(No. 64.)

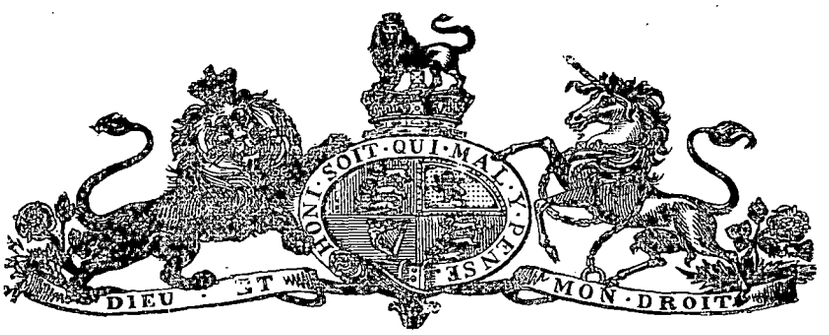
1890.

PARLIAMENT OF TASMANIA.

REPORT OF THE SECRETARY OF MINES, FOR 1889-90 :

INCLUDING INSPECTOR OF MINES' REPORT.

Presented to both Houses of Parliament by His Excellency's Command.



REPORT OF THE SECRETARY OF MINES.

Office of Mines, Hobart, 21st July, 1890.

SIR,

I HAVE the honor to submit my Report upon the Mines Branch of the Lands and Works Department for the year ending 30th June, 1890.

Appendices.

Appended will be found Reports of the various Commissioners upon the state of the Mining industry in the Divisions under their charge. The Report of the Inspector of Mines, the Annual Report of the Geological Surveyor, Reports by the Geological Surveyor upon the Blue Tier Tin-field, and on the state of the Mining industry on the West Coast; Return of the operations of the Diamond Drills, with Tables showing the yields of Gold, Tin, and Coal; the number of persons engaged in mining; the number of Leases and area of land held for mining purposes; the net revenue paid to the Treasury from Mines; with the amount of Dividend Tax paid by Mining Companies.

General remarks.

Although it has been currently held that during the past year the Colony has suffered from what is styled "a depression in mining," the facts which will be revealed in this Report will justify the statement that such depression as has existed has been rather a depression in scrip-broking and speculation than in the legitimate industry of mining. True, there has been a falling off in the quantities of gold and tin won, and a consequent reduction in dividends paid; but, as will be shown hereafter, the reasons for this are of a temporary and explainable character only, and are no evidence of any decadence of the industry.

The only discovery of present importance which has been reported during the year is that of an alleged enormous deposit of silver-bearing ore at Mount Dundas, a locality bearing about 7 miles N.E. of Mount Zeehan, on the West Coast of the Colony. This field at this moment is exciting a large amount of attention, both here and in the neighbouring Colonies. So far, the roughness and inaccessibility of the country has precluded anything beyond assay tests. Other discoveries of minor importance have been made in various parts of the Colony, and are steadily developing.

Compliance with the labour covenants of leases is a subject very frequently discussed in the public press, and the opinions expressed are as varied as they are numerous. Whilst, admittedly, it is to the interest of the state and of the community that the earth's riches should be wrung from her as speedily as possible, and that anything like systematic "shepherding" should be discountenanced, a rigid enforcement of the labour covenants would be disastrous in its effects. It would, in the unsettled parts of the Colony,—the West Coast, for instance,—force leaseholders either into a useless and unwarranted waste of the capital at their disposal, or the other alternative of surrendering their claims: neither of which is desirable from any point of view. I have, therefore, felt it to be my duty to advise that until reasonable facilities exist for the transport of machinery and the treatment or carriage of the mine products, every application for forfeiture shall be dealt with upon its merits; and unless it can be shown that the non-compliance is avoidable, no forfeiture shall be granted.

A most encouraging sign of confidence in the mineral wealth of the Colony has recently been afforded by the purchase of a considerable number of mineral sections by English and other foreign companies and persons, which will lead to the expenditure of a large amount of outside capital in opening up the mines. The value to the Colony of this departure cannot be over-estimated, and it is most earnestly to be hoped that the mining community will, upon being satisfied of the *bona fides* of foreign investors, be prepared to deal honestly and fairly with them, for by so doing they will be acting in their own truest interest, and be fostering the introduction of capital, without which their industry must languish.

Gold. The yield of gold for the year has been 29,244 ounces, as against 42,003 ounces for the preceding year. The falling off has occurred mainly upon one goldfield, Beaconsfield, where, owing to inadequate pumping appliances, work in the lower levels has been greatly retarded. Improved machinery is about to be erected, and it is anticipated that a largely increased yield will be the result. A discovery which bids fair to be of some importance has lately been made at Middleton's Creek, on the Pieman River, West Coast.

The New Golden Gate Mine at Mathinna continues to give excellent returns; and although only in its infancy, gives promise of permanancy and increased richness.

Silver. The recently discovered field at Mount Dundas, before alluded to, is causing some excitement owing to its alleged richness and extent. So far, only assay tests have been made, and being situate in a wild rough country some time must elapse ere it will be possible to submit any quantity of the ore to a furnace test. Some 16,000 acres have been marked off for lease. A road is in course of construction, and settlement is in progress.

At Mount Zeehan steady development is going on. Machinery has been erected upon several claims. Lodes are being proved, and all being made ready for a large output of ore so soon as the railway now in course of construction shall be complete. Under great difficulties, and at large cost for transit, some tons of ore have been sent for treatment, with, in every case, most satisfactory results.

At the Heazlewood and Whyte River fields much work is being done, but until the road now in progress is completed no real test of the value of the mines here can be had.

Tin. There has been a falling off of 713 tons as compared with last year. This is attributable partly to the dryness of the late summer, partly to cessation of work owing to reorganisation of companies, and also to much of the shallow alluvial ground in the North-Eastern Division having been worked out.

The celebrated Bischoff District, our chief producer, has yielded some 259 tons less ore this year than last.

Copper. The large deposit of this metal at Mount Lyell is temporarily unworked, owing to the difficulties of transport.

Bismuth. An effort is being made to open up a deposit of this mineral at Mount Ramsay, distant some 14 miles S.W. of Mount Bischoff. The deposit was reported upon some years ago by Professor Ulrich, and stated by him to be "a discovery representing to my knowledge one of, if not the most, important and richest made of this rare metal in recent times."

Coal. No new discoveries have been made during the year. The output of coal is steadily increasing, the quantity raised during the past year being 40,970 tons, or 6145 tons in excess of the previous year, and this in the face of the competition of Newcastle coal brought hither by inter-colonial steamers, and sold at the same, or even less price than the best native coal.

It is satisfactory to note that Tasmanian coal is finding an increased market in Victoria. The quantity exported during the year was 8744 tons from one mine only.

Cement. A discovery which bids fair to be of very considerable commercial importance has been made at Maria Island. The stone appears to be unlimited in quantity, very easily treated, and the cement manufactured therefrom to be of excellent quality. Steps are being taken to commence the manufacture upon a large scale.

Division of the Colony. For departmental convenience the Colony is divided into Districts, as follows:—The Northern and Southern, comprising the country on the right and left banks of the River Tamar as far west as the River Forth, and on the east to the Scottsdale District, with such mineral country as there is in the southern portion of the Colony, and includes the gold-fields of Beaconsfield, Lefroy, and Lisle. The North-Eastern District comprises the whole of the north-eastern country, including several important tin-fields, with the gold-fields of Mount Victoria and Waterhouse. The Eastern District comprises the eastern portion of the Colony, and includes the tin-mining centres at Ben Lomond Weldborough, and Gould's Country, with the extensive coal-bearing country around Fingal and Seymour, and the gold-fields at Mangana and Mathinna. The Western District embraces the wide area of country extending from the River Forth northwards, southwards, and westwards to the sea; it includes the celebrated tin mines at Mount Bischoff, an extensive area of tin-bearing country at Heemskirk, the silver-fields at Mount Zeehan and Heazlewood the gold-field at the Linda, and other more or less important mining centres.

The Inspector of Mines. The report of this officer is annexed. I much regret that the number of fatal accidents during the year has been larger than usual.

This officer (who also acts as Inspector of Mines) arrived in the Colony from New Zealand, and entered upon his duties in September last. In addition to his other work, it is intended that he shall form classes for the purpose of giving practical instruction in technical matters relating to mining in various mining centres. A valuable Annual Report, together with Reports upon the Blue Tier Tin Field, and upon the state of the Mining Industry on the West Coast, by this officer, will be found annexed. The Geological Surveyor.

The staff of the offices at Hobart and Launceston has undergone no change. Departmental Staff.

During the year 56 new companies have been registered. The Mining Companies Acts.

Only one drill has been at work during the year. It was employed for the greater part of the year in searching for the underlay of the celebrated Tasmania Reef upon the Phœnix Claim adjoining, and after a great struggle, owing to the exceptionally difficult nature of the country, was successful in finding it. The details of the bore will be found annexed. Diamond Drills.

One company only—viz., the Moonlight—is utilising this vote. Work at their claim is slowly proceeding. Three companies—viz., the New Native Youth at Lefroy, the Lefroy at Beaconsfield, and the West Cumberland at Heemskirk—which had each £1000 allotted, did not utilise the vote, but allowed it to lapse. Deep-sinking Vote.

