set-in-cement foundation. The winding-drum is 9ft. in diameter, a flexible round steel-wire rope being used for winding. The steam is to be supplied by two Cornish boilers with two flues in each, and fitted up with Galway tubes. The winding-plant is capable of lifting far more coal than the extent of the workings can ever supply. The water is lifted by a vertical Tangye pump, 18in. cylinder and 10in. ram, having 2ft. stroke.

The chamber at the bottom of the shaft is 18ft. high and 16ft. wide, lined with brick, and has an arched roof. The main heading has been carried forward for some distance, and all provision made to commence work as soon as the winding-gear is completed. There have been thirty-five men employed underground on the old mine, and ten men on the surface, and nine men employed in sinking the new shaft; five bricklayers, three engineers, and fifteen men on surface at the new pit. The output of coal for last year was 24,000 tons. W. Collins, who was formerly manager, resigned this position, and W. Tately has been appointed in his stead. Plans of the mine were posted up to date, and a daily-record book kept. The provisions of the Act have been fairly complied with.

6. *Taupiri Reserve Mine.*—These workings were, at my first visit to this mine, in October last, confined to the University Reserve; but in November last a heading was commenced into the dip outside the University Reserve and under Lake Kimihia. This mine is well laid out, the ventilation is good, and the mine carefully worked. The workings under the lake will have to be carefully looked after, as there is not a great depth of cover on the coal and a certain thickness of coal has to be left on the roof, as the covering above the coal will not stand when the whole of the coal is taken out. It is only intended to take narrow bords and leave all the pillars intact, so that, if the mine is carefully worked on this principle, there will be no danger in getting out a certain portion of the coal under the lake.

The locomotive-engine driver, William Gilley, met with an accident on the 8th of October last, which proved fatal. The water in the lake was very high and was washing against the sleepers of the railway on which the coals are conveyed from the mine to the Government line. The company's locomotive was bringing out from the mine six railway-wagons full of coal. On going down an incline near the side of the lake the driver shut off the steam and put on the brake of the locomotive, and told the stoker to jump down and run forward to a certain low place on the line to see if it was safe to cross. The driver also jumped off the engine and went to put down the brake on one of the coal-wagons, in order to stop the train. On jumping on the brake his foot slipped, and the train passed over his ankle. This happened about 11 o'clock in the forenoon. He was

taken to Hamilton Hospital the same day and had his leg amputated, but he died directly afterwards.

The average number of men at work has been twenty underground and six on the surface. Plans of the workings are kept posted up, and a daily-record book kept, and the provisions of the Act fully complied with. The output of coal for the year was 16,640 tons.

7. *Miranda Mine.*—The workings in this mine were not well laid out at the commencement, and plans of the workings show that careful surveys have not been made before commencing to cut up the pillars. The coal is 40ft. in thickness in some portions of the mine, and a commencement is now being made to carry bords at a higher level on the pillars that have been left in the first instance, and the result is that it is only by mere chance that the bords are not taken on top of the ones driven below. This was the case in one instance, where men were driving an upper bord on the top of the lower one, and, there being only about a foot of coal between the bottom of the one bord and the top of the other, it gave way and might have been the cause of an accident, as the lower bords are carried for about 16ft. high. The place was afterwards secured with timber at my request, and the workings in the bord referred to stopped. The roof-covering is remarkably good, so that with ordinary care a fair proportion of the coal can be won. The ventilation is very good, and the provisions of the Act have been fairly complied with. The average number of men employed is five below ground and five on the surface, and the output for the year has been 3,423 tons.

The company has heretofore been keeping the water down by baling by means of a tank; but they have now erected a Tangye pump, and are erecting an additional steam-boiler to supply steam to work the Tangye.

I have, &c.,

HENRY A. GORDON,
Inspector of Mines.

SOUTH ISLAND.

Mr. G. J. BINNS, F.G.S., Inspector of Mines, to the UNDER-SECRETARY of MINES, Wellington.

SIR,— Office of the Inspector of Mines, Dunedin, 24th March, 1890.

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.

As a supplementary report was sent in on the 7th June, 1889, and the present report deals only with the period terminating on the 31st December last, there is only about seven months' work to be considered. During this period my ordinary official duties have occupied, with the exception of three days' sick leave and some of the usual holidays, the whole of my time. In July and August three weeks was devoted to attendance in Wellington before a parliamentary Committee.

The following remarks comprise all that appears to be worthy of notice regarding the various mines, 126 of which have been visited during the year. As some have not been inspected since the date of my last report, there will be no reference made to them.

8. *Wallsend Colliery, Collingwood* (4th November, 1889).—At this date only three stalls were being worked, and the seam, including bands of dirt, averaged about 2ft. 5in. As the mine is very wet the working-places are exceedingly uncomfortable. Natural ventilation has not yet been superseded by more efficient means, nor was the Act in other respects so carefully observed as might have been anticipated. Dynamite was taken into the mine in 5lb. packages, instead of in a proper case. A copy of the Coal-mines Bill, 1886, was made to do duty for the Act.

9. *Mokihinui Coal-mine, Mokihinui* (28th October, 1889).—The development of this undertaking seems to be lamentably slow. At the end of October a party of contractors were engaged in taking the water out of an excellently-timbered drive, which has followed the Hut Seam for 100 yards on the full dip. Only a common Davy lamp was on the premises. The thick seam had been worked opencast to a considerable extent, and in addition a large drive has been commenced for the purpose of allowing the locomotive to pass through the spur. The company has purchased a steamer carrying 400 tons on 9ft. draught, but the coal-mines can never hope to be thoroughly successful until the railway is secured. At my visit very little was being done, and on the 30th November I wrote to Mr. Straw, the manager, calling attention to various portions of the Act.

10. *Westport Ngakawau Coal-mine* was mentioned last year, though not included in the statistical table. During the latter half of 1889 special rules were, after a good deal of correspondence, finally approved by the Minister. The railway has been for some time finished, and the mine only awaits a demand in order to put out a quantity of coal. On the 19th October the works were standing, 1,600 tons of stuff being then ready for shipment. A dip had been driven below the level of the river, and a 6in. double-cylinder engine erected for hauling. As the seam dips at 38°, and the bords are driven to the full rise, they are very difficult to ventilate, especially as a good deal of gas is given off. No names were appended to the copy of the Act hung up. In December Mr. Marshall sent me a copy of the plan up to 24th September, 1889.

11. *Coalbrookdale Colliery, Westport.*—The principal point to be noticed with regard to this coal-mine is the unfortunately large number of accidents which have occurred during the past year, as compared with the almost perfect immunity which was enjoyed during 1888. As this will, however, be dealt with in another portion of the report, it is unnecessary to do more at present than notice the fact. On the 25th and 26th October I examined the mine, books, &c., with the following result: At that time 310 men were employed below ground and 70 above, making a total of 380. Most of these were in the Iron Bridge district, but a few in the old Wooden Bridge area, which was nearly worked out, and a few in Harris's jig. In the new Coalbrookdale area, where the coal crops out on each side of a stream, and there were twenty openings to daylight, a good deal of coal was being obtained. In this part of the field there are two seams, not far apart, but varying somewhat

in thickness, dip, and distance from each other. The ventilation generally was good, measuring 24,225 cubic feet per minute in the Iron Bridge workings, and the formalities of the Act seemed to be carefully observed. In October Mr. Brown telegraphed that he had laid an information against a local hotelkeeper for riding up the incline. At the same time several convictions were obtained against workmen who had committed the same offence. In the first-mentioned case, however, the defence was set up that under section 27 of the Act the special rules could only be made to apply to persons acting or employed "in or about" the mine, and that therefore the special rule forbidding outside persons to ride on the trucks was *ultra vires*. The Magistrate upheld this view, and dismissed the case—a result which is much to be regretted.

12. *Waimangaroa Coal-mine, Westport* (formerly Haylock and Young's).—On the 31st October the workings, which then consisted of three drives, appeared to be well secured, but there was no return from any of the adits. On the 5th December I sent a copy of the Act, and a letter pointing out the portions which required attention.

13. *Murray Creek Coal-mine, Reefton.*—On the 17th October the mine was in good order, and the air guided. Mr. James Sara, the new manager—whose name had not, by the bye, been substituted on the rules for that of his predecessor—appears to take every care to observe the law.

14. *Golden Treasure Coal-mine, Reefton.*—After several years' cessation, this mine is again at work, but opencast only in October. The manager, Mr. John Fox, promised to send me word when underground working commenced.

15. *Inkerman Coal-mine, Reefton.*—Inspected on the 19th October, 1889, when there was nobody at work. The mine was in the condition described in former reports—viz., the whole of the seam had been taken out and timber substituted. As the place has been standing for some years, the Act was not observed, so I wrote on the 3rd December to the legal manager requiring attention, stating that, in my opinion, the system of taking out all the coal and not substituting any stone-packs is unsafe—a similar letter, in fact, to that which I wrote on the 2nd October, 1885.

16. *Lankey's Gully Coal-mine, Reefton.*—Last March I reported that in November, 1888, the place was gutted and in bad order. In October, 1889, it had fallen in and was in a bad state. Report kept only about once a week, in spite of my letter of the 17th July, 1888, so I wrote again on that subject on the 3rd December. A copy of the Act, with the requisite names, was at the mine, and an approved lamp. The workings are badly carried on. The owners have constructed an incline on the surface from the top of the hill.

17. *Boatman's Coal-mine, Boatman's.*—Visited the 23rd October, 1889; nobody about. The owner subsequently told me he had not worked there for some months.

18. *Burke's Coal-mine, Boatman's.*—Failed to find anyboby about on the 23rd October last.

19. *Coghlan's Coal-mine, Boatman's.*—A new undertaking about a quarter of a mile from the last, and commenced about July, 1889. No notice of commencement was sent, and no Act observed.

20. *Boatman's Creek Coal-mine, Boatman's.*—Another new mine, worked by a dip and water-balance. Nobody about, and the entrance securely fenced.

21. *Phœnix Coal-mine, Reefton.*—In July, 1889, Mr. A. Harris wrote stating that he had taken this mine, and, in reply, I called attention to section 19, *re* manager. On the 16th September Mr. Harris wrote stating that the mine was very small, and employed only himself and his three boys, and stating that enforcing the certificated-manager clause "simply means shutting up the few mines here." Then followed a request for a certificate, on account of many years' experience in mining, and a representation of the disastrous results which would follow the enforcement of this clause. I quite agree with Mr. Harris as to the hardship that will be caused, but, at the same time, as explained last year, I do not see my way to grant any certificates of exemption. On the 17th October the workings were opencast, the adit having been standing for a week. On inspection of the underground workings, I was surprised to find several points neglected. Only a Davy lamp; no report; and no copy of the Act. Even were it possible to grant exemption from certified management, neglect of the provisions of the Act would prevent its being done. On the 4th December I wrote to the manager.

22. *Inglewood Coal-mine, Reefton.*—On the 17th October no work was being carried on. The contractor informed me that the coal was at that time obtained by stripping the surface.