The experiment of voting a direct money aid to mining has not been a success. In 1888 the sum of £3000 was voted by Parliament. Of that sum £2800 was applied for, and £1900 allotted, but of this £1900 only £967 was spent. Taking this and the lapsing of the Deep Sinking Vote as a clear indication that those for whose benefit the money was provided did not care for it, no further vote has been included in the Estimates. Aid to Mining Vote.

Various causes have contributed to delay the completion of this work. It is anticipated that it will be completed and handed over to the Board about the 21st of August next, and when in full operation will comprise 33 miles of main race and nine miles of branches, and will convey some 50 heads of water from the Mussel Roe River through and on to an extensive area of stanniferous country hitherto unworked for lack of water. Mount Cameron Water-race.

The Mount Cameron Water-race Board, consisting of the Secretary of Mines, the Inspector of Mines, the Commissioner of the Division, and two Members appointed by the Government, will have control of the whole Race when complete. The middle section—namely, the 12 miles originally purchased by the Government—came under their control in January, 1888, and after undergoing some extensive repairs sales of water commenced in August of that year. From that date up to the 30th June last 839 heads of water have been sold, yielding a revenue of £644 12*s.* 3*d.*, of which sum £155 13*s.* 3*d.* has been carried to credit of the Sinking Fund up to 31st December last. Sales during the past year have been greatly interfered with owing to extensive damage done to the Race by an abnormally high flood in November last; and, moreover, it is not to be expected that much revenue could have been derived from this portion of the Race, as it passes through barren country where there is no demand for water. When the whole work shall be completed it is anticipated that the Race will deliver 50 heads of water continuously; that there will be a full demand for it at a remunerative rate; and that the result will be a fair return for the outlay. The 12 miles of Race purchased from the Company will, however, for some years be the weak link in the chain, and must be expected to be a source of expense in repairs and renewals of fluming and weak spots.

The Board have held four meetings during the year, and have made all arrangements necessary for taking over and working the Race when complete.

I have the honor to be,
Sir,
Your very obedient Servant,

F. BELSTEAD, *Secretary of Mines.*

The Hon. the Minister of Lands and Works.

REPORTS OF COMMISSIONERS.

Mr. Commissioner Glover, in charge of this Division, reports :— Northern and Southern Division.

During the past twelve months the partial depression of mining prospects in one portion of the northern division, the Lefroy Gold-field, has been more than counterbalanced by the buoyancy and brighter prospects obtaining in other portions. The two mines on the Golden Point line of reef at Lefroy, which, after long abandonment, were resuscitated some two years ago with sufficient hopes of success to induce the re-erection of machinery, have again lapsed into inactivity without undergoing any actual prospecting. On the New Native Youth line the principal mine, which, having attained a depth of 800 feet and yielded a large quantity of gold, subsided into inactivity for several years, but which, two years ago, again became the scene of active operations, is still undergoing exploration at existing levels, but as yet without success. Lefroy.

On the New Chum line the two principal mines, which had in the past given such splendid yields of gold, and had more recently been amalgamated under one proprietary, but operations on which had for the last year been carried on in a desultory manner from want of capital, have just been placed under a new organization, by an association of capital, to enable effectual mining to be prosecuted by the indispensable operation of deep-sinking, and hopes are again revived that this once prolific source of gold production will resume its former position. The total yield from Lefroy for the year was 762 ounces.

Beaconsfield. Here mining operations are proceeding with all energy and activity. The various leased sections bounding the claims on the celebrated Tasmania reef are being actively prospected by the holders in the expectation of finding the continuation of the said reef in their respective sections. That on the north-east is also, in addition to the ordinary mining, employing the Government diamond drill, No. 1, in boring for the reef. On the contiguous section on the south, known as the "Phœnix," the same drill has been successfully employed to intersect the Tasmania reef on its southerly "underlay," having fully accomplished this object at a depth of 730 feet, proving not only the continuance of the reef at that depth, but its continued richness. The development of a new mine at that spot has been commenced. The work on one of the western sections succeeded in discovering a reef supposed to be a continuation of the desired one, and its development is proceeding with fair results; and on the other leased sections to the westward the work of mining is still actively proceeding. The two original productive mines on the Tasmania reef, now amalgamated under one Company, having attained a depth of 450 feet, the constant difficulty of coping with the subterraneous water without adequate machinery has resulted in the exclusion of the miners from the lower and richer levels, except at rare intervals and for very short periods. To this circumstance is to be attributed the recent serious reduction in the yield of gold from Beaconsfield. But as the necessary steps have at length been adopted to procure adequate pumping machinery from England, as soon as this shall be accomplished, the hitherto obstacle of water will be overcome, and the richness of the reef at those lower depths (as actually proved and visible) being equal to the richest obtained in the past, the probability is manifest that, with the contributions of other mines which are in a fair way of development, the gold production of Beaconsfield is destined in the near future even to exceed its yield in the past. Further, on this gold-field an alluvial enterprise remains to be noticed, which is likely to prove of importance, although situated on private property. Among the various expensive efforts which have been made by certain capitalists in Sydney to prove the deep alluvial lead presumed from geological conditions and logical deductions to exist along the foot of the eastern slope of Cabbage Tree Hill, a diamond drill has recently been employed for the purpose. This bore having passed through some 15 feet of "wash," at a depth of 387 feet, is reported to have revealed very rich prospects. If this should prove to be a *bonâ fide* discovery it will lead to a number of alluvial mines being established on the contiguous crown land which occupies the line onwards. The total yield of gold from Beaconsfield for the past year was 19,567 ounces, value £71,362.

Middlesex Plains. On the Middlesex Plains Goldfield nothing worthy of mention has transpired, but the work of prospecting is being carried on upon several of the leased sections, some 20 men being employed thereon.

Lisle. On the alluvial goldfield of Lisle the number of diggers still keeps up to an average of 50, who make satisfactory earnings, many of them working extended claims at a greater depth on the partially worked and abandoned ground; and the quantity of gold obtained is, as nearly as can be estimated, about 1200 ounces for the year.

Ilfracombe. The mineral paint manufacturing industry at Ilfracombe, which has been for some time suspended, will, I am informed, be resumed on the arrival from England of a manager expert in the manufacture, together with the proper appliances for carrying on the industry on a sufficiently large scale.

George Town. During the past year coal was discovered about three miles N.E. from George Town on private land, but nothing in the way of development has been done. An association, however, has obtained a prospecting area of 320 acres of crown land adjoining for the purpose of boring for coal, but nothing has yet been reported.

No. 1 diamond drill was employed successfully, as before stated, by the Phœnix Gold Mining Co. The details of the work are annexed, and it is at present operating for the East Tasmania Co. at Beaconsfield. No. 2 drill has not been employed.

North-Eastern Division. Mr. Commissioner O'Reilly writes thus as to the Division under his charge :—

Gold.

Mount Victoria. "Since my last annual report there has not been any improvement in the condition of gold mining in this district. Operations, principally prospecting, have chiefly been confined to the Mount Victoria locality, where, on an average, about twenty men are employed. But a small quantity of quartz has been crushed in connection with prospecting operations. The yield of gold from a trial crushing on one of the claims was found to be very satisfactory, 37 tons of quartz having yielded 61 oz. 14 dwts.

Waterhouse. "At Waterhouse prospecting operations have been resumed on two of the claims—viz., the Southern Cross and the Gold and Pyrites Mining Coompanies, two men being employed on each claim preparing quartz, &c. to be forwarded to Victoria for treatment.

Average number of men employed	24
Quartz crushed	334 tons.
Gold won	237 ounces.

Tin.

Upper Cascade and Ringarooma. "During the past year mining operations have not been so actively carried on at the Upper Cascade and Ringarooma localities as in former years. On an average fifteen Europeans and seventy-five Chinese miners have been employed, and about 100 tons of tin ore have been raised.

"But little has been done towards prospecting or developing the tin lodes in the Upper Cascade locality. At Mount Maurice one claim only is now being worked, by a party of five Chinese.

"Since my last Report there has been some depression felt in the state of mining in the Branxholm District, caused in a large measure through the stoppage by the Arba Tin Mining Co. of mining operations, and consequent discharge of a large number of European miners. It was alleged that the discontinuance of work was brought about principally by the flooding of the mine by water percolating from the adjoining mine held by the Ormuz Tin Mining Co., and which led to a dispute between these companies, now settled by arbitration. I am informed that the working of this mine will soon be resumed, when it may reasonably be expected that, as in the past, large yields of tin ore will continue to be raised therefrom. At the Ormuz Co's. claim mining operations are carried on now by European labour, and it is stated that the prospects of this mine at present appear more encouraging and hopeful through recent developments. **Branxholm.**

"At the Bismarck Tin Mining Co's. Claim three Europeans and thirty-six Chinese miners are employed, who have raised during the past three months seventeen tons of tin ore. In the Ruby Flat and Branxholm Creek localities there are several small claims at work producing satisfactory returns.

"The Ringarooma Valley Tin Mining Co. are carrying on operations with much enterprise, and employ a large number of European miners.