23. *Progress Coal-mine, Reefton.*—Visited the 22nd October, 1889. As usual, very badly worked, and the law disregarded. Powder in keg about half-full; safety-lamp not used; no report; no sprags. On the 4th December, 1889, I wrote to Mr. P. Brennan, calling attention to my letter of the 19th September, 1888, giving notice to observe the particulars mentioned therein, and requesting name and address of the manager. No answer has been received.

24. *Brunner Coal-mine, Greymouth.*—Inspected on the 10th, 12th, and 14th October, and 12th and 13th November, 1889. The work was confined to the far pillars. The roof there breaks freely; no very large lumps of rock. The air is good, and the Act observed. With regard to pillar-working in this mine, I have to report as follows: In compliance with your memorandum of the 23rd September, I paid, during October and November, particular attention to this subject—not that it had been by any means lost sight of, as you will see by reference to my report of the 7th March, 1889. It was also fully considered in years gone by, as you may read in my report of the 31st January, 1882, and in that by Mr. Cox, F.G.S., dated the 25th May, 1881. The question appears to be, shortly, this: Is there any danger of a sudden and gigantic slip of the rock above Brunnerton, riverwards, owing to mining operations? My answer is, that I do not apprehend such danger, and for the following reasons: At present the pillars worked are 55 chains back from the face of the cliff, beyond the fault. On the right bank of the river, opposite the Tyneside Mine, and where the cliff approaches very near to the water's edge, the strata dip to the south-west at 16°, or nearly in the same direction as the course of the stream. Going further to the north, the dip comes round to the eastward, so that at the Brunner coke-ovens the strike of the measures is parallel with the river. The effect of this change in the geological structure of the district is at

once physiographically apparent in the comparatively flat ground on which the northern portion of Brunnerton is situated. As this is a dip slope, the prospects of a surface-slip are very apparent, more especially as the increase of population has caused almost all the surface-vegetation to be removed. Given a wet climate, a dip slope, and hardly anything in the shape of roots to hold the soil together, nothing is more likely than the collection of water in the soil, and a consequent slip. With this, however, the extraction of coal will have had absolutely nothing to do, as the seam has been denuded from this locality. The cause of the change of dip is to be found in an anticline, the axis of which extends on a line drawn from a little north of the Tyneside Mine past the Brunner coke-ovens. This is well shown by the dip of the coal in the Tyneside Mine, which, somewhere about the Catholic chapel, is to the south-east, as it is also in the old mine on the river's bank. On one or two points which have an important bearing on the subject a misapprehension appears to exist. Firstly, as to the thickness of the seam, so far from extending to 26ft., it has never been stated, even in the earliest records which I can find, as being more than 12ft. to 16ft. (Geol. Rep., 1877–78, Statistics of Collieries). My own recollection is something under 20ft., and Messrs. R. Elliott and John Morris, who have been connected with the management for a long period (the former until within the last few years, and the latter continuously in various capacities for twenty-three years), state that it is usually 16ft. thick, seldom 18ft., and once (according to Mr. Morris) 20ft. Secondly, as regards the relative prevalence of irregularities in the floor and roof, my own impression, strengthened by inquiry, is rather the reverse of what has been stated—viz., that the irregularities were mainly in the roof. Thirdly, the fracture has taken place quite as much in the floor as in the roof. Many old roads have completely closed up, and without any fracture of the roof; indeed, this action has been going on for many years, and is so common that it is very usual for the floor to give the familiar hollow sound when walked on that indicates a forcing-up of the ground. On the 30th November I examined a good deal of the old workings about the coke-ovens, and found that a considerable portion of the roof was standing very well, but in places the floor had fractured in the centre, and in others the roof had fallen. This is my view of the case, founded on eleven years' acquaintance with the mine, and on as careful consideration as I can give it; but, at the same time, in a matter of so much importance, I beg to suggest that the matter should receive additional attention, and that other engineers may be called in to give their views.

25. *Coal-pit Heath Colliery, Greymouth.*—On the 11th October, 1889, I examined this mine. Fortunately the old shaft is no longer used for men, who walk down the incline from the Brunner. This road also forms a downcast; and the fan-shaft and old winding-shaft, in which are steam-pipes, are used as returns. This change has improved the air very much, and when the small hauling-engine has been removed, and the pump steam-pipes put in a new back heading, the ventilation will be much better. The bords were moderate in width and well timbered. The only fault to be found was about the old places, all of which were not fenced. In reply to a letter on this subject dated the 3rd December, Mr. Alexander wrote on the 18th of that month, saying fences were being erected. When in Wellington during August I was requested to report on the supposed working of pillars between the Brunner and Coal-pit Heath Mines. As already stated, there is no intention of working pillars anywhere nearer the river than 20 chains. Above the Coal-pit Heath winding-shaft, the workings approach to within less than 1 chain of the river-bank, but below the shaft the average distance is about 4 chains. Between these latter workings and the river a narrow heading for steam-pipes is being driven, but I do not think it will in any way weaken the support.

27. *Blackball Coal-mine, Grey Valley.*—Although prospecting operations under Mr. A. B. Lindop's directions have been carried on by the company owning this property for some time, the output of coal has not yet commenced; indeed, considerable expenditure will be necessary before a communication can be established. The lease is situated to the north of the Grey River, and contains two seams of coal, varying from about 12ft. in thickness downwards, and dipping in a south-easterly direction. A tunnel is being driven through the measures overlying the seam, and on October 14th was in a distance of 94ft. Twelve men altogether were at work, and the Act was not observed, as coal had not been touched. Dynamite and caps were left carelessly about. Mr Dombrain, of Christchurch, secretary to the company, sent me notice of commencement in August, and subsequent notification of Mr. R. Schofield's appointment as manager.

28. *Wallsend Colliery, Greymouth.*—On the 21st October, 1889, when this mine was last inspected, about a hundred men were at work below ground, and the ventilation was excellent. Gas is still found in the workings—in fact, a somewhat powerful blower was then existing in the dip workings. The defective place in the shaft mentioned in my last report had not been repaired, nor were there any safety-cages. The ropes had not been periodically tested, as required by General Rule 20, but are examined every week. Mr. Bishop shares the opinion of many engineers that putting severe strains on ropes for the purpose of testing them is very prejudicial. The proposed deepening of the winding-shaft has been carried out, and a subway for water constructed, so that in the event of damage to the pumps buckets can be used, and the ventilation need not be interfered with.

29. *Springfield Colliery, Springfield.*—This keeps on working in a very small way, notwithstanding which the efficiency of the arrangements appears to be maintained. In the beginning of October only four men were working at the coal. The air was not very good, but otherwise there was no fault to find. A new engine-driver had been recently appointed, who involuntarily tested the safety appliances by winding the cage up to the wheel. Both the detaching-hook (a King-Humble supplied by the Mines Department) and the safety-cages, which were made on Mr. Lindop's design, acted perfectly.

30. *Canterbury Colliery, Sheffield.*—The shaft is now used for winding coal. There are no cages or guides, and men are raised and lowered by means of a horse-whim. As there are no ladders, General Rule 18 is not observed. The report was kept only about once a week, and the copy of the Act was in tatters. The ventilation was produced by steam-jet.

31. *Homebush Coal-mine, Glentunnel.*—Examined on the 7th October, 1889. The places seemed tolerably safe, but I should have liked to have observed a little more attention paid to the roof. Report kept. Approved lamp at mine. No motive-power for ventilation. Abandoned places not fenced. Mr. Brown keeps a plan of the mine.

32. *Snowdon Coal-mine, Rakaia Gorge.*—Nobody was at work on the 5th October, and the drive had been damaged by the extraction of too much coal. Inferior timber, badly set, had not compensated for this. This is not a safe pit.

33. *Acheron Coal-mine, Lake Coleridge.*—On the 4th October I found the drive closed by a slip. Nothing had been done for some time.

34. *Stobwood Coal-mine, Rockwood.*—Mr. H. Levick wrote in January, 1889, stating that he had reopened this mine; and early in October I visited the place and found it well worked, but no Act kept. Very shortly after a notice was sent stating that the mine had been closed.

35. *Whitecliffs Coal-mine, Whitecliffs.*—On the 28th September, 1889, Mr. Leeming wrote for a certificate of exemption from the certificated-manager clause, stating that he had been for about eleven years engaged in mine-management in the South Malvern district, without accident, and that, owing to the fact that he "was not engaged as manager during the twelve months immediately preceding the passing of the Act," he could not apply for a certificate of service. This appears to be a considerable hardship, and has acted as such in many cases. This mine is carefully managed now: a copy of the Act was exhibited, and a copy of the Homebush Colliery Special Rules, with proper names attached; plan kept, and workings examined in the morning. Two shafts required fencing, as I pointed out to the manager in a letter dated the 4th December, 1889.

36. *Mount Somers Coal-mine, Mount Somers.*—In the early part of the year Mr. Wright sent word that Mr. James Duke was in charge; but on visiting the mine in November I found that Mr. D Jebson had resumed the management, and had paid some considerable attention to getting things in order. A daily report was kept, also a plan; and a copy of the Act was exhibited, but the latter was incomplete, and no names were attached. An approved lamp, which appeared to be in working-order, was in the mine.

37. *Duke's Coal-mine, Kakahu.*—It was only on the 31st December that I heard definitely from Mr. James Duke that he was working here; so the place was not visited last year. A copy of the Act was sent, with a letter calling attention to all the necessary points.

39. *Kurow Coal-mine, Kurow.*—Last time I had to remark on the difficulty of obtaining any answer to letters addressed to the owner of this mine. On the 5th August last Mr. Wade sent the output-return for the previous year. On the 23rd I replied that notice of the manager was required, and no answer has yet been received.

40. *Phillips's Coal-mine, Kurow.*—The output-return from this mine arrived on the 24th July, 1889.

45. *Shag Point Coal-mine, Palmerston.*—On the 19th June, 1889, I found that Mr. Williams was driving to the dip below the shore. The seam here was very variable, and the roof in places bad, but well secured. The air in the lowest seam, main jig, was good and cool. In the upper-seam rise-workings were two men, who were prevented by an imperfect brattice from getting a proper supply of air. "In the lower seam," I noted, "the air is much better." The shaft-cover was constructed to be lifted from the inside. Reports kept. On the 15th April a fire broke out about a chain from the shaft, and a box was put in to carry the air. I must say that the frequently-recurring fires in this colliery are a cause of some considerable anxiety. Mr. Rich's name was posted up as owner, and on subsequent application to the manager I was informed that this had been changed and the names of Messrs. Hazlett and Glendining substituted. On the 26th September I found the air feeble at the extremity of the rise-workings in the lower seam. The places in the dip were driven carefully, and good pillars left. At the same time it is absolutely necessary to have check-surveys made for the purpose of guarding against any possibility of danger, and on the 27th September I wrote to you stating this. On the 21st October I received your letter dated the 9th of that month, stating that I should satisfy myself as to whether the plan is incorrect before going to the expense of an additional survey. The check-survey has not, so far, been made.

46. *Allandale Colliery, Palmerston.*—I examined the workings of this mine on the 21st August, 1889, when the air was not very good, as it reversed. There was a daily report, but no weekly report on the machinery, &c. The refuge-holes were still choked with rubbish, and the timbering in one place was to my mind inefficient. The owners informed me that a bore-hole had been put down near the Shag Point Company's line, about 150 yards north of McIntosh's store, and that at 198ft. a 3ft. 6in. seam was met with, separated by 5ft. of fireclay from an underlying 7ft. 6in. seam. The safety-lamp had not when I was there been used for the morning examination of the mine. On the 23rd August I wrote to Mr. McIntosh requiring him to keep refuge-holes clear, to write a weekly report, and keep report at mine; and received a satisfactory reply on the 29th August.

63. *Excelsior Coal-mine, Cromwell.*—This is one of the three mines that have not been inspected during 1889. In February, when I passed near, the owners told me that it was abandoned, and only on the 13th December I received notice that it had been recommenced by Mr. J. Burrowes.

73. *Fernhill Coal-mine, Green Island.*—On the 11th September the air was not good, the furnace being low. The plan was away from the mine, and the report very late.

74. *Green Island Colliery, Green Island* (10th September, 1889).—At this time the workings were very limited in extent (only three men being employed), and in a poor condition. The man in charge told me that the registered manager had not been at the works for a fortnight. By your letter of the 27th September, 1888, which I communicated to the manager, it was decided that the manager must attend daily at the works; so I wrote again on the 11th September, 1889.

75. *Saddle Hill Colliery (Christie's No. 2), Saddle Hill.*—On the 24th September I found there was no report at the mine, and that a change in management had taken place, Mr. James Christie having succeeded his brother. I wrote on the 30th September, requesting notice on this point.

76. *Bank Coal-mine, Saddle Hill.*—Called at mine on the 24th September, and found it fallen in and abandoned.

77. *Glenochiel Coal-mine, Saddle Hill.*—Again I have to report that on the 24th September the Act was to some extent neglected. I can only refer to former report. The workings were in good order.

78. *Walton Park Colliery, Green Island.*—On the 2nd July I received word from Mr. Loudon that an extensive fall had occurred on the north side of the dip. It was the 22nd August before I could get out to the mine, and then Mr. T. Shore, late of Orepuki, was in charge of the underground workings. It appears that there were two falls, one on the 1st and one on the 17th July; and, though the amount of ground which fell was not large, an enormous amount of sand ran into the excavations left by the removal of the coal. After the fall took place water was allowed to accumulate, which, of course, spread the sand to a great extent. The plan was undated, reports kept, Act and rules exhibited, and the workings well timbered. In considering the effect of the inrush of roof-sand the principal danger appeared to be in the direction of the shaft, which was sunk partly through a quicksand, and which is considerably out of plumb. On the 22nd September I examined the shaft-timber, and found that, generally speaking, it was well packed, though in places where I could not see between the slabs it knocked hollow. In the dip great care was taken to secure the roof as the explorations went on, very heavy timber being used.

79. *Abbotsroyd Colliery, Green Island.*—Inspected on the 10th July, 1889, when sixteen men were working, mostly down among the old pillars of the Otago Colliery. On examining these old workings, which had been under water for ten or eleven years, it was found that many of them had stood perfectly, and that when the water was drawn off the floor swelled up. No daily report was kept; rules and Act exhibited. The workings were safe, but the men were working too close to places containing black-damp.

80. *Mosgiel Colliery, Mosgiel* (17th July, 1889).—Workings on the east side, and well protected and driven. Pillars mostly large; plan kept; pumps worked by cranks off winding-drum connected by wires 8 chains in length; reports kept; and mine carefully worked.

81. *Brighton Coal-mine, Brighton* (19th December, 1889).—Absolutely nothing done to keep the Act, except an unbonneted lamp purchased. Wrote to Mr. Walker on the 24th December.

82. *McColl's Coal-mine, Brighton.*—Driving an adit only. Visited 19th December, 1889, and sent copy of Act on the 24th.

83. *Bruce (No. 1) Coal-mine, Milton.*—Not working when I was there in August.

84. *Bruce (No. 2.) Coal-mine, Milton.*—On the east side of the gully, opposite the old mine. The pillars were far too small, and the Act disregarded. I wrote to Mr. Hardwick on the 9th September.

85. *Real McKay Coal-mine, Milton* (28th August, 1889).—Act neglected. Mr. Young stated that he had been away all winter until two days previous to my visit. There is far too large a proportion of coal got, and the mine has fallen in in places.

87. *Wallsend (late Cannon's) Lignite-mine, Lovell's Flat.*—Openwork still, and very well stripped.

88. *Paskell's Lignite-mine, Adams's Flat.*—Not at work; fallen in.

89. *Gibson's Coal-mine, Lovell's Flat.*—A new shaft, sunk by Mr. James Gibson, whose manager has sent me every necessary notice. On the 27th August I found the shaft had reached 194ft. from the surface, and was lined throughout with 6in. by 2½in. black-birch. Horse-power was used, and ten men were employed. Subsequently another shaft was sunk, on a bore-hole which had already been put down, and a 20ft. seam of coal was reached at 250ft. It is intended to construct a trainway to the railway at Lovell's Flat.

90. *Elliott Hill Coal-mine, Lovell's Flat.*—In July, 1889, Mr. A. Carruthers wrote, stating that in January he had sent the notice of commencement; however, I never received it. On the 28th August I visited the locality, and found a landsale pit, employing three men, and in good order, except that a miner was working below dangerous coal. A daily report was kept.

91. *Adams's Flat Lignite-mine, Adams's Flat.*—Visited 28th August, 1889. Well worked, open-cast.

92. *Benhar Coal-mine, Balclutha.*—On the 12th September, 1889, I found a copy of the Act exhibited, but it lacked the necessary names. Report kept daily. Five men were working at pillars, two under what I considered to be conditions of considerable danger. As the owner was absent, I left a letter requesting him to discontinue this system of work, and on the 13th another letter was sent, requesting an immediate answer. On the 17th a letter arrived, dated the 14th and postmarked the 16th, explaining the system, and stating that the coal is very tough and upwards of 30ft. thick; adding, "My instruction to the men is to get all the coal out consistent with their safety, and whenever they think it is getting too dangerous to retire to the next pillar." This is simply placing all responsibility on the men, and cannot be countenanced. However, Mr. Nelson withdrew them, and when I called on the 18th of the same month no pillar-working was being carried on.

93. *Morrison's Coal-mine, Benhar.*—On the 12th September I found the manager away, and one man working an apparently safe place. No Act observed, so far as could be seen, but an approved lamp, in a state of dirt and rust, hanging in the mine. I subsequently wrote to the owner.

94. *Rigfoot Coal-mine, Benhar.*—Visited 12th and 18th September, 1889. Approved lamp, but no report. Wrote 12th September *re* keeping Act and report at mine, but on the 18th failed to find them.

95. *Kaitangata (No. 2) Coal-mine, Kaitangata* (17th and 18th September, 1889).—Plan up to date, but not on works. The newly-discovered seam mentioned in my last report had been opened up to some extent, and nineteen men (on two shifts) were working, with lamps, as a good

deal of gas existed. On the 18th September I measured the main return at 26,350 cubic feet per minute, and found the workings cooler than formerly. Owing to the lesson taught by the unfortunate fatality last year, the bords have been since worked with a row of centre-props. The workings seem ordinarily safe, and care is used not only in working the mine, but in observing every portion of the Act.

97. *Castle Hill Coal-mine, Kaitangata.*—On the 29th August this mine was visited, and two men only, in addition to the manager, were found to be at work. A copy of the Act was in the mine, but no names were attached. A Marsant lamp, in good order, was on the premises. No report was kept, nor was there any motive-power for ventilation. Mine in good order.

98. *Wangaloa Coal-mine, Wangaloa.*—I never find anybody working in this mine, which was last inspected on the 29th August, 1889. As the output for 1888 was only 62 tons, it would not take many days' work to get it.

99. *Lesmahagow Coal-mine, Wangaloa.*—Mr. Sewell always keeps his pit in good order, though he might take a little more trouble to observe the law. A copy of the Act was at the hut, but no report or safety-lamp. On the 16th September I received a letter stating that the output was only 4 tons a month, and requesting me to forward an application for a certificate of exemption from the certificated manager clause. I accordingly did so, and pointed out that the enforcement of this portion of the Act would cause this and many other similar mines to be closed.

100. *Crofthead Coal-mine, Kaitangata.*—A new manager (Mr. W. Coulter) had taken charge, and did not properly observe the Act. The workings were all right in September, but I had to write and request a daily examination with a safety-lamp, also a new copy of the Act, the old one having been partially removed.

101. *Cullen's Lignite-mine, Waikoikoi* (12th December, 1889).—Nobody about. The mine did not look as if much had been done.

102. *Mainholm Lignite-mine, Waipahi.*—A large openwork mine, well worked, and drained by steam-power.

103. *Wyndham Lignite-mine, Wyndham;* and

104. *Munro's Lignite-mine, Wyndham,* adjoin, and were visited on the 9th December. They are both opencast.

105. *Parratt's Lignite-mine, Menzies' Ferry.*—On the 9th December the mine was full of water, and I could not take the dip of the seam. Messrs. Kerr and Shields have now possession of the property.

106. *Menzies' Ferry Lignite-mine, Menzies' Ferry.*—Seam only 6ft. thick, and about 13ft. of heavy clay stripping.

108. *Luzi's (Junior) Lignite-mine, Gore;*

109. *McKinnon's Lignite-mine, Gore;*

110. *Hoffmann's Lignite-mine, Gore;*

114. *Heffernan's Lignite-mine, Gore;*

115. *Sargenson's Lignite-mine, Gore;*

116. *Chatton Lignite-mine (Pacey's) Chatton;* and

117. *Chatton Lignite-mine (Pemble's) Chatton,* are all openwork, and were visited in December.

118. *Perseverance Lignite-mine, Pukerau.*—Notice of manager sent.

119. *Pukerau Lignite-mine, Pukerau,* has not been inspected since my last report. The owners have written several letters pointing out the hardship of having to employ a certificated manager.

121. *Otama Lignite-mine, Otama* (7th December, 1889).—Seam only 2ft. 8in., covered by fine banded tenacious clay, in places 20ft. thick. Owner anticipates closing soon.

128. *Edge's Lignite-mine, Waikaka* (7th December, 1889).—Still worked opencast.

129. *No. 14 Lignite-mine, Waikaka.*—Since my last visit the owner has commenced to work by driving, but, as nobody was about at my last inspection, I did not go into the mine. Subsequently a letter was sent to the owner, pointing out what he should do.

140. *Fairfax Lignite-mine, Fairfax,* continues to be well worked. On the 10th December the owners informed me that they projected an adit, and would send word of its commencement.

142. *Isla Bank Lignite-mine, Fairfax,* was visited in December, and requires no comment.

Accidents.

Again it is my pleasing duty to report a diminution in the number of accidents as compared with the previous year. In 1888 there were seventeen separate accidents, injuring seventeen persons, and in 1889 twelve separate accidents, injuring twelve persons. These occurrences were due to two causes only—viz., falls of ground, and trucks. The former may be debited with eight accidents and the latter with four.