"At Brothers' Home considerable depression has been felt, brought about principally through the Brothers' Home No. 1 Tin Mining Co. having ceased to carry on mining operations, and consequent discharge of 114 European miners. This Company has lately been re-formed, and work is now resumed at the mine, so far, I understand, with encouraging results, notwithstanding the difficulties and expense incurred in raising the ore by underground mining. **Brothers' Home.**

"The large number of men usually employed by the Briseis Tin Mining Co. has been considerably reduced, the works carried on being principally of a preparatory character towards the opening of the mine and facilitating the raising of tin ore. The Krushka Brothers' Claim continues to produce satisfactory yields, and apparently will do so for years to come.

"The Triangle and North Brothers' Home Co's. Claim is now worked on tribute by twenty-three European miners, with every reasonable prospect of success. This is the most numerous party of European tributors in this district, and it is much to be hoped that their spirited enterprise and industry in entering on so large an undertaking will be amply rewarded. Several of the small claimholders in the localities of Main Creek and Lower Cascade River are actively engaged in mining operations, and doing fairly well.

"Steady and satisfactory progress has been made in the working of the claims in the immediate vicinity of Moorina, and the yields are looked upon as remunerative. **Moorina.**

"The Pioneer Tin Mining Company's claim at Bradshaw's Creek is now worked on tribute by a party of thirty Chinese, with two Europeans, who have raised during the past three months about 20 tons of tin ore. The prospects of this mine are very good—indeed, they seem to improve as the claim becomes more opened out. **Bradshaw's Creek and Wyniford River.**

"Mining in the Wyniford River locality is carried on with a fair amount of vigour, and the yields, on the whole, are considered remunerative. The Argus Company's mine, formerly worked by European miners on wages, is now wholly mined by 35 Chinese tributors, and the output of tin is looked upon as satisfactory,—about 38 tons having been raised during the past three months.

"The Garibaldi Tin Mining Company's claim continues to produce large yields of tin ore,—the output of tin ore during the past twelve months being 261 tons, raised on tribute by a party of 50 Chinese. The prospects of this mine appear very promising. There are several small claims in this part of the District now being worked producing fairly remunerative returns, and, on the whole, the quantity of tin raised is satisfactory.

"The extent of mining operations in this locality is very limited,—carried on principally by Chinese. The Colossus Tin Mining Company have been working their claim for some time with European labour, but the yield of tin has not been so large as anticipated, and the cost of pumping the water from the Ringarooma River to supply the workings at the mine must form a considerable item in the working expenses of the claim. **South Mount Cameron.**

"Many of the claims in the Mount Cameron District have suffered severely through a heavy flood in the early part of last summer, which caused the bursting of dams and consequent loss of water conserved for carrying on mining operations. The stoppage also of the supply of water from the Esk Company, caused by the damage their pumping plant received through the flood, considerably retarded mining operations during the early summer months, and caused thirty-four miners to cease mining for a period of over two months, during the time repairs to the above works were being effected. However, the dams were promptly repaired; a good supply of water secured from the winter rains; and mining is now actively carried on with fair yields. **Mount Cameron and Gladstone.**

"As the completion of the Mount Cameron Water-race by the contractor for the Government is now looked forward to at an early date, it may be reasonably expected that the large extent of tin-bearing lands in its immediate vicinity will be extensively mined, and no doubt large returns of tin ore produced. The Chinese miners are already flocking in large numbers to Gladstone, and will be customers to a considerable extent for the water supplied from the race.

"The total output of tin ore from the North-Eastern District for the year ending 30th June, 1890, amounts to 1921 tons 14 cwt., as against 2216 tons 14 cwt. for the corresponding period of 1889,—there being a decrease on the former year's supply of 295 tons. **Tin Ore shipped.**

The following return shows the quantity shipped in each year during past years :—

	Boobyalla. Tons.	*Bridport.* Tons.	TOTAL. Tons.
For year ending 30th June, 1887	994	888	1883
„ 30th June, 1888	1125	728	1854
„ 30th June, 1889	1133	1082	2216
„ 30th June, 1890	1113	808	1921

"I attribute the decrease of 295 tons in the past year in a great measure to the stoppage of mining by the Brothers' Home No. 1 Tin Mining Co. and the Arba Tin Mining Co. Those claims were very large producers of tin, the former company having raised during the year ending 30th June, 1889, 313 tons of tin ore, and for the month of July, 1889, (included in this year's returns), 40 tons; after which mining operations ceased. The outlet of these claims for forwarding tin to Launceston was by Bridport or Scottsdale, and it will be seen from the foregoing returns that the decrease in the quantity of tin forwarded by Bridport or Scottsdale for the year as compared with 1889 is 274 tons 11 cwt., while the decrease from Boobyalla for similar period is only 19 tons 19 cwt.

"I look forward with confidence to a large increase in the output of tin for the coming year as compared with the last.

Mineral Applications. "During the past year the department has received and dealt with 79 mineral applications from this district, embracing 1904 acres. Of the above, 63 applications, covering 1580 acres, were made by Europeans, and 16 applications, covering 324 acres, by Chinese. A considerable proportion of the above embrace lands formerly held under lease but subsequently forfeited or cancelled. A very large extent also has been taken up by working miners.

Water Rights. "There have been 13 applications for water-rights, embracing 23 sluice-heads of water; about 10 of the above being made by Europeans, including 20 sluice-heads, and three by Chinamen for six sluice-heads. Nearly all the available water within easy distance of claims is now secured under water-rights.

Number of Miners employed. "During the past year an average of 284 Europeans and 564 Chinese miners were employed at the mines.

General Observations. "Depression has been felt in connection with the tin-mining industry of this District during the greater part of the last year, but it appears to be of a temporary character, and already there are apparent signs of its passing away. The discharge of a large number of European miners employed by the Arba and Brothers' Home No. 1 Tin Mining Companies (before referred to), in all, I would say about 174 men, was very materially felt, not alone in the reduced quantity of tin ore raised, but in an especial manner by the storekeepers and other persons engaged in trade in this District, and consequent cause of complaint by them of the "dulness of the times." There is no doubt that the gradual absorption by the taking on tribute working by Chinese miners, of several of the principal large-yielding mines of the District, such as the "Argus," "Garibaldi," and "Pioneer," &c., upon which European labour could fairly compete with Chinese, has much to do with the complaints referred to of tradespeople in those localities of the "dulness of the times," as it may also with merchants in Launceston, so far as their trade in this District is concerned, for it practically means a large withdrawal of custom from European traders and a concentration thereof with Chinese dealers. As the Chinese but seldom deal with Europeans so long as they can be supplied by their own people with the articles they may require, consequently the trade of this mining district, if the present system continues of employing Chinese labour on tribute, will gradually, in a very large measure, pass from the European dealers and merchants to the Chinese storekeepers, &c. The system hitherto adopted by mining companies working of working their claims by European day labour is now gradually passing away and drifting into working such by miners on tribute, and it is gratifying to observe that European miners are becoming alive to the fact that if they are at all to hold their position in this district they must combine together and work on tribute also. There are now several claims worked by Europeans on tribute, and, so far as I can learn, all are doing fairly well, and I look forward to a much larger number of European miners being employed on tribute during the coming year.

"There is a large quantity of land in this district held by leaseholders or mining companies on which no work is being done. It is stated that the West Coast mineral country has drawn a considerable amount of capital that might otherwise have been invested in this district. Some experienced prospectors belonging to this district who have been absent during the greater part of last year on the West Coast have now returned, and I am informed they will again follow their former pursuits in this district.

"On the whole, I do not observe any grounds in the present state of mining in this district for causing me to depart from the favourable opinion I have hitherto expressed in former reports as to its progress and permanency for a considerable time.

Eastern Division. Mr. Commissioner Dawson reports as to his Division :—

Alluvial Tin Mining. "The yield of tin from the alluvial does not vary much. About the same number of men are employed, and the rate of wages continues from 6*s.* 6*d.* to 8*s.* 4*d.* per day. There is a large area of tin-bearing ground about 6 miles from St. Helen's that will shortly be tested by the St. Helen's Tin Mining Company, who are pushing on their works. The intake of their water-race is from the George's River. The race is now surveyed, and will be about 14 miles in length. I am informed that the Company intend to test their ground with water from the Clio Race, which is about seven miles long, before cutting their race from the George's River. It is to be hoped that this company will meet with the success it deserves, for the thorough business way that they are going to work.

Lode Mining. "The Full Moon Company at the Blue Tier, and the Anchor Company near the Junction, are the only Companies that may be said to be engaged in developing their lodes. The former company have erected 'Huntingdon's Mill and Giant Rock Breaker,' together with Frue's Vanners. 1854 tons of stone have

been treated for 25 tons 1 cwt. of tin ore. The boiler power does not seem nearly sufficient for extensive operations. The engine is only 12-horse power.

"The Anchor Company, I am informed, intend to adopt a portion of the Huntingdon machinery, but intend to use their own stampers for crushing. With their magnificent water-power, this Company's prospects promise success. Lode-miners are looking forward with great interest to this new development in lode-mining. **Lode Mining.**

"There is a good deal of preparatory work being done in this neighbourhood, and the prospects are encouraging. The existence of valuable tin lodes in that locality is undoubted, and only capital and energy are required to develop them. **Ben Lomond.**

"This industry is now almost confined to Mathinna; but, with the exception of the New Golden Gate Company, not much is being done. The value of gold raised from this mine during the past year has been £14,955. A considerable amount of legitimate prospecting is being done both in the vicinity of Mathinna and Mangana. **Gold Mining.**

"The winding-up of the Company at the Scamander, whose operations were confined to mining on Mr. Steele's private property, brings this industry at present to a close in this District. **Silver Mining.**

"The Mount Nicholas and Cornwall Mines have now fairly settled down to steady work. The yield of coal for the past year was 35,872 tons. **Coal Mining.**

"In conclusion, I do not think that I am too sanguine in saying that the mining interest in this District is in a healthy condition.

"Although the finds of tin ore have not been large, still we have large areas of ground that will pay as soon as a good supply of water is obtained from the George River. The operations of the St. Helen's Tin Mining Company will soon be able to prove this. Should the Company have more water than they require, no doubt they will be able to satisfactorily dispose of their surplus to holders of sections in the vicinity of the Company's ground."

The Registrar resident at Waratah reports:— **North-Western Division.**

"A fair amount of prospecting has been done in this Division during the year, at the Rocky River, Long Plains, and elsewhere the results have not been important so far. **Gold.**

"At the Paradise River a good find has recently been reported, and a considerable quantity of gold obtained.

"At Specimen Reef work is going on in a desultory manner, owing chiefly to deficiency of water.

"The Whyte River District is being well prospected, and the reports therefrom are highly encouraging: all the claims are in full work in that neighbourhood. At the Heazlewood also a fair amount of work is being done. The want of a road is the great obstacle in the way of progress in this direction; so soon as the road now in course of construction is complete, better things may be looked for. **Silver.**

"The scarcity of water has seriously diminished the output of tin at Bischoff. The Stanhope Company have stopped working and discharged all hands, which has thrown 47 men out of employment. It is contemplated to erect machinery on the North Valley side, and to work the mine from that side. **Tin.**

"Operations have commenced to work the deposit of this ore at Mount Ramsay. Little has been done at present, but it is expected that early arrangements will be made to develop the mine. **Bismuth.**

"On the whole, I think the mining industry in this Division is in a very healthy state.

Mr. Commissioner Fowell in charge of this Division writes:— **Western Mining Division.**

"I can with confidence state that the mining industry has steadily progressed during the past 12 months. The Zeehan field bears evidence of active work and steady development.

"Mount Dundas is the scene of considerable excitement, and gives promise of great value and extent. Already some 16,000 acres have been marked off under application for lease, and upon some of the sections a considerable amount of work has been done. The broken nature of the country will enable most of the lodes to be worked by adits, thus avoiding the heavy expense of pumping and winding machinery. This field is some 5 miles north-east of Zeehan. The road has been partially cleared and has a good grade, but, as yet, is otherwise in a state of nature, and in a terrible condition for travelling and for the conveyance of such tools and necessaries as are required by those on the field.

"Some little tin-mining is being done in the vicinity of Mt. Agnew and Heemskirk, with a fair amount of success, but the exceptional dryness of the season has materially interfered with the output of ore.

"I regret to report the closing of the workings at the King River, the Princess and the Macquarie Company's mines; after a considerable amount of prospecting and outlay, their working has, unfortunately, proved unremunerative. Some further prospecting and testing is in progress at the Princess Extended. At the Madam Howard, at Howard's Plains, the work of development is steadily and satisfactorily going on. At Mt. Lyell there has been a change of management, and with it a change in operations: it is early yet to speak as to the result. At the Linda fair work is being done. The inadequate supply of water has impeded operations here and in various other localities from which alluvial gold is being won fairly successfully.

"The copper deposits which were being worked with such promise last year have been temporarily abandoned, pending a reformation of the Company, and the acquisition of the necessary capital to enable work to be resumed. It is satisfactory to note that the Railway construction is proceeding rapidly. Until this work is completed and means thereby afforded for the transport of machinery to, and ore from, the fields at Zeehan and Dundas, no very large amount of development can be expected in those localities; in the meantime there is an evidence among claimholders of active preparations, so that when railway

facilities are afforded they may be ready to avail themselves thereof. Speaking generally, I think that present appearances afford every reasonable prospect of great activity and progress in the mining interest in this Division of the Colony during the ensuing year.

ANNUAL REPORT OF THE INSPECTOR OF MINES FOR THE YEARS 1890-90.

Inspector of Mines Office, Launceston, 30th June, 1890.

SIR,

I HAVE the honor to submit to you my report of the work of this Office since I entered upon its duties in September, 1889.

Accidents in Mines.—Twenty-four persons were killed or injured in the mines of the Colony during 1889. The number of fatal accidents was, unfortunately, larger than usual, eight lives having been lost; of the non-fatal ones, eight were of a serious character and eight of less consequence. Twelve persons were hurt by falls of rock or earth, three by falls of timber, two by being struck by trucks, one by falling from a ladder, one by falling from a cage, one by falling down a winze, one by entering an old shaft full of foul air, one by an explosion, one by being jammed between the bucket and the side of the shaft, and one by falling through a hole cut in the engine-house floor for effecting repairs. In most of these cases the injured men themselves were the only persons to whom any blame could be attributed for the accidents, no negligence being shown on the part of the management of the mines. Many mining accidents are every year due to the indifference to danger of the miners, who are rather apt to run unnecessary risks than take due precautions.

During the year 1890 there have been reported up to date seven accidents, one of which was fatal, a man being killed by the fall of a derrick. None of the other accidents resulted in serious injury, and three of them were quite trivial. The causes of the accidents were as follows:—(1) fall of earth, (2) fall of derrick (as above), (3) fall of piece of timber, (4) being caught between cage and opening set through getting on to cage in motion, (5) being lowered suddenly on to catches in cage, (6) being caught and carried round by engine shaft, (7) getting caught in a fly-wheel.

Surveys of the Underground Workings of Mines.—The clause in "The Regulation of Mines Act" which requires that annual surveys of underground workings should be made has been obeyed hitherto in rather a perfunctory manner by mineowners, the value of the information given by them being greatly deteriorated by want of accuracy in furnishing details. Steps have been taken this year to have these surveys more thoroughly done, and in future this very necessary regulation will be strictly enforced. There is an amount of opposition on the part of mineowners to the carrying out of this portion of the Act that does not speak well for their state of enlightenment, as nothing is more useful for the proper working of a mine than an accurate survey of it.

State of Mine Workings.—A list of the mines visited by me up to date is given in Appendix A attached hereto. I have pleasure in saying that, in most instances, the state of the workings was satisfactory as regards the safety of the workmen, every reasonable care being taken to prevent accidents. In four instances only did I feel called upon to direct that greater precautions should be taken. In one instance also I have had to animadvert upon the unreasonably and unnecessarily dirty state of the workings, which was such as to cause discomfort to the workmen. Mine managers should recollect that it is enonomical to make their men as comfortable as possible, as they then work better and more willingly.

The requirements of "The Regulation of Mines Act" are carried out satisfactorily in all the more important mines visited. More frequent testing of the safety cages and safety hooks is desirable. Frequent overhauling of these appliances is necessary to ensure their proper working.

I have, &c.

A. MONTGOMERY, *Inspector of Mines.*

The Secretary of Mines, Hobart.

APPENDIX A.

LIST of Mines visited by the Inspector of Mines from 6th September, 1890, to 30th June, 1890.