Mr. Inspector Gow has been, as usual, good enough to forward a list of the accidents which he has investigated on the West Coast. And with this information I am able to give the following:—

Classification of Accidents.

	Separate Accidents.	Persons Injured.
Below—		
Trucks	2	2
Falls of roof and sides	8	8
	— 10	— 10
Above—		
Trucks	2— 2	2— 2
	12	12

Remarks on Accidents.

Five of the accidents had already occurred when my last report was sent in, and of the remaining seven three were investigated by Mr. Gow, so that only four remain for me, and none of these requires special notice.

In addition to the actual mining accidents there has been this last year a large number of occurrences in and about mines which have been brought under my notice. It may be interesting to give a list of these, although the first three have been already reported on:—(1.) 15th January, 1889; Coalbrookdale Colliery; a boy named Manderson was injured, while trespassing, by a truck. (2.) 29th March, 1889; Clay-pit near Homebush Colliery; James Jewell was killed by a fall of clay. (3.) 6th April, 1889; Coal-pit Heath surface railway; Mrs. McGee was killed while trespassing. (4.) 24th June, 1889; B. Thomas committed suicide by hanging in an old bord, at the Coalbrookdale Colliery. (5.) 20th September, 1889; a boy named Andrew McCrorie was injured, while trespassing, by a mine-truck at the Walton Park Colliery. (6.) 5th November, 1889; Coalbrookdale Colliery; a boy named Alex. Brown was killed by a railway-truck at the screens; he was trespassing. These require no comment. Four owed their death or injuries to being illegally on mining premises.

There has been no decrease in the number of fatalities, which remain at two. As the output, however, and number of men employed will probably be increased, we shall have a better death-rate this year.

Certificates.

The time for requiring certificates has been extended to 18th February, 1890, and I have received many touching appeals for exemption. At the same time I have granted none, nor do I think it advisable to do so. The law is entirely inapplicable to these small mines, and should be speedily amended.

Number of Coal-mines.

The past year shows an increase of eight mines, bringing the number to 129. Nine were struck off the list, Tyneside being the only one of any importance. Sixteen were added, fourteen of which were new and two restored. Of the new ones, Ngakawau, Blackball, and Gibson's may be of importance.

Methods of Working.

Worked by shafts—			
Steam-power used...	6		
Horse-power used...	5		
	—	11	
Worked by adit—			
Engine-plane	12		
Horse-power	13		
Hand-power	44		
Indeterminate	1		
	—	70	
Openwork		48	
			129

I have, &c.,
George J. Binns,
Inspector of Mines.

The Under-Secretary, Mines Department, Wellington.

Accidents in the Westland Coalfields.

Mr. J. Gow, Inspector of Mines, to the Under-Secretary of Mines.

Sir,— Kumara, 22nd February, 1890.

I have the honour to report on the several accidents which have occurred in the Brunnerton mines, and have been inquired into by me, during the year ending 31st December, 1889.

1. *Wallsend Mine.*—On the 11th January James McMinn was slightly crushed by a fall of coal.

2. *Wallsend Mine.*—M. Kirkwood and son, on the 13th May, were injured by a large fall of coal. Kirkwood was badly bruised when I saw him in the hospital, and it was supposed several of his ribs were broken. The son was slightly injured in his heel.

3. *Coal-pit Heath.*—On the 4th June J. King was injured by a fall of coal. The coal came down while he was placing the ladder against the face to enable him to drill a hole. The coal was loose.

4. *Coal-pit Heath.*—On the 24th October E. Smith got his leg broken. He was filling a tub near the top of incline, and when attempting to push it up it overpowered him, and caught his leg in its descent.

5. *Wallsend Mine.*—On the 21st December John Curry was badly injured while near the bottom of one of the inclines. No one saw how it was done, and the injuries are of such a nature that he was rendered speechless. I learned, however, that Curry's lamp had gone out, and that he had come down the incline to get another lamp. He took a lighted lamp, and started on his return to work. The trucks were travelling at the time, and it appeared to me from the position of his cap, which was found on the tram-rail, that he had started up the incline behind the empty tub while it was in motion. The tub had gone up some distance when it became detached, and started back, striking Curry full in the face, which it smashed in a terrible manner. It is supposed he had been in a stooped position at the time it struck him, looking ahead to see if all was right. The empty tub had been off the rails and was lying on its side, and Curry was found several

feet lower down. The shackle pin was found near the empty tub. The pin is held in its place by a small pin through its end, but in this case the small pin had been worn or corroded away flush with the pin itself. Curry had no right to be there when the tubs were travelling. The full tub was standing in position at the bottom of the incline. I have, &c.,

The Under-Secretary, Mines Department, Wellington. J. Gow, Inspector of Mines.

INSPECTION OF QUARTZ-MINES.

Mr. G. J. Binns, F.G.S., Inspector of Mines, to the Under-Secretary of Mines, Wellington.

Sir,— Office of Inspector of Mines, Dunedin, 20th March, 1890.

I have the honour to make the following report on the quartz-mines on the west coast of this Island.

1. *Golden Treasure Extended Quartz-mine, Reefton.*—On the 17th October, 1889, only six men were employed, driving a level. Mr. James Martin, who was in charge, stated that he had never received a copy of "The Mines Act, 1886." A copy of the old general and special rules was exhibited, and a report was said to be at the house. Explosives were kept in a proper tin, but detonators were not adequately guarded. The drive seemed to be too far before the air.

2. *Inglewood Extended Quartz-mine, Reefton.*—Stoping was, at the time of my visit, being carried on, under the superintendence of Mr. Rogers, mine-manager. The reef is very irregular, running north-east and south-west, and averaging about 3ft. in width. Fourteen men were at work, in very good air. There were no proper dynamite-tins, and a box of detonators was placed close to the travelling-road. A report was kept, but not signed. The mine generally was in good order.

3. *Energy Quartz-mine, Reefton.*—Formerly known as the Energetic. When I inspected, it was in the hands of six working partners. The old shaft was fenced; ventilation pretty good; winze-ladders defective. A daily report—which was merely a record of work done—was kept; still, as twelve men were not employed, a registered manager was not required. Dynamite taken loose into the stopes. A copy of the Act was at the mine, and a plan was said to be at the house of one of the partners. Instead of the large reef, which used to make this claim so dangerous, is a 5ft. lode, which was at that time, unfortunately, rather poor.

4. *Wealth of Nations Quartz-mine, Reefton.*—On the 18th October I found this mine working in a small way. The machinery report had been neglected, but Mr. Watson promised to recommence it. The level worked at the time of my visit is just above the battery, and is 800ft. in length. At the end is a 10ft. by 4ft. shaft, divided into three, and 200ft. in depth. The winding-rope of this shaft works off the main water-wheel drum, 1,000ft. away. The reversing-wire is also worked from the brace, and there is an indicator attached, the wire of which is 1,000ft. in length. At the bottom of the shaft is a level driven N. 10° W. for 550ft., and at the end of this a block of stone was found. Dynamite was taken in in 5lb. paper packages. The shaft was properly fenced, and a code of signals posted up. Cage-cover $\frac{3}{8}$in.-thick iron, and easily lifted. Safety-cages, but no detaching-hooks. No copy of the Act was hung up, the one previously exhibited having been, Mr. Watson stated, torn down. As usual, everything about the place was in a state of complete efficiency.

5. *Keep It Dark Quartz-mine, Reefton.*—Work was, on the 18th October, 1889, carried on at the 500ft. level, below which another shaft had been sunk for 130ft. A cage was fitted to one side of this shaft, and proper ladders, with two platforms and plenty of space for foothold, on the other. For winding, the main rope is shackled on to a subsidiary rope, along the level, and down the shaft. The main shaft is usually fenced except on the water-baling side, where the fence is usually clewed up, owing to a fanciful idea that the lever of the bucket could not otherwise be properly worked. It requires a very little of Mr. Fitzmaurice's ingenuity to overcome this slight difficulty; but unfenced shafts have been for many years customary in the district, and so association has no doubt rendered them dear. Air excellent throughout, and dynamite apparently carefully used. The signal in the main shaft required continuing to the bottom level. Signals properly posted up, and brace covered. Cage-cover only $\frac{3}{16}$in. thick, and no copy of Act at mine. No safety-hooks, but an apparently efficient safety-cage. Plan at mine. With the exceptions named above, the whole mine and plant appeared to be in excellent order, and well looked after.

6. *No. 2 South Keep It Dark Quartz-mine, Reefton.*—Only four men were employed here below ground on the 19th October last. Dynamite was not properly looked after: to the 280ft. level it was taken in a tin, but down the winze from this point loose plugs were used. The shaft was fenced, and copy of the Act was at the mine, but no signals down the shaft, though the code of signals was posted up in the engine-room. The brace was not covered, and there were no safety appliances on the cage. The mine-manager, Mr. Q. Lawn, stated that he had several times applied to the owners to have them put on, without effect. A weekly report was kept, but not signed. Considering how little was being done, it seemed to me that Mr. Lawn had taken some trouble to comply with the provisions of the Act.

7. *Hercules Quartz-mine (late Nil Desperandum), Reefton.*—From the old Nil Desperandum level a shaft has been sunk to a depth of 300ft.; in fact, it has been sunk from the surface, but the upper portion is used only to pass the ropes. We descended by the old winze, where the ladders were in pretty good order, but new centres required. The cages had no safety appliances whatever, nor were they covered. Dynamite was taken down in 5lb. packages. Copy of Act at mine, but plan at the office in Reefton. No reports kept, and one side of the shaft very poorly fenced. Like the Wealth of Nations, the engineman here is some considerable distance from the water-wheel which forms the motive-power. In this case the distance is about 400ft., and the attachment for shutting off water is very poor. The manager states that the brake will stop the wheel with water full on.

8. *Supreme Quartz-mine, Reefton.*—This claim is in the neighbourhood of the Inkerman battery, and was, when I was on the ground, on the 19th October last, not doing much—in fact, only four men were at work. The reef, which appeared to be somewhat mixed up with mullock, is of considerable dimensions on the upper levels, 45ft. from the top of a shaft which is 187ft. deep. The ladders in the shaft are overhanging in places, and have no adequate foothold. There was a proper case for dynamite.

9. *Globe Quartz-mine, Reefton* (21st October, 1889).—This claim was at this time in full swing, employing thirty men below and ten above. Quartz was raised from the 280ft. level by a twenty-horse-power (nominal) engine, made by Hornsby, and below this sinking was being carried on. One side of the pit-mouth was properly fenced, and the other was fitted with a heavy door which is very unlikely to be kept closed. Only one signal-wire from the bottom of the shaft. No safety-cage, detaching-hooks, or spring-doors. Ladders good; explosives very carelessly used. The engine is fixed wrong way round, so that the engineman has his back to the shaft. The mine was carefully worked and well timbered. Filling also was well carried out, but the manager in charge of a mine like this ought to pay more attention to the details of the Act.