Name of Mine.	District.	Date of Visit.
Tasmania	Beaconsfield	16/9/89—22/1/90—23,24,28/1/90.
Union	Mangana	10/10/89.
Lottah	Blue Tier	17/10/89—25/10/89.
M'Gough and Young's	Ditto	18/10/89.
Full Moon Extended	Ditto	19/10/89.
Giant	Ditto	22/10/89.
Full Moon	Ditto	19/10/89—21/10/89.
Wellington	Ditto	22/10/89.
Blue Tier	Ditto	23/10/89.
Crowther's	Ditto	23/10/89.
Ethel	Ditto	24/10/89.
Anchor	Ditto	25/10/89.
Red Hills	Weldborough	30/10/89.
Dorset	Wyniford	31/10/89.
Moonlight	Beaconsfield	14/11/89—30/1/90—6/2/90 18/4/90.
Little Wonder	Ditto	14/11/89—29/1/90.
New Golden Point	Lefroy	3/1/90.
New Native Youth	Ditto	3/1/90—4/1/90.
West New Chum	Ditto	4/1/90.
Unity	Ditto	4/1/90.
West Tasmania	Beaconsfield	28/1/90.
Olive Branch	Ditto	4/2/90.
East Tasmania	Ditto	4/2/90.
Bonanza	Ditto	12/2/90.
Leviathan	Ditto	12/2/90.
Cosmopolitan	Ditto	14/2/90.
Mount Lyell	Mount Lyell	7/3/90.
Linda	Ditto	7/3/90.
Carlson's	Ditto	7/3/90.
Delaney's	Ditto	7/3/90.
Madam Howard	Howard Plains	8/3/90.
Princess	Princess River	9/3/90.
Silver Queen	Mount Zeehan	11/3/90.
Montana	Ditto	11/3/90—13/3/90.
Argent	Ditto	11/3/90.
Balstrup's	Ditto	12/3/90.
Silver Queen Extended	Ditto	12/3/90.
Mount Zeehan	Ditto	13/3/90.
Junction	Ditto	13/3/90.
Evans'	Ditto	13/3/90.
Silver Crown	Ditto	13/3/90.
Western	Ditto	13/3/90.
Silver Duke	Ditto	14/3/90.
Tasmanian Silver-Lead	Ditto	14/3/90.
Grubb's ditto	Ditto	12/3/90.
Comstock	Ditto	14/3/90.
Silver King	Ditto	15/3/90.
Silver Spray	Ditto	15/3/90.
Silver Bell	Ditto	16/3/90.
Webster and Bennett's	Mount Dundas	17/3/90.
Mellor's	Ditto	18/3/90.
Davis and Lambie's	Ditto	18/3/90.
Specimen Reef	Hall's Creek	23/3/90.
Castray River	Heazlewood	25/3/90.
South Heazlewood	Ditto	25/3/90.
Heazlewood	Ditto	25/3/90.
Heazlewood Extended	Ditto	26/3/90.
Whyte River	Ditto	26/3/90.
Bell's Reward	Ditto	26/3/90—27/3/90—5/6/90.
Godkin's Extended	Ditto	27/3/90.
Godkin's	Ditto	27/3/90—4/6/90—5/6/90.
Mount Bischoff	Waratah	28/3/90—29/3/90.
Stanhope	Ditto	29/3/90.
Briseis	Derby	19/6/90.
New Brothers' Home No. 1	Ditto	19/6/90.
Krushka's Brothers' Home	Ditto	19/6/90.
Triangle and North Brothers' Home	Ditto	20/6/90.

ANNUAL REPORT OF THE GEOLOGICAL SURVEYOR, 1889-1890.

Geological Surveyor's Office, Launceston, 30th June, 1890.

SIR,

I HAVE the honor to report to you on the work of this office since my taking charge of it in September, 1889.

Reports.—Reports have been made to you on the Blue Tier Tin-field, on the coal found at Mike Howe's Marsh, on the black marble of the Gordon River, and on the state of the mining industry on the West Coast of the colony; also a special report on the Godkin silver mine, Whyte River. These reports have dealt with the economic rather than the purely geological aspects of the subjects treated of.

Technical Classes in Mining Centres.—This subject has had much attention from me. The reasons for the establishment of classes in which miners and prospectors might improve their knowledge of minerals, and their modes of occurrence and metallurgical treatment, are numerous and cogent. It is indubitable that valuable ores have been over and over again passed by by prospectors ignorant of their value; whilst the opposite error, of mistaking useless for valuable minerals, has often been the cause of loss to the country through the loss of time and discouragement of the finders. Again, much loss is liable to occur in opening up and developing mines from mistakes which quite an elementary acquaintance with geological rules would render impossible. And, when the mines are in working order and producing ore, the preparation of this for the market requires an amount of knowledge that unfortunately is often wanting. What may appear to be quite a slight error or oversight in the amalgamation of gold quartz, for example, may make all the difference between profit and loss to the owners. The consequences of ignorance, in short, in all mining operations are liable to be incalculably disastrous. That the little instruction that can be given in such classes as are proposed can do much to prevent the evil consequences of ignorance is more than can be hoped for; but if it resulted in one good new find in a year that would otherwise have been missed, or prevented one serious mistake, the benefit would immensely exceed the expense. This should be remembered in all discussions as to the practical utility of such classes. It is in the nature of things that while the expense is in evidence, the return for it, though great and real, may not be apparent.

Now, what is it practicable to do in this matter to ensure the wished-for advantage to the mining industry? To produce immediate benefit instruction must be given to the men actually engaged in prospecting and mining. The establishment of a School of Mines in a town does not help these much, for very few are able to leave their work and go to it to study. The pupils of any School of Mines situated outside of a busy mining district are almost necessarily young men and lads who have time to devote to it. It must be some years before these can get such a standing among mining people and in mining work as to make their influence felt. Though the thorough training that is given in a good School of Mines is of the greatest service to the mining industry in the long run, and is indeed indispensable to provide for the gradual replacement of our present mine managers by a class of men who will possess scientific in addition to practical knowledge, yet something should also be done to give present help to those whose struggle for daily bread in the mines prevents them from going to a central school. If we had a large town situated in the centre of a great number of mines the establishment in it of a School of Mines would meet the difficulty, as working men desirous of attending it would be able to get work in the neighbourhood. But none of our mining towns are yet sufficiently advanced to have a claim to be the seat of a colonial School of Mines that would counterbalance the many obvious advantages of having it in Launceston or Hobart. If Mount Zeehan and Mount Dundas fulfil their present promises, their district would undoubtedly be the proper one for the school.

The scheme that seems to me most practicable in present circumstances is, first, to establish in Launceston classes for the study of Geology, Mineralogy, and Assaying, which might form the nucleus round which a School of Mines might grow; and, secondly, to encourage the formation in the different mining centres of associations of miners for the purpose of study and mutual instruction in subjects bearing on their calling. I should be able to give fairly regular attention to the first of these, and to pay occasional visits to each of the outlying centres. I have submitted to you a list of apparatus and chemicals required for a series of lectures and classes on these lines. It will, however, be necessary for each association to provide itself with a few appliances; and, as these are not easily obtainable, I would recommend that a supply be imported by the Government and sold to them at cost price, or given as subsidy on local subscriptions.

As collections of typical minerals are most useful and necessary for such classes, I advertised for some time in the Launceston newspapers asking for donations of mineral specimens for them; but I am sorry to say my request was very poorly responded to. Mr. H. W. F. Kayser, of Waratah, Mr. F. D. Stephens, of Lefroy, Mr. Blackman, of Beaconsfield, and Mr. Commissioner Fowell have been good enough to send collections; and Mr. W. F. Petterd has kindly offered the use of his fine cabinets to the classes to be held in Launceston. The Committee of the Launceston Mechanics' Institute have also offered the use of the Museum collections and of a room. I have had many inquiries from intending students as to when the classes were to begin, and much disappointment has been expressed at the delay that has taken place. I ought not to omit to mention, as showing the readiness of the mining population to seize upon opportunities of getting instruction, that, owing to the energy and enthusiasm of Mr. W. A. Carins, an association was got together at Derby. Owing to several prominent members of it leaving the district it has not of late been so successful as at first, but a fair measure of success has attended the experiment, and I have no doubt that if it were better supplied with minerals and apparatus, and had occasional help from myself or a Government instructor, that it would soon be in a flourishing condition.

Geological Surveys.—I regret that I have not been able to complete my geological survey of Beaconsfield in time for this report. The boring operations now in progress there are, however, of such importance for a proper knowledge of the geological structure of the district that the report is much better

to be delayed pending their completion. The main object of this survey was to determine as far as possible the position of the different beds of silurian grits, sandstones, slates, and limestones in which the auriferous reefs occur, so that it might be possible to locate the mines in the beds which have proved to be most favourable for gold. The shoots of gold in the Tasmania Mine dip very much the same as the beds of the country rock enclosing the reef. The beds of sandstone have hitherto proved the most favourable country for gold in this mine,—the grits and slates having been very barren. As it has been repeatedly found on numerous goldfields that the auriferous character of a reef is generally dependent on the nature of the country rock traversed, the utility of determining the relative positions of proved favourable and unfavourable country rock is unquestionable. I am not very sangutne of arriving at very tangible results from my examination of the district so far as it has gone, but it will afford a basis for future observations that may show better results. A great deal of useful information gathered in past years by means of bores and shafts has been lost or become unreliable for want of being recorded ; and I wish to prevent this being the case in future. Geological surveys should be made of all our principal mining districts, embodying all that is at present known as to their structure. As work progresses these may be amplified, and rendered increasingly useful. The Ringarooma District seems to me one most likely to be benefited by a somewhat elaborate geological survey, as the tracing of the old river systems now buried under basalt would result in a great extension of mining operations.

Beaconsfield Mining.—In the course of my stay in Beaconsfield, while making the geological survey of it, I had opportunities of visiting the workings of the mines frequently, and a few observations on the state of mining there may not be out of place. The Tasmania mine still continues to produce golden stone, and to pay dividends to its fortunate shareholders. There has been a great deal of trouble found in keeping down the water with the present pumping machinery, and the sooner the powerful new pumps that have been ordered are at work the better it will be for the mine. The quartz for the battery now comes mostly from the deep levels, and it is more than time that a new level should be opened out, fifty or one hundred feet below the present lowest one, in order that constant supplies of quartz may be obtained. The success of the boring with the diamond drill on the Phœnix Company's ground, proving that the reef lives down and carries gold below 700 feet, ought to induce the Tasmania Company to lose no time in sinking deeper. This work has, in fact, been delayed much too long, and the difficulties the Company are now experiencing are simply the result of not keeping the development of new ground sufficiently ahead of the exploitation. The West Tasmania mine has lately produced some good quartz from the upper levels of the Moonlight reef. From the same reef the Moonlight and Little Wonder Companies formerly got gold in the upper levels also, but found it get poor as they went deeper. Both these last-mentioned Companies are still prospecting for payable stone, without much success. The event of the year at Beaconsfield has been the striking of the Tasmania reef at 700 feet by the Phœnix Company's diamond drill bore. The Company are now having their old shaft enlarged, and are said to intend to sink down to 850 or 1000 feet and then drive for the reef. There is the serious difficulty in the way of their doing this that they will have to pump all the water now raised by the Tasmania Company as soon as they get below the level of the latter's workings. While the diamond drill was at work it was found impossible to keep the hole full of water, as it got away at once through the porous rock into the Tasmania mine. This proves how very easily water passes through this rock. Even if, however, the wall of rock between the Phœnix shaft and the Tasmania workings should avail to confine a great part of the water to the latter, it would not do so when the reef was reached, and the water would then be sure to get down freely, and the more the reef was worked the more easily it would get down. The Phœnix and Tasmania Companies ought, for mutual advantage, to come to an arrangement for sharing the cost of pumping to 1000 or 1200 feet. If they would only arrange to combine, both properties could be worked with advantage from the Tasmania new main shaft.

The East Tasmania Company have been trying to find the eastern continuation of the Tasmania reef, first by sinking a shaft and driving from it, and latterly by boring with the diamond drill. As yet they have met with no success. Owing to the distance from any known part of the reef at which it is necessary to bore, it is quite likely that several bore-holes may have to be put down before the reef is found. The most obvious and satisfactory way of proving the eastern extension of the reef is to drive along it from the most easterly workings in the Tasmania mine. From these to the eastern boundary of the Tasmania Co.'s ground is a distance of about 950 feet. For their own sake, not to speak of their neighbours, the Tasmania Company ought to prove this long extent of untried ground. While the mine is prosperous and paying dividends is the proper time for doing deadwork in prospecting.

Lefroy Mining.—This goldfield is in a very languishing condition, work being confined to some four mines. Most of it is done by tributors, the owners being unable or unwilling to find capital for systematic working on their own account. This field has an excellent record as a gold-producer, and it is a great pity to see it so neglected. But unless owners will provide a considerable working capital for the deadwork that must be done in every mine, it is useless to expect steady returns. The present system of working the mines by tribute is every day increasing the amount of deadwork that will have to be done in future. There are no unusual difficulties to contend with, the ground does not require much timber, and the amount of water met with is not very great. There is good communication with Launceston and George Town, so that there is no difficulty in getting machinery and supplies. Timber for support and fuel is plentiful. With these advantages, and the large amount of gold that has been taken from it, proving the richness of the reefs, Lefroy has a right to complain of being hardly treated in being so neglected by the investing public.

Lefroy is well provided with crushing machinery. The New Native Youth battery comprises 40 heads of stamps, but only 20 are now kept in working order. The West Chum battery has 20 heads, of which 15 were ready for use when I visited it. So far as they go, both of these batteries are well appointed, but I was much struck with the want of sufficient appliances for dealing with the tailings. The blanket tables are alone relied on for saving the gold which escapes amalgamation, the blanket sand being sold to Messrs. Stubbs' pyrites works. To ascertain the value of the pyrites in the tailings I took a sample from a

large heap of tailings at the West Chum battery, taking it from enough separate places to make it fairly representative of the whole heap. Having concentrated the sample by washing off the sand and obtaining clean pyrites, I had these assayed by the Government Analyst, when they proved to contain 4 ozs. 5 dwts. 17 grs. of gold to the ton. As the pyrites are thus richly auriferous, every effort should be made to save them. For this purpose it would be well to replace the blanket tables by Frue vanners, which concentrate at one operation the bulk of the pyrites from the tailings. The clean concentrations are then at once ready for the Pyrites works.

The Pyrites works consist of one long inclined handworked roasting furnace, in which the tailings brought from the batteries are roasted, and a set of 12 berdans in which the roasted ore is ground and amalgamated. The owners have also two Chilian mills; but these are not now in use, as the berdans are considered to be superior to the mills as gold-savers. The berdans are worked in charges, not continuously. Though the extreme simplicity of these machines and the ease with which they may be cleaned out commends them greatly to mill-men, their very small capacity is very much against them. By actual trial, too, I have found that for fine gold they are not efficient gold-savers, being much inferior to the American combination pan in this respect.

The want of sufficient appliances for dealing with tailings is felt at Beaconsfield as well as at Lefroy. The Little Wonder battery has no means of treating the tailings at all; and the Tasmania battery, which might be fairly expected to be a model not only to this but also to all the Australian Colonies, has only lately introduced appliances for doing so. These are of local invention, being the patent of Mr. Wilson, the battery manager. Their introduction is said to have led to a marked saving of gold, which is plain proof that they were required. Without careful trials, checked by assays of the ore before and after treatment, it is not possible to say how well or how badly these machines are doing their work, but they do not appear to me to be any better than, or even equal to, many of the better proved types of tailings mills. That the Tasmania battery has been losing much gold for a long time past is notorious, as the Pyrites works of Messrs. Masters and Windred have been subsisting on its tailings for years.

I append to this Report some notes on gold-milling written for the American Engineering and Mining Journal by Mr. C. H. Aaron, and published in that journal on the 10th and 17th August last. These notes are so full of valuable information that I commend them to the careful perusal of all who are engaged in the gold-mining industry.

The cause of the apathy shown by shareholders and directors to the losses of gold that go on in the batteries is simply ignorance. They do not know what is being lost, and accept the sanguine estimates of battery managers, that what is lost is not worth saving, with implicit confidence. It is natural for amalgamators to flatter themselves that their work is perfect, but they have no means of knowing that it is so unless regular assays of the tailings are made; and these assays are not made, or made so seldom and irregularly as to be of no value. I have referred to this subject in a previous report; but the utter folly of neglecting to check the work of batteries by systematic assays is the cause of such serious losses that I should not be doing my duty to the mining industry of the Colony if I did not call attention to it on every possible occasion.

I have the honor to be,
Sir,
Your obedient Servant,

A. MONTGOMERY, *Geological Surveyor.*

The Secretary of Mines, Hobart.

NOTES ON GOLD MILLING.

Written for the Engineering and Mining Journal by C. H. Aaron.

These notes are based partly on my own observation and experience, partly on information received privately, and partly on the late report of the State Mineralogist of California.

In many gold quartz mills no attempt is made to ascertain the true gold content per ton of the rock 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 gold rock which will correctly represent the average.

The question of individual skill and ability is beyond discussion, and I admit, because I believe, that the average loss of free gold and, where concentrators are used, of gold in sulphurets also, is below the estimate 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, consistently with the object in view, which is profit, should be the subject of constant endeavor, and the most likely thing to promote such endeavor is an exact knowledge of the extent of the loss in percentage of the original content of the rock.

The absolute loss per ton is easily ascertained by the assays of tailings, of which correct samples can readily be taken, but, in order to reduce this to percentage, it is necessary to know the weight and value per ton of the rock crushed; this is not so difficult as many suppose.

In some cases, that is, where the gold is distributed in extremely small particles through the gangue, samples of gold rock can be taken, before it goes into the battery, with the same facility as in the case of smelting ores. Samples should be taken in measured quantity every hour from the feeders, or from the breakers, and the accumulation of each 24 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 may refuse the sieve must be separately estimated and the assay of the powder corrected in the usual way, as explained in works on assaying. Samples thus taken at the Bunker Hill mine during five years have not varied more than 10 cents per ton from the milling results; the free gold recovered and the gold contained in the concentrates and tailings correspond invariably to the monthly battery samples.

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 rock 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, we shall have all the data necessary for calculating the percentage of loss in the crushing. The subsequent loss in treating the concentrates is another matter. It will, of course, be necessary to weigh the ore which is sent to the mill, and to correct the weight for moisture in case the rock is not dry. This is a very 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 inclosing substance, excludes that portion of the metal which exists in the sulphurets in such a condition as to be practically incapable of amalgamation in the batteries or on the plates. The first thing to be ascertained is, how much of the gold is being carried off in the tailings. There should be a systematic weighing of the rock crushed in each run and sampling of the tailings, both of which can and should be done automatically. The concentrates must be also weighed, 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. The sample, with a statement of the value of free gold saved, the weight of ore crushed and the weight of the concentrates, should be sent to a competent assayer, and he will report the value per ton of the ore worked and the percentage lost. 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. Among these causes are or may be the following:

(A) Floatation.—The loss from this will increase: Firstly, with the fineness of the golden particles; secondly, in absolute quantity, though not in percentage of the whole, with the richness of the rock 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 applied as to dilute the mud as far as possible without causing much of the gold to be swept away by the too forcible current. In this connection, 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 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) Inclosure in Particles of Gangue.—Evidently there is no remedy for this but finer 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 the 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 it might, in some cases, be found advantageous to submit the rock to two distinct operations of crushing and amalgamation, with an intermediate separation of slimes. This is done, in effect, at the Plumas Eureka mine, where the 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 arrastras driven by water-power. There are about 30 arrastras thus occupied on the tailings from that mill.