10. *Scotia Quartz-mine, Reefton.*—On the 21st October, 1889, I found Mr. T. Nasmyth in charge, with sixteen men below ground. The timber was excellent, air good, and dynamite in a tin; but too many caps about. The report was only up to the 5th October, and not signed; nor was there a copy of the Act at the mine. The reef, which has proved very rich, was then, in the winze, somewhat thin, but with well-defined walls. The height of the old block was 100ft.

11. *Inkerman Quartz-mine, Reefton.*—This is not the original Inkerman reef, but one situated in Devil's Creek, and discovered about March, 1888. The quartz is taken over the hill which intervenes between the claim and the battery in Rainy Creek by an aerial tramway 73 chains in length. The appliances at the shaft were, in October, very primitive, but a new shaft was being sunk, and an engine had been purchased. The reef varies from 1ft. to 7ft. in thickness. The ladders in the winze were sloping, and fitted, at intervals of 12ft., with platforms; but the timbering was very poor, and the platforms loaded with rubbish. No proper ladder existed in the slopes. Plan kept at mine, but no copy of the Act, or weekly report.

12. *Progress Quartz-mine, Reefton.*—On the 22nd October, 1889, this claim was in full swing, with twenty-nine men below. The workings are now situated in an adit from Devil's Creek, near the battery. The reef is 9ft. to 30ft. thick, and, in my opinion, there was quite enough ground standing on timber. Mr. Wilson, the mine-manager, stated that he was on the point of filling in. I found bellite and gelatine dynamite about the mine. Proper tins were in the workings, and a box nearly full of detonators. No plan or copy of the Act at the mine. This company has erected a Frue vanner for the purpose of concentrating their tailings; but it was badly fitted up, and worked so defectively, and banged so violently against the framework, as to be useless.

13. *Fiery Cross Extended Quartz-mine, Boatman's.*—On the 23rd October, 1889, I found the shaft fenced, and an indicator on the engine; safety-cages, but no detaching-hooks; dynamite in boxes. Plan, copy of Act, and report were said to be at the manager's house, near the mine. From the 450ft. level a shaft has been sunk to a depth of 140ft. The mouth of this was unfenced. The reef was there about 5ft. thick, and the ventilation of the stopes pretty good. Signals posted up; brace covered; and signals up and down shaft. The old water-wheel was destroyed by a landslip, and a double-cylinder semi-portable fourteen-horse-power (nominal) engine is now used.

14. *Welcome Quartz-mine, Boatman's* (23rd October, 1889).—At this date the only workings carried on were between Nos. 6 and 7 levels. No safety-cages, as the catches were taken off; dynamite loose in the mine; no report kept; copy of Act at office; cage-covers lift up; no signals posted up in engine-house or pit-bottom. The shaft is considerably bulged—so much so, in fact, that the cage passes the guides with considerable difficulty.

15. *Beaconsfield Quartz-mine, Waimangaroa, Westport.*—At my visit on the 26th October, 1889, no mining work was being carried on. The shaft, which was fitted with good ladders, was being baled out, but the Act was not generally observed. Indeed, Mr. George Edwards, the manager, stated that he had not received a copy.

16. *United Alpine Quartz-mine, Lyell.*—No quartz—at least, from stopes—was being raised on the 9th November last; and an effort was being made to find the reef in an uprise from No. 7 level, which is 2,310ft. in length. Dynamite was carelessly left about; a copy of the Act was at the office, and a report kept; the plan was not at the mine.

17. *Just in Time Quartz-mine, Boatman's.*—At the time of my visit there was only one man in addition to the manager, Mr. John Lawn.

I have, &c.,
GEORGE J. BINNS,
Inspector of Mines.

The Under-Secretary, Mines Department, Wellington.

APPENDIX.

No. 1.

Statistics of Workings in Coal-mines, 1889.

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 1889.			Approximate Total Output to 31st December, 1888.	Approximate Total Output to 31st December, 1889.	Number of Men ordinarily employed.			Power used for drawing Mineral.	Pumps.			Means of Ventilation.	Date of Inspector's Last Visit.
										Size of Shaft or Adit.	Depth of Shaft or Length of Adit.		Coal.	Slack.	Total.			Above.	Below.	Total.		Stroke.	Size of Barrel.	Height of Column.		
Kawakawa District.													Tons.	Tons.	Tons.	Tons.	Tons.									
1. Kawakawa	Moody, T. P. ..	25	semi-bitum.	1	2′ 6″ to 15′	2′ 6″ to 15′	1 in 6	bord and pillar	4	7′ x 10′	..	engine-incline	27,000	..	27,000	683,625	710,625	17	73	90	engine	6′	two 12″	247′	furnace	16/10/89
2. Kamo	Geary, Joseph ..	13	brown	2	4′ to 14′	4′ to 10′	varies	ditto.	3	15′ x 6′ and 12′ x 2½′	240′	shaft	12,014	..	12,014	147,132	159,146	7	33	40	„	3′ to 7′	10″	268′	natural	25/1/90
3. Whauwhau	Graham, J. ..	25	„	1	5′ to 10′	5′ to 10′	„	„	1	6′ x 5′	1,300′	adit	3,300	..	3,300	67,553	70,853	1	9	10	horse	..	..	..	„	19/10/89
Waikato District.																										
4. Waikato Mine, near Huntly	Garrett, John ..	13	„	1	6′ to 18′	6′ to 18′	„	„	..	adit 8′ x 9′ and 6′ x 6′	90′ and 60′	adit and self-acting incline	8,733	145	8,878	104,877	113,755	8	20	28	horse and self-acting incline	..	..	..	„	24/10/89
5. Taupiri, Huntly ..	Tatley, William ..	14	„	1	5′ to 45′	5′ to 35′	„	„	6	adit 10′ x 6′	672′	engine-incline	24,000	..	24,000	298,207	322,207	10	35	45	engine and horse	2′ 6″ 2′ 0″ 1′ 6″ 1′ 6″	8″ 6″ 5″ 5″	110′ 110′ 112′ 112′	natural and steam exhaust upcast	12/2/90
6. Miranda, Bridgewater ..	Shore, Thomas ..	2½	„	1	53′	40′	1 in 5·67	„	1	shaft 5′ x 14′	210′	shaft	2,423	..	2,423	9,900	12,323	5	5	10	engine	..	..	..	natural	23/10/89
7. Taupiri Reserve, near Huntly	Ord, J. ..	2½	„	1	14′ to 20′	10′ to 16′	1 in 7	„	1	adit 9′ x 6′ 3″ shaft 5′ x 4′	adit 583′ shaft 43′	incline adit	16,640	..	16,640	11,006	27,646	6	20	26	horse whim	No. 6 pulso-meter	..	43′	natural	12/2/90

West Wanganui.																									
8. Wallsend, Collingwood ..	Walker, James ..	21	bitum.	1	2′ 5″	all	N. 60° W. 1 in 10	longwall	..	..	..	adit	2,727	847	3,574	29,120	32,694	6	16	22	hand	*	..	..	natural	4/11/89
Westport.																									
9. Mokihinui, Mokihinui ..	Straw, M. ..	9½	„	2	11′ to 16′ 32′	„	E. 1 in 8 uncertain	narrow, open	..	..	..	engine-plane	2,250	..	2,250	1,041	3,291	6	16	22	water-wheel	..	..	..	„	28/10/89
10. Westport, Ngakawau, Ngakawau	Marshall, John ..	..	„	1	16′ to 18′	8′	S. 60° W. 38°	bord and pillar	..	..	..	ditto	1,568	..	1,568	..	1,568	3	8	11	engine	6″	2″	9″	„	29/10/89
11. Coalbrookdale, Westport	Brown, T., Mine Manager Waters, T. J., Man. Engineer	11	„	2	vary up to 27′	varies	varies	ditto	3	8′ 8′ 6′	120′ 45′ x 35′ 140′	„	142,452	20,563	163,015	558,603	721,618	84	326	410	„	..	..	..	furnace	26/10/89
12. Waimangaroa, Westport	Haylock, E. ..	1	„	1	30′	..	W. 30°	narrow	..	..	..	adit	..	200	200	..	200	4	..	4	hand	..	..	..	natural	31/10/89
Reefton.																									
13. Murray Creek, Reefton ..	Sara, James ..	6	glance	1	16′ to 17′	10′	W. 10°	bord and pillar	1	4′ x 2′ 6″	45′ 6″	„	500	..	500	3,728	4,228	2	..	2	„	..	..	..	„	17/10/89
14. Golden Treasure, Reefton	Fox, John ..	18	„	1	14′	10′	E.	open	..	..	..	..	570	..	570	1,830	2,400	3	4	7	..	..	..	..	..	17/10/89
15. Inkermann, Reefton ..	McAllum, James	4	„	1	5′	all	S. 70° W. 60°	stoping	..	..	..	adit	300	..	300	1,340	1,640	..	1	1	hand	..	..	..	natural	19/10/89
16. Lankey's Gully, Reefton	Lamberton, W. ..	12	„	1	8′	„	varies	bord and pillar	..	..	..	„	270	12	282	4,413	4,695	1	1	2	„	..	..	..	„	18/10/89
17. Boatman's, Boatman's ..	Coghlan, John ..	9	„	2	2′ 7″ and 1′ 7″	„	S. 30° W. 12½°	ditto	..	..	..	„	4	3	7	1,586	1,593	..	..	..	„	..	..	..	„	23/10/89
18. Burke's, Boatman's ..	Coghlan, John ..	8	„	1	19′ 3″	6′	N. 80° W. 29°	„	..	..	..	„	69	45	114	1,772	1,886	1	1	2	„	..	..	..	„	23/10/89
19. Coghlan's, Boatman's ..	Coghlan, John ..	1	„	1	12′	8′	W. 33°	„	..	..	..	„	28	10	38	..	38	1	1	2	„	..	..	..	„	23/10/89
20. Boatman's Creek, Boatman's	Coghlan, John ..	1	„	..	..	..	..	..	..	..	..	engine-plane	300	150	450	..	450	1	1	2	water-balance	..	..	..	„	23/10/89
21. Phœnix, Reefton ..	Harris, A. E. ..	5	„	1	20′	10′	E. 30° to 40°	bord and pillar	..	..	..	adit	610	..	610	1,992	2,602	..	1	1	hand	..	..	..	„	17/10/89
22. Inglewood, Reefton ..	Collings, A. G. ..	1¼	„	1	8′+	8′	..	open	..	..	..	..	..	200	200	4	204	..	1	1	..	..	..	..	..	17/10/89
23. Progress, Reefton ..	O'Connor, P. ..	10	„	1	12′	8′	S.E. 7½°	bord and pillar	..	..	..	adit	200	200	400	1,094	1,494	..	2	2	hand	..	..	..	natural	22/10/89
Greymouth.																									
24. Brunner, Greymouth ..	Bishop, J. ..	25	bitum.	1	8′ to 10′	all	S.W. 1 in 4	ditto	..	..	..	engine-plane	13,977	5,009	18,986	725,735	744,721	41	37	78	engine	..	..	..	Schiele fan	13/11/89
25. Coalpit Heath, Greymouth	Alexander, F. ..	13	„	1	16′	„	S.W. 1 in 4	„	2	10′ x 6′ 6′ diam.	280′ 75′	shaft	50,532	8,667	59,199	256,665	315,864	43	143	186	„	†4′ †3′ †1′ 3″ †1′ ‡10″ ‡10″	10″ 6″ 6″ 4″ 6″ 6″	250′ 250′ 90′ 90′ 250′ 250′	ditto	11/10/89
26. Tyneside, Greymouth ..	Dando, M. ..	12	„	1	16′	„	S.W. 1 in 4	„	2	10′ 6′ x 6′	116′ 25′+12′	„	..	..	..	18,398	18,398	..	..	..	..	..	..	..	..	..
27. Blackball, Greymouth ..	Schofield, R. ..	1	„	2	4′ 6″ to 12′	..	S. 30° E. 9°	opening out	..	..	..	adit	..	..	..	..	..	2	12	14	not determined	..	..	..	..	14/10/89
28. Wallsend, Greymouth ..	Bishop, J. ..	13	„	1	16′	all	S.W. 1 in 4	bord and pillar	2	11′ diam. 14′ „	670′ 660′	shaft	52,835	6,884	59,719	119,130	178,849	30	117	147	engine	3′ 6″ 3′	10″ 8″	650′ 150′	guibal fan	12/10/89

* 5 syphons varying from 1″ to 2″, lift 18′ to 24′, length 600′ to 700′. † Tangye's double-acting. ‡ Double-acting, 4 rams to each set, 8 in all.