(C) Inaptness of the 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 envelopes the auriferous grains; this is notably the case with the 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 seems probable that the difficulty is sometimes caused by the quality of the water used. Mr. William Skey has made a study of this subject and he has said that the presence of iron sulphate in the water is injurious to amalgamation, and iron sulphate is often to be found in the 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 the presence of quartz or other matter, particles of which then 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 solution of potassium cyanide to flow constantly into the battery, and I think it would be still better if some red oxide of mercury were dissolved in the cyanide solution. In such a liquid every particle of gold becomes coated with quicksilver. I have found gold in beach sand which refused to amalgamate even with the aid of potassium cyanide, but yielded instantly in 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 from 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 the metallic state by the chemical action of the iron 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, though 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 the 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 came to the conclusion that pure mercury, or silver amalgam, is best, though there is some reason to think that zinc amalgam is sometimes useful, and cadmium amalgam shows remarkable readiness to attach gold to itself.

I hear of an instance of gold failing to amalgamate immediately in pans. The material treated was a coarse sand saved from the tailings in "riffle sluices," and containing gold to the value of $23 per ton, also a little iron oxide 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 the gold was in the fine particles of pyrite, which become oxidized by 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 any suitable vessel (for instance, an enameled 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 or 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 the 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 the copper, is one of the difficulties of the gold millman. This is an interesting and important subject for investigation in regard to which many inquiries have been made. The electroplating of the copper surfaces does not seem to be efficient in preventing discoloration in all cases, and is not universally favored by millmen. Some consider the silver plating as very advantageous, while others say it is void of merit. One gentleman observed that, although the 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 Co. they discarded silvered plates, for the reason that the silver disappeared so soon that it would cost too much for the frequent replating necessary, 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 rock worked 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 of 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 this connection 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 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 the addition to the water of slaked lime, and was prevented by a small quantity of ferrous sulphate, also by a trace of potassium bisulphate, 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 plate and in the water 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 24 hours was slightly tarnished. Another strip treated with a little mercury containing a little cadmium retained its color three days.

In view of these and other known facts, I recommend that millmen, who have trouble with their plates, should make some 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.

(This has been done in some mills with good effect). Those who have occasion to work auriferous material in pans would do well to try 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 a little 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 pressure of zinc blende in the ore has probably a favorable effect on amalgamation by tending to prevent oxidation of the plates, with which it forms a galvanic couple in the same way as does a piece of zinc.

As to the loss of auriferous sulphurets, admitting that the best known concentrators are used with the 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 the loss are similar to those of free gold under "*A*" and "*B*." Floatation is promoted by the fineness of the particles of the sulphurets, by the quantity and rapidity of the flow, and turpidity 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 an ore containing copper pyrites was treated on an Embrey concentrator, which is a traveling belt with an "end shake." The sulphurets would remain on the belt until the travel had carried them to a point beyond the jets, where the reflux of the 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 probably be 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 of sulphurets which is lost is even more rarely known than that of the 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 $2 per ton, and the tailings assay 20 cents per ton, while one ton in ten is retained as headings, we have in ten tons of material $20, in nine tons of tailings $1·80, consequently the one ton of headings must contain $18·20, and the recovery of value by concentration is 91 per cent.

The loss of quicksilver on the mother lode varies from 1 to 2 cents' worth per ton of ore usually, according to the richness of the ore. The monthly loss at the Keystone mill one year was 1276 ounces troy, and 10 ounces additional in retorting; another, 861 ounces troy, and 10 ounces additional in retorting. At the Bunker Hill mine, 67½ pounds avoirdupois are lost monthly with about the same number of tons of rock, crushed, say 100 tons per day, or 3000 tons per month.

Testing tailings in a horn does not show at these mills 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 where 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.

But the question suggests itself whether or not 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 $50 per day between the sluices and concentrators. In this case the greater part of this 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 $50 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 their 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 the curve in the plates is worth attention. Mr. Tregidgo 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 76 pounds of mercury are lost in working 4600 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 the mercury is lost in the form of a dry amalgam, containing one-fifth of its weight of gold, the above quantity represents 95 pounds of amalgam containing 19 pounds of gold, which, with $14\frac{58}{100}$ troy ounces to the pound, at $14 per ounce, would give a value of $3878·28 to 4600 tons of ore, or 84·31 cents per ton. However, it may be conceded that not all of the lost mercury is in the form of dry amalgam.

As to the causes of the loss of mercury, it may well be supposed that a portion of that loss is due to ordinary wear; that is, that the metal is, to a slight 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 workmen, by splashing when poured, &c., and it is quite

possible that a little may become oridized 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 quite all of the quicksilver, a portion remaining with the gold, and not all that is expelled is condensed and collected, as at the Keystone mill, where 10 ounces monthly are thus lost. 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 the 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 for 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 a little 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 processes of unequaled efficacy. It makes no difference as to how the mercury is induced to attach itself to the plate, unless it may be in 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 it nitric acid of such 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, clean surface, afterwards rubbing it with quicksilver and solution of cyanide of potassium. Others prime the plate 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 by the aid of nitric acid had the same property.

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 the more 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 violence of that current by restricting is to a narrower channel, which is done in almost every instance, as will be seen by reference to the notes on mills, in the late report of the Mining Bureau, the aprons having a width of from 4 to 5 feet, while the plated sluices are only from 14 to 16 inches wide? If the sluice was turned sidewise to the stream, the plates curved as a segment of a cylinder, and the pulp spread over a width of 12 feet, instead of 16 inches, and at the same time suitably diluted with clean water, it would probably deposit more of the suspended gold in the 16 inches of traverse across the plate than it now does while rushing through the 12 feet of length with only 16 inches of breadth. The principle has been demonstrated to be correct by actual experiment.

There is a manifest tendency toward 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 the battery, and for this reason screens of that character have been left generally to the silver mills, while even they have more commonly used punched screens for wet work.

The general idea is that the brass will become amalgamated, and that first choking, and then destruction of the screen will ensue; but this does not seem to be the case, which will not greatly surprise any one who has tried 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 some little gold attached are returned for new ones, pound for pound, and they are found to discharge well.

In many (if not in all) of the best gold quartz mills the screens are not more than 8 inches high—often not more than 6 inches—and experience proves that this is ample, and that the old style of from 14 to 16 inches high has no advantage over the present. As to placing the screens vertically, or with a slight inclination outward, it seems to make no appreciable difference.

In batteries the tendency is toward heavy stamps, some of the new mills having them of 1,100 pounds weight, while 1000-pound stamps in some sections are becoming quite common. Another change is the increasing substituting 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 usually considered more economical than iron, and are being more generally used than formerly. In some California mills, as well as in the Silver King Mill, in Arizona, it has been found that the steel dies become worn in holes, and so irregularly as to be rendered useless long before they are 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 counter-bored, and this practice is also being applied, though less generally as yet, to cams. The effect of the counter-bore 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 counter-bore being slightly oval, with the longer axis passing through the key-seat in the cam, or the gib in the tappet. This gives greater stability by preventing oscillation or wobbling.

In regard to the weight of the stamp, it must be remarked that the 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 50 pounds, 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 the 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 the battery, the lower and more uniform can the feed be made, and the less drop 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, 1000 pounds, and 1100 pounds, 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 weights, being respectively 9 and 10 inches, 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 weight of stamps, drop, number of drops, and grade of screens, yet the respective stamp duties are $1\frac{7}{10}$ and $2\frac{2}{10}$ tons, while the Yuba, with fifty pounds more weight of stamp, $1\frac{1}{4}$-inch 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 750-pound stamps, consuming a power represented by 58, has a duty of $2\frac{75}{100}$ tons daily, while the Omaha, with 900-pound stamps and a power consumption represented by 50, gives a duty of $1\frac{6}{10}$ 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 950-pound stamps and a power in the proportion of 59, crushes $2\frac{5}{10}$ tons through the same screen; hence, with slightly less power, the lighter stamp again crushes more than the heavier by 10 per cent.

Comparing the mean results of the Blue Bell and Washington with the results of the Crown Point, we have—

Weight of stamps..... 850 pounds; power, 44; duty, 1·95.
Weight of stamps..... 750 pounds; power, 45; duty, 1·50.

As the screen is the same, the result is in favour of the heavier stamp.

Following are the results of some calculations of the proportionate power required to crush one ton of ore in different mills. The proportional power is found in this way: the nominal weight of the stamps is corrected by the subtraction of 50 pounds for trimming and mean wear; the stated drop is reduced by one inch to allow for the loss of drop by the ore under it. The corrected quantities are then multiplied together, and the product is multiplied by the number of drops per minute; this product divided by the stated stamp duty gives a relative figure representing the power used in lifting the stamps.

Screen, No. 9 Slot.		Screen, No. 7 Slot.		Screen, No. 6 Slot.		Screen, No. 5 Slot.	
Nominal weight of stamp.	Proportional power to 1 ton.	Nominal weight of stamp.	Proportional power to 1 ton.	Nominal weight of stamp.	Proportional power to 1 ton.	Nominal weight of stamp.	Proportional power to 1 ton.
lbs.		lbs.		lbs.		lbs.	
950	144	850	207	850	144	850	168
900	109	750	168	850	174	750	151
800	198	750	151	750	166	...	...
800	144	...	...	...	...	...	...
650	255	...	...	...	...	...	...