Statistics of Workings in Coal-mines, 1889—*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 1889.			Approximate Total Output to 31st December, 1888.	Approximate Total Output to 31st December, 1889.	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.									
29. Springfield, Springfield ..	Lindop, A. B. ..	13	brown	1	7′ 6″	all	S.E. 1 in 6 to 1 in 12	bord and pillar	1	12′ x 5′ 2″	246′	shaft	1,492	690	2,182	63,347	65,529	2	4	6	engine	1′ 10″	8′	263′	steam	6/10/89
30. Canterbury, Sheffield ..	Austin, J. ..	27	″	2	2′ 3″ and 2′	″	S.70° E.21°	narrow	1	5′7″diam	140′	″	1,225	29	1,254	32,855	34,109	3	7	10	horse	1′	6″	140′	natural	2/10/89
31. Homebush, S. Malvern ..	McIlraith, J. A., Agent Brown, T., Mine Manager	17	″	1	7′	″	E. 10° S. 1 in 3	bord and pillar	2	3′ 6″ x 3′ 3′ 6′ x 3′	60′ 20′	adit	3,476	331	3,807	78,771	82,578	2	7	9	″	..	..	..	..	7/10/89
32. Snowdon, Rakaia Gorge..	Gerard, W. (owner)	..	″	1	9′ 3″	″	N. 80° E. 32°	narrow	..	..	..	″	50	..	50	190	240	..	2	2	hand	..	..	..	..	5/10/89
33. Acheron, Lake Coleridge	Murchison, John (owner)	22	anthracite	1	5′ 3″	″	S.W. 18°	″	..	..	..	″	..	..	..	195	195	..	..	..	″	..	..	..	..	4/10/89
34. Stobwood, Rockwood ..	Levick, H. ..	4	brown	1	7′ to 10′	″	S. 12°	″	1	3′ x 1′ 10″	16′	″	350	..	350	493	843	..	2	2	″	6°	3″	6′	natural	3/10/89
35. Whitecliffs, South Malvern	Leeming, W. ..	9	″	2	7′ & 5′ 6″	″	E. 5° S. 35°	″	2	3′ 6″ x 2′ 4′6″x2′6″	15′ 85′	″	1,942	122	2,064	10,414	12,478	..	5	5	″	1′ 6″	4″	90′	″	7/10/89
36. Mount Somers, Mount Somers	Jebson, D. ..	25	″	1	24′	8′	S. 60° E. 10°	bord and pillar	..	..	..	″	2,067	120	2,187	8,151	10,338	..	5	5	″	..	..	..	″	19/11/89
37. Duke's, Kakahu ..	Duke, James ..	1	″	1	3′	all	..	..	..	..	..	″	200	100	300	..	300	..	1	1	″	..	..	..	..	..
Timaru.																										
38. Wharekuri, Wharekuri ..	..	23	″	1	25′	14′	S. 60° W. 60°	narrow	1	4′ x 3′	80′	″	31	..	31	8,222	8,253	..	1	1	″	..	..	..	natural	6/2/89
39. Kurow, Kurow	Wade, J. E. ..	10	″	1	19′	all	N.E. 45°	open	1	6′ x 2′ 6″	53′	..	400	..	400	1,275	1,675	1	2	3	..	..	..	..	..	6/2/89
40. Phillips's Kurow ..	Phillips, James ..	1	″	..	indefinite		..	″	1	8′ x 6′	8′	..	30	15	45	..	45	1	..	1	..	..	..	..	..	6/2/89
Otago.																										
41. Prince Alfred No. 1, Papakaio	Willetts, John	20	″	1	8′	all	N. 50° E. 12°	bord and pillar	1	4′ diam.	42′	adit	1,659	..	1,659	27,450	29,109	2	6	8	hand	..	..	..	natural	7/2/89
42. Prince Alfred No. 2, Papakaio		13	″	1	9′	″	E. 10° S. 1 in 5	ditto	2	3′ x 3′ 4′ x 4′	40′ 75′	″														
43. St. Andrews, Papakaio ..	Nimmo, John ..	11	″	1	6′ 6″	″	E. 13°	″	2	4′ diam. 4′ x 3′	26′ 60′ x 15′	″	1,272	..	1,272	10,587	11,859	2	2	4	horse	..	..	..	furnace	7/2/89
44. Ngapara, Ngapara ..	Nimmo, G. S. ..	11	″	1	25′	7′ to 8′	N. 5° E. 1 in 4	″	1	4′6″x2′ 3″	36′	″	738	..	738	8,670	9,408	1	2	3	″	..	..	..	″	7/2/89
45. Shag Point, Palmerston..	Williams, W. H.	26	pitch	2	..	..	E. 1 in 4	″	2	13′ x 5′ 6′ x 4′	247′* 162′	shaft	8,266	1,038	9,304	199,012	208,316	15	45	60	engine	2′	6″	170′	steam	26/9/89
46. Allandale, Palmerston ..	McIntosh, A. ..	2½	″	1	4′ 6″	all	N. 60° W. 14° to 30°	″	..	..	..	engine-plane	2,392	198	2,590	21,172	4,762	3	6	9	″	..	..	..	natural	21/8/89

47. Hill's Creek, Hill's Creek	McKnight, J. ..	25	lignite	1	10′	all	E. 25°	open	..	..	..	..	119	..	119	590	709	1	..	1	..	8″	3″	10′	..	15/2/89
48. Beck and McLean, Rough Ridge	McLean, L. ..	3	″	1	15′+	15′	N. 5°	″	..	..	..	..	1,151	..	1,151	894	2,045	2	..	2	..	..	..	..	..	15/2/89
49. Idaburn, Rough Ridge ..	Andrews, R. ..	19	″	1	23′	all	N. 30° W. 3°	″	..	..	..	..	..	1,603	1,603	18,940	20,543	..	2	2	..	6″	2″	20′	..	15/2/89
50. Ida Valley, Rough Ridge	Turnbull, G. ..	19	″	1	20′	12′	N.W. 20°	″	..	..	..	..	323	..	323	1,473	1,796	1	..	1	..	6″	2½″	15′	..	15/2/89
51. Blackstone Hill, Hill's Creek	Dunsmuir, A. ..	23	″	1	12′	all	N. 70° W. 5°	″	..	..	..	..	75	..	75	210	285	1	..	1	..	..	..	..	..	15/2/89
52. Cambrian (Jones's), Cambrian	Jones, J. R. ..	28	″	1	40′	25′	W. 10°	″	..	..	..	..	800	..	800	10,888	11,688	3	..	3	..	..	..	..	..	16/2/89
53. Cambrian, Dungey's ..	Dungey, C. ..	5	″	1	16′	8′	N.W. 3°	″	..	..	..	..	1,251	..	1,251	2,560	3,811	2	..	2	..	..	..	..	..	16/2/89
54. Kyeburn, Keyburn ..	McCready, D. ..	16	brown	1	25′	12′	S. 45° W. 40°	narrow	1	3′ x 2′	10′	adit	230	100	330	13,734	14,064	..	2	2	hand	..	..	..	natural	14/2/89
55. Perseverance, Kyeburn ..	Archer, C. ..	11	″	1	14′	10′	S. 45° W. 40°	″	1	5′ x 2′ 6″	50′	″	111	10	121	5,216	5,337	..	1	1	″	..	..	..	″	14/2/89
56. Commercial, Kyeburn .. [burn	Archer, C. ..	7	″	1	8′	5′ 6″	S. 45° W. 70°	″	..	..	..	″	459	20	479	706	1,185	1	1	2	″	..	..	..	″	14/2/89
57. Commercial (No. 2), Kye-	Archer, C. ..	1	″	1	..	..	..	open	..	..	..	..	20	..	20	..	20	1	1	2	..	..	..	..	..	14/2/89
58. Alexandra, Alexandra ..	Thomson, W. ..	10	″	1	12′	6′	N. 20° E. 1 in 7½	bord and pillar	2	5′6″x2′9″ 4′6″x2′6″	60′ 50′	shaft	650	..	650	11,139	11,789	1	1	2	horse	..	..	..	natural	22/2/89
59. Macqueenville, Alexandra	Lett, R. ..	..	″	1	5′	all	S. 75° W. slight	ditto	1	4′ x 3′	62′	″	358	..	358	4,951	5,309	1	1	2	″	bucket			..	22/2/89
60. Earnscleugh, Clyde ..	Field, G. ..	13	″	1	14′	8′	S.W. 1 in 8	″	1	4′10″ x 3′	35′	adit	..	..	..	3,700	3,700	..	..	..	hand	..	..	..	natural	21/2/89
61. Waikerikeri, Clyde ..	Holt, W. ..	8	″	1	20′	..	S. 1 in 3	stoping	2	3′ 6″ x 3′ 4′ x 3′ 6″	160′ 36′	shaft	334	..	334	17,726	18,060	1	1	2	horse	..	..	..	″	21/2/89
62. Dairy Creek, Clyde ..	Collins, T. M. ..	18	″	1	20′	10′	S. 45° E. 45°	bord and pillar	2	4′ x 3′ 6″	36′	adit	..	..	..	3,723	3,723	..	..	..	hand	..	..	..	″	21/2/89
63. Excelsior, Cromwell ..	Burrowes, J. ..	8	″	1	12′	7′	E. 6° S. 60°	ditto	1	6′ x 4′	58′	″	..	..	..	2,112	2,112	..	..	..	″	..	..	..	″	14/3/89
64. Parcell and Jones's, Cromwell	Jones, E. ..	1¼	″	1	10′ 6″	6′	S. 40° W. 5°	″	..	..	..	″	349	..	349	..	349	..	1	1	″	..	..	..	″	21/2/89
65. Bannockburn, Cromwell	Clarke, A. W. N.	18	″	1	12′	6′	N. 70° W. 1 in 9	″	1	6′ x 2′ 6″	..	engine-plane adit	..	..	..	8,628	8,628	..	..	..	engine	3′	6″	50′	″	21/2/89
66. Kawarau, Cromwell ..	Pryde, J. ..	12	″	1	15′	7′ 6″	W. 1 in 4	″	2	4′ x 3′ 6′ x 2′	90′ 30′	adit	1,409	..	1,409	8,865	10,274	..	3	3	horse	..	..	..	″	21/2/89
67. Gibbston, Gibbston ..	Cowan, James ..	22	pitch	2	7′6″ & 1′6″	all	W. 22½°	narrow	1	3′6″x3′6″	130′	″	993	..	993	13,070	14,063	..	2	2	hand	..	..	..	″	18/2/89
68. Steele's, Gibbston ..	Steele, Henry ..	3	″	1	25′	″	S. 60° W. 35° to 40°	″	..	..	..	″	350	..	350	924	1,274	2	2	4	″	..	..	..	″	18/2/89
69. Cardrona, Crown Range..	Robinson, W. ..	5	″	1	20′+	20′	W. 35°	open	..	..	..	..	800	..	800	400	1,200	3	..	3	..	..	..	..	..	18/2/89
70. Birch's, Crown Range ..	Thomson, W. ..	4	″	1	10′	10′	W. 35°	narrow	..	..	..	adit	..	..	..	212	212	..	..	..	hand	..	..	..	natural	18/2/89
71. Jones's, Roxburgh ..	Jones, J. ..	19	lignite	1	25′	20′	W. 1 in 7	open	..	..	..	..	1,000	..	1,000	3,271	4,271	3	..	3	..	..	..	..	..	22/2/89
72. Perseverance, Roxburgh	Craig, James ..	2	″	1	undef.	undef.	undefined	″	..	..	..	..	654	..	654	597	1,251	2	..	2	..	..	..	..	..	22/2/89
73. Fernhill, Green Island ..	Gray, James ..	12	brown	1	19′ 6″	7′	N. 10° E. 1 in 10	room and rance	1	4′9″x3′6″	40′+50′	adit	6,219	2,286	8,505	66,873	75,378	4	14	18	hand	..	..	..	furnace	10/9/89
74. Green Island, Green I. ..	Allen, E. G. ..	17	″	1	14′	10′	E. 10° N. 1 in 10	ditto	..	..	..	″	1,660	1,536	3,196	105,002	108,198	1	5	6	horse	..	..	..	natural	10/9/89
75. Saddle Hill (Christie's No. 2), Saddle Hill	Christie, James ..	3	″	1	19′ 6″	6′	E. 1 in 10	″	2	5′ x 2′ 4′ x 4′	50′+10′ 20′	″	1,350	2,965	4,315	64,296	68,611	3	7	10	″	..	..	..	″	24/9/89
76. Bank (formerly Saddle Hill), Saddle Hill	Harris, Adam ..	6	″	1	19′ 6″	6′	E. 1 in 10	″	1	5′ x 2′ 4″	35′	″	2	40	42	4,081	4,123	..	2	2	″	..	..	..	″	24/9/89
77. Glenochiel, Saddle Hill..	Bryce, D. ..	8½	″	1	20′	8′	varies	″	1	8′ x 4′	48′	″	519	104	623	2,980	3,380	1	3	4	″	syphon			..	″	24/9/89

* Winding from 145′.

Statistics of Workings in Coal-mines, 1889—*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 1889.			Approximate Total Output to 31st December, 1888.	Approximate Total Output to 31st December, 1889.	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.									
78. Walton Park, Green Island	Loudon, J., General Manager; Shore, T., Mine Manager	19	brown	1	18′	7′	E. 1 in 9	room and rance	3	11′ x 4′ 12½′ x 4½′ 5′ x 4′	175′ 173′ 25′	shaft	13,625	4,020	17,645	351,620	369,265	7	39	46	engine	4′ 6″	11″	175′	furnace	24/9/89
79. Abbotsroyd, Green Island	Freeman, James	8½	″	1	16′	7′	E. 10° N. 1 in 10	ditto	2	4′ x 4′ 4′ x 4′	80′ 45′	engine-plane	8,908	2,195	11,103	124,256	135,359	8	20	28	″	2′ 6″	6″	47	″	10/7/89
80. Mosgiel, Mosgiel ..	Sneddon, James..	5	″	1	15′	7′	S. 1 in 10	″	2	4′ x 4′ 6′ x 6′	27′+6′ 32′	″	1,460	4,800	6,260	11,728	17,988	4	7	11	″	syphon		..	natural	17/7/89
81. Brighton, Brighton ..	Walker, James ..	3	″	1	6′ to 8′	6′	S. 80° E. 6° to N. 20° E. 12°	″	1	3′ x 2′ 6″	20′	adit	339	112	451	719	1,170	1	1	2	hand	..	..	..	″	19/12/89
82. McColl's, Brighton ..	McColl, D. L. ..	1	″	1	5′	not	yet working		1	4′ x 2′	30′	″	12	..	12	..	12	1	1	2	″	..	..	..	..	19/12/89
83. Bruce, Milton	Hardwick, N. ..	15½	pitch	1	12′ 6″	6′	varies	bord and pillar	1	4′ x 3′	20′	″	943	350	1,293	16,084	17,377	2	2	4	″	..	..	..	natural	28/8/89
84. Bruce (No. 2), Milton ..	Hardwick, N. ..	1	″	1	18′ 6″	7′	N. 30° E. 10°	ditto	1	4′ 6″ x 2′ 6″	28′	″	..	..	..	..	..	..	..	..	″	..	..	..	″	28/8/89
85. Real Mackay, Milton ..	Young, A. ..	21½	″	1	25′	8′	N.E. to E. 1 in 8	″	1	4′ 6″ x 3′	34′	″	749	..	749	13,908	14,657	2	..	2	″	..	..	..	″	28/8/89
86. Fortification, Milton ..	Reid, T. ..	5	″	1	12′	6′ to 7′	S. 60° E. 5°	″	..	..	..	″	..	..	..	1,784	1,784	..	..	..	..	..	..	..	..	..
87. Wallsend (late Cannon's), Lovell's Flat	Hewitson, R. ..	19	lignite	1	25′	all	S. 20° W. 1 in 4	open	..	..	..	..	650	..	650	4,140	4,790	1	..	1	..	..	..	..	..	28/8/89
88. Paskell's, Lovell's Flat ..	Paskell, J. T. ..	25	″	1	8′	″	N.E. 1 in 6	″	..	..	..	..	8	2	10	309	319	1	1	2	..	..	..	..	..	28/8/89
89. Gibson's, Lovell's Flat ..	Spence, T. ..	1	pitch	1	20′	..	..	..	2	11′ x 4′ 8′ x 4′	250′	..	5	..	5	..	5	5	5	10	..	..	..	..	..	27/8/89
90. Elliotthill, Lovell's Flat	Carruther, A. ..	1	″	1	20′+	6′	E. 15° to N. 5°	bord and pillar	..	..	..	adit	600	..	600	..	600	1	2	3	..	..	..	..	natural	28/8/89
91. Adams Flat, Adams Flat	Reid, J. ..	7	lignite	1	8′	all	S. 45° E. 12½°	open	..	..	..	..	167	..	167	756	923	1	..	1	..	..	..	..	..	28/8/89
92. Benhar, Benhar ..	Nelson, J. ..	26	brown	1	40′	20′	S. 17°	bord and pillar	1	4′ x 4′	48′	engine-plane	2,877	600	3,477	55,263	58,740	1	5	6	engine	steam-		jet	furnace	18/9/89
93. Morrison's, Benhar ..	Morrison, J. ..	3	″	1	6′	6′	S. 12°	ditto	..	..	..	adit	200	..	200	246	446	1	..	1	hand	..	..	..	natural	12/9/89
94. Rigfoot, Benhar ..	Aitken, J. ..	3	″	1	8′	8′	S. 12°	″	..	..	..	″	492	45	537	727	1,264	1	1	2	″	..	..	..	″	18/9/89
95. Kaitangata (No. 1), Kaitangata	Watson, W. P. Gen. Manager	14	pitch	1	30′	25′	W. 45°	″	1	13′ x 5′ 6″	392′	shaft	33,803	19,489	53,292	445,946	499,238	14	116	130	engine	..	..	..	..	..
96. Kaitangata (No. 2), Kaitangata	Shore, Wm. M. Mine Manager	6	″	2	10′ to 34′ 19′	25′	W. 1 in 4	″	1	6′ diam.	210′+10′	engine plane									″	2′	5″	384′	furnace	18/9/89
97. Castle Hill, Kaitangata ..	Carson, M. ..	2¼	″	1	14′	7′ to 8′	N. 20° E. 14°	″	1	3′ 9″ x 2′ 6″	54′+4′	adit	631	134	765	1,158	1,923	..	2	2	horse	..	..	..	natural	29/8/89

98. Wangaloa, Kaitangata	Smith, J.	9	"	1	10′ 6″	6′	E. 1 in 6	"	..	..	..	"	18	6	24	852	876	..	1	1	hand	..	..	..	"	29/8/89
99. Lesmahagow, Kaitangata	Sewell, R. M.	8	"	1	5′	all	N. slight	"	..	..	..	"	61	..	61	784	845	..	..	..	"	..	..	..	"	29/8/89
100. Crofthead, Kaitangata	Coulter, W.	3	"	1	14′	8′	N. 20° E. 10°	"	..	..	..	"	1,042	10	1,052	1,240	2,292	..	2	2	horse	..	..	..	"	29/8/89
101. Cullin's, Waikoikoi	Cullen, James	2	lignite	1	4′	all	N. 5°	open	..	..	..	..	30	..	30	30	60	1	..	1	..	..	..	..	..	12/12/89
102. Mainholm, Waipahi	Lischmer, A.	3½	"	1	14′	"	E. 3°	"	..	..	..	..	..	900	900	900	1,800	3	..	3	..	7″	3″	26′	..	12/12/89
103. Wyndham, Wyndham	Genge, T.	12	"	1	2′	"	level	"	..	..	..	..	..	30	30	1,928	1,958	1	..	1	..	..	..	..	..	9/12/89
104. Munro's, Wyndham	Munro, E.	1	"	1	3′	"	"	"	..	..	..	..	900	..	900	..	900	2	..	2	..	..	..	..	..	9/12/89
105. Parratt's, Menzies' Ferry	Kerr, D.	4	"	1	6′	2′	"	"	..	..	..	..	200	..	200	254	454	2	..	2	..	Californian			..	9/12/89
106. Menzies' Ferry, Menzies' Ferry	Morris, J.	9	"	1	6′	all	"	"	..	..	..	..	485	..	485	2,851	3,336	1	..	1	..	6″	3″	20′	..	9/12/89
107. Smyth's, Gore	Smyth, W.	4	"	1	10′+	10′	W. 10°	"	..	..	..	..	200	..	200	150	350	2	..	2	..	6″	3″	20′	..	10/5/89
108. Lieze's (jun.), Gore	Lieze, M., jun.	12	"	1	6′ to 7′	6′	S.E. 5°	"	..	..	..	..	53	..	53	929	982	1	..	1	..	..	..	..	..	6/12/89
109. McKinnon's, Gore	McKinnon, A.	8	"	1	10′	all	level	"	..	..	..	..	360	..	360	1,235	1,595	1	..	1	..	..	..	..	..	6/12/89
110. Hoffmann's, Gore	Hoffmann, J.	7	"	1	10′+	10′	N. 12°	"	..	..	..	..	40	..	40	2,269	2,309	1	..	1	..	6″	3″	12′	..	6/12/89
111. Gore (Hunter), Gore	Hunter, George	2	"	1	10′+	10′	..	"	..	..	..	..	755	..	755	655	655	3	1	4	..	..	..	..	..	6/12/89
112. Gore, Gore	Hunter, George	1	"	1	10′+	10′	..	"	..	..	..	..				715	1,470									
113. Croydon, Croydon	Tweedie, George	½	"	1	9′	9′	S. 60°	bord and pillar	..	..	..	adit	..	..	..	336	336	..	..	..	..	..	..	..	..	..
114. Heffernan's, Gore	Heffernan, P.	11	"	1	12′+	12′	W. 15°	open	..	..	..	..	145	..	145	462	607	1	..	1	..	..	..	..	..	6/12/89
115. Sarginson's, Waikaka	Sarginson, J. H.	3½	"	1	9′+	9′	N.E. 20°	"	..	..	..	..	75	..	75	110	185	1	..	1	..	..	..	..	..	6/12/89
116. Chatton (Pacey), Chatton	Pacey, W. R.	13	"	1	10′	10′	S.E. 1 in 6	"	..	..	..	..	400	..	400	4,398	4,798	2	..	2	..	..	..	..	..	7/12/89
117. Chatton (Pemble), Chatton	Pemble, Henry	12	"	2	26′ and 20′	all	90° strike N. and S.	"	..	..	..	..	800	85	885	8,980	9,865	2	..	2	..	..	..	..	..	7/12/89
118. Perseverance (formerly Mapp and McKenzie's), Chatton	McKenzie, James	3	"	1	7′ 6″ to 10′	"	N. 20° W. 15°	bord and pillar	..	..	..	adit	294	..	294	321	615	1	2	3	horse	..	..	..	natural	11/5/89
119. Pukerau, Chatton	O'Hagan, C.	9	"	1	16′	6′	W. 1 in 10	ditto	..	..	..	"	913	30	943	15,836	16,779	..	2	2	hand	..	..	..	"	11/5/89
120. Enterprise, Pukerau	McKenzie, James	½	"	1	7′	all	N. 60° W. 11°	"	..	..	..	..	..	..	..	165	165	..	..	..	..	..	..	..	..	..
SOUTHLAND.																										
121. Otama, Otama	Hunter, T.	4½	"	1	2′ 8″	"	N.E. 5°	open	..	..	..	..	200	..	200	150	350	1	..	1	..	..	..	..	..	7/12/89
122. Waimea, Riverdale	Carmichael, J.	4½	"	1	12′	"	N. 10°	"	..	..	..	..	436	..	436	2,350	2,786	2	..	2	..	..	..	..	..	13/5/89
123. Mataura (Beattie), Mataura	Beattie, James	14	"	1	12′ 6″	8′	N.W. 4°	"	..	..	..	..	1,228	..	1,228	14,204	15,432	3	..	3	..	6″	3″	22′	..	15/5/89
124. Mataura (Town), Mataura	Town, C.	3	"	1	13′	all	N. 70° W. 5°	"	..	..	..	..	1,651	..	1,651	2,843	4,494	3	..	3	..	6″	4″	15′	..	15/5/89
125. McGowan's, Mataura	McGowan, F.	2	"	2	3′ and 2′	"	N. 70° W. 1 in 8	"	..	..	..	..	12	..	12	89	101	1	..	1	..	..	..	..	..	15/5/89
126. Sleeman's, Mataura	Sleeman, C. P.	3½	"	1	4′	"	N. 70° W. 3°	"	..	..	..	..	75	..	75	170	245	1	..	1	..	..	..	..	..	16/5/89
127. Townshend's, Mataura	Townshend, E.	2½	"	1	8′+	8′	level	"	..	..	..	..	48	..	48	155	203	2	..	2	..	..	..	..	..	16/5/89
128. Edge's, Waikaka	Edge, A. A.	11	"	1	14′	all	N. 60° E. 15°	"	..	..	..	..	220	20	240	325	565	1	..	1	..	..	..	..	..	7/12/89
129. No. 14, Waikaka	Edge, W. H.	2¼	"	1	8′ 7″	"	W. 35°	bord and pillar	..	..	..	adit	50	..	50	40	90	..	2	2	hand	..	..	..	natural	7/12/89
130. Nightcaps (No. 1), Nightcaps	Handyside, W., Gen. Manager	9	pitch	1	2′ 4″	"	N.E. 1 in 7 to 1 in 2½	ditto	2	6′ x 4′ 6′ x 3′	10′+16′ 135′	engine-plane adit	11,000	..	11,000	63,544	74,544	13	6	19	engine horse ..	3′ 9″	6″	135′	furnace	7/5/89
131. Nightcaps (No. 2), Nightcaps	Lloyd, J., Mine Manager	7	"	2	15′ and 10′	"	N.E. to E. 1 in 4 to 1 in 6	"	2	4′ x 3′ 6′ x 4′	'50 58′+16′															
132. Nightcaps (No. 4), Nightcaps	..	1	"	1	9′	"	S. 80° E. 5°	open	..	..	..	..														
133. Flett's, Nightcaps	Flett, S.	2	"	2	3′ 4″ to 5′ 6″ 2″ to 3′	"	S.E. 10°	"	..	..	..	..	..	..	..	50	50	..	..	..	..	..	..	..	..	7/5/89

Statistics of Workings in Coal-mines, 1889—*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 1889.			Approximate Total Output to 31st December, 1888.	Approximate Total Output to 31st December, 1889.	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.		
													Tons.	Tons.	Tons.	Tons.	Tons.									
134. Wallace, Nightcaps ..	Reid, William ..	1	pitch	1	10′ & 4′	all	S. 80° E. 5°	open	..	..	..	..	250	..	250	1,315	1,565	3	..	3	..	..	..	..	..	7/5/89
135. Wairio, Nightcaps		9	″	1	9′	″	N.E. 5°	″	..	..	..	..														
136. Wairio (No. 2), Nightcaps	Knight, James	9	″	1	9′	6′	E. 10°	bord and pillar	..	..	..	adit	..	..	..	2,909	12,909	..	..	..	hand	..	..	..	natural	7/5/89
137. Morley Village, Nightcaps	Alley, J.	2½	″	1	3′	all	S. 80° E. 5°	open	..	..	..	..				541	717	1	..	1						
138. Morley Village, Nightcaps	Alley, J.	1	″	1	4′	″	N. 60° E. 5°	″	..	..	..	..	176	..	176	427	427	..	..	..	..	..	..	..	..	7/5/89
139. Hokonui, Winton ..	Somerville, W. ..	3	″	1	12′ to 3′ 6″	8′	W. 14°	bord and pillar	..	..	..	adit	170	215	385	6,684	7,069	2	4	6	hand	..	..	..	natural	14/5/89
140. Fairfax, Fairfax ..	Graham, P. S. ..	11	lignite	1	5′ 6″	all	N. 60° W. 4°	open	..	..	..	..	754	..	754	5,877	6,631	3	..	3	..	..	..	..	..	10/12/89
141. McDowall's, Fairfax ..	McDowall, H. ..	3	″	1	5′	″	S.W. 1 in 20	bord and pillar	..	..	..	..	..	..	..	1,384	1,384	..	..	..	..	..	..	..	..	..
142. Isla Bank, Fairfax ..	McIntosh, James	9	″	1	6′	″	N.W. 5°	ditto	..	..	..	..	270	..	270	620	890	1	..	1	..	..	..	..	..	10/12/89
143. Orepuki, Orepuki ..	Lindsay, J. B. ..	4	pitch	2	9″ 5′	″	S. 75° W. 15°	″	..	..	..	adit	285	..	285	4,186	4,471	2	..	2	hand	6″	2″	21′	natural	9/5/89
144. Popham's Cluny, Orepuki	Popham, James ..	1	lignite	1	3′	″	S. 12½° W. 8°	open	..	..	..	..	17	..	17	80	97	3	..	3	..	..	..	..	..	..
													499,160	87,285	586,445	5,060,303	5,646,748	466	1251	1717						
Output from mines included in former statements, and whose operations were suspended prior to 1888													..	..	..	..	177,226									
Less output of four mines where operations were resumed, and the output of which was included under this heading last year													..	..	..	..	4,697									
Total output																	5,819,277									

ACCIDENTS IN COAL-MINES.

No. and Date.	Name of Mine.	Locality.	Cause of Accident.	Above Ground.	Below Ground.	Fatal.	Non-fatal.	Name of Sufferer.	Remarks.
			North Island.						
1889. 1. Jan. 27	Whauwhau ..	Whangarei	Winding-drum ..	1	..	1	..	Alex. Love ..	He got his arm jammed in the winding drum, and had it amputated, but he only lived for six weeks after the accident.
2. July 13	Kawakawa ..	Bay of Islands	Riding on a truck	..	1	..	1	James Rouse	Was riding on a truck used to haul water out of the mine when it capsized, and his leg was broken.
3. Oct. 8	Taupiri Reserve	Waikato ..	Railway-wagon ..	1	..	1	..	William Gilley	Was braking a railway coal-truck, when his foot slipped, and train passed over his ankle. He had his leg amputated, but died shortly after.
			Middle Island.						
4. Jan. 11	Wallsend ..	Greymouth	Fall of coal ..	..	1	..	1	J. McMinn.	
5. „ 19	Coalbrookdale	Westport ..	Truck on incline	1	..	1	..	C. Ribey.	
6. May 13	Wallsend ..	Greymouth	Fall of coal ..	..	1	..	1	M. Kirkwood.	
7. „ 27	KaitangataNo.2	Kaitangata	„ ..	..	1	..	1	Wm. Dixon.	
8. „ 28	„	„	„ ..	..	1	1	..	James Howard	Inquest attended.
9. June 4	Coalpit Heath	Greymouth	„ ..	..	1	..	1	J. King.	
10. „ 4	Nightcaps No. 4	Nightcaps	„ ..	1	..	..	1	H. Robertson.	
11. Sept. 18	Coalbrookdale	Westport ..	Trucks above ..	1	..	..	1	W. Thomas.	
12. Oct. 15	„	„	Fall of stone ..	..	1	..	1	H. McDonald.	
13. „ 18	Coalpit Heath	Greymouth	Trucks below ..	..	1	..	1	E. Smith.	
14. Dec. 21	Wallsend ..	„	„ ..	..	1	..	1	John Curry.	
15. „ 21	Coalbrookdale	Westport ..	Fall of coal ..	..	1	..	1	T. Matheson.	
				5	10	4	11		
				15		15			

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