These results show the impossibility of deducing anything useful in this respect from the records of different mills working on different ores, as given in the report of the State Mineralogist.

Of machines other than stamp batteries for the reduction of auriferous rocks, I can say but little, 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 70 cents per ton, on which a profit of 20 cents 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 the man who not only undertakes to handle seventy-cent ore without loss, but has actually paid off some $8000 of debts from the proceeds. In this plant the five-foot 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 report 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 are 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 pulverisers 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 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 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. Knights are generally used in hoisting works, on account of the hydraulic nozzle. With two six-foot Knight wheels and power gates and nozzles the engineer can run the cable four hundred feet 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 when that becomes necessary. 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.

I have examined a sample of concentrated sulphurets, as to an alleged volatilization of gold in roasting them in the muffle without salt. The sender stated that he found a loss of $22 in gold and 2 ounces of silver to the ton.

Two assays were made on the raw material with very nearly concordant results, and two others were carefully roasted prior to the smelting, the results of these also nearly agreeing. The difference between the means of the raw and the roasted assays showed a loss of 0·3 ounces 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; 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 45 minutes, being twice removed from the muffle, cooled, uncovered, and stirred. Afterward the covers were removed and the roasting was 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 the 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.

The losses noted by my correspondent must be ascribed to the decrepitation of the ore, too rapid roasting, or absorption into the dishes, or to all of these causes combined, neither of which, however, would have much effect in the roasting in a three-hearth reverberatory furnace.

REPORT ON THE BLUE TIER TIN FIELD.

Geological Surveyor's Office, Launceston, 5th November, 1889.

SIR,

IN accordance with your letter of the 12th October, 1889, I have visited the Blue Tier District and examined the tin deposits there, and I have now the honor to report thereon.

The district has been reported upon previously by Mr. G. Thureau, F.G.S., and I have pleasure in saying that my observations confirm his report and judgment of the field in almost every particular. Since his Report was written so little work has been done on the field that it is practically in the same state as when he saw it. Much of my Report must therefore be only a repetition of what Mr. Thureau has already said.

The following properties were examined by me on this occasion :—Lottah, Ethel, Anchor, Full Moon, Full Moon Extended, M'Gough's, W. L. Crowther's, Blue Tier, Giant, and Wellington. These are all situated towards the eastern end of the Blue Tier range, which is here about 2500 feet above sea level. The Lottah, Ethel, and Anchor properties lie on the southern slope of the range, on the head waters of the Ransom River, and the slopes to Crystal Creek and the Groom River. This side of the range falls rapidly to the Groom River, and in this respect presents a great contrast to the other side of the range, where the ground falls very slowly to the Wyniford River. As a consequence of this configuration of the ground, the holdings lying on the northern slope of the mountain are difficult to work to any depth by means of adits, and will probably have to be worked from shafts.

The general country rock of the district is a grey granite, composed of quartz, black mica, and white or pinkish felspar. Large crystals of felspar are common throughout it. This granite would make beautiful ornamental stones if cut and polished. It appears to resist the action of the atmosphere very well, as the large boulders commonly occurring show only a superficial honeycombing from the removal of felspar and mica, without being altered to any depth. In some of the cuttings alongside the roads, however, the granite was seen decomposed *in situ* to a considerable depth, showing that parts of it are easily attacked by surface waters.

Tin ore is found throughout the district in three distinct modes of occurrence—(*a*) as alluvial tin ore, (*b*) in true lodes and veins, and (*c*) impregnated through dykes of a granite of different character from the grey country granite above mentioned.

(*a.*) *Alluvial Tin Ore.*—The Blue Tier District has for many years been a very rich alluvial field; but the best and most easily accessible portions are now worked out, and European miners are rapidly giving place to Chinese. With systematic conservation of water and hydraulic sluicing it is still, I believe, possible to obtain a rich harvest, but this I shall deal with later on. Much of the alluvial tin ore is but little worn, and some of it shows no signs of having been carried by water, being quite bright, and with sharp angles. The tin ore is found almost everywhere over the surface of the mountain in greater or less quantity, and in quite shallow ground, not, as a rule, more than from one to five feet in depth. In the valleys and along the course of the streams the deposits are perhaps deeper, and in the Anchor ground there is some pretty deep alluvial matter in the Groom River Valley, but, as a rule, I was struck with the evenness with which a shallow layer of tin-bearing surface stuff was spread over the whole of the ground, ridges as well as basins. I do not think that much of the ore has been spread in this way by the action of free-running water, as the appearance of the tinstone shows that much of it has never been rolled in the bed of a stream. It seems rather to have been derived from the gradual wearing away of the underlying country rock, under the solvent influences of water charged with carbonic and humic acids. The sharp angular grains of quartz found all over the country would also be accounted for in this way, being the insoluble portion of the granite. Wherever the underlying granite has been bared by sluicing it has been found to be traversed by numerous small veins of quartz, often carrying good tin ore. These veins, so far as I have seen, are not anywhere so numerous as to convert the rock into a stockwork; still they are common enough to account for a great deal of tin ore, and it is quite possible that stockworks may yet be found. There does not appear to be any evidence of the existence of enough large lodes in the district to have produced the surface tin ore. Much tin ore has also doubtless been set free from the stanniferous dykes to be mentioned later on, and many of the best finds of tin have been directly on these dykes, and resulting from their disintegration. It will be seen from these remarks that I do not consider the existence of large tin-bearing lodes to be at all necessary to explain the presence of the rich deposits of alluvial tin that have been found.

(*b.*) *Lodes.*—Besides the small tin-bearing veins which, as above mentioned, are very commonly found traversing the granite, there have been discovered in the Lottah, Full Moon, Ethel, and Wellington properties veins which, from their size, persistent strike, and mineral character, must be considered to be true fissure lodes. These have been developed in the Lottah mine more thoroughly than anywhere else in the district, and there can be no doubt as to their nature. The lodes in the Lottah show a very marked banded structure, sometimes as many as eight or ten separate bands being visible. Some of the bands are quartz, the others being granite more or less altered by the infiltration of the lode solutions. The quartz carries cassiterite (tinstone), but, as far as I could observe, not so much of it as is to be found in the dark altered granite immediately enclosing it. With the tinstone in the Lottah I observed a little wolfram, a little fluorspar and calcspar, a good deal of molybdenite, a very little copper pyrites, and a few specks of native bismuth. Felspar forms a considerable part of much of the veinstone. Green talc and altered mica (chlorite) are also common. A few vughs were observed in the quartz lined with the characteristic quartz crystals. Traces of combed structure in the quartz were also seen in a few places. In the lode in the Ethel ground there was much wolfram, bornite, and indigo copper ore along with the tin ore. I have no reason to doubt that the Lottah lodes will be permanent to any depth to which they may be worked. Very rich stones of tin ore have been obtained from this mine. The other mentioned lodes in the district have not had much done to them, bnt good tin ore has been obtained from all of them, giving encouragement to prospect them more thoroughly.

(*c.*) *Dykes.*—These are to my mind the most important occurrences of tin ore in the district, and on their economical treatment the future of the field will greatly depend. They are dykes of a granite of different nature from the country rock generally. The dyke granite varies so much in its mineral character that it is somewhat difficult to give it an appropriate name. In parts it is mainly composed of rounded and subangular grains of quartz, but occasionally felspar predominates, and in other places there is much mica. The name "Quartz Porphyry" is the one most applicable to the rock taken as a whole. Portions of it consisting mainly of quartz and mica with very little felspar might almost be called "Greisen," but as a rule the rock contains too much felspar to go by this name. Many of the differences in appearance shown by this dyke-stone are due to decomposition of the felspars and micas. This is best seen in the Anchor mine workings where the stone has been opened up to some depth. The lowest parts of the rock consist of quartz and felspar and mica, both the latter showing signs of alteration, and here and there impregnated through the stone may be seen specks of tin ore, molybdenite, and copper pyrites. At a higher level the felspar and mica are much more decomposed, and at the surface the rock consists of quartz imbedded in a clayey matrix, which is all that remains of the felspar and mica. I was not able to get any of the rock free enough from alteration to determine the exact species of the felspar. It is one that is evidently much more easily decomposed than the orthoclase of the country granite, and it may prove that a plagioclase felspar will be found at a greater depth, in which case the rock would be called a "Granitite." The commercial importance of this dyke-rock lies in its being more or less impregnated with tin ore throughout. Samples were crushed and washed from all parts of it during my examination of the district and there was always some tin ore in it, thought not always in payable quantities. In many places the porphyry was richly impregnated with tin ore, and a great deal of it should be payable. These porphyry dykes were found in all the properties examined, except the Lottah. The principal workings of the Full Moon and Anchor mines are on this description of rock.

Basalt Dykes.—In various parts of the district dykes of black basalt are encountered. In the Lottah and Wellington mines these are found to cut right through the lodes without faulting them to any extent; they are plainly of much later origin than the lodes, and could hardly have any connection with their formation or filling with minerals.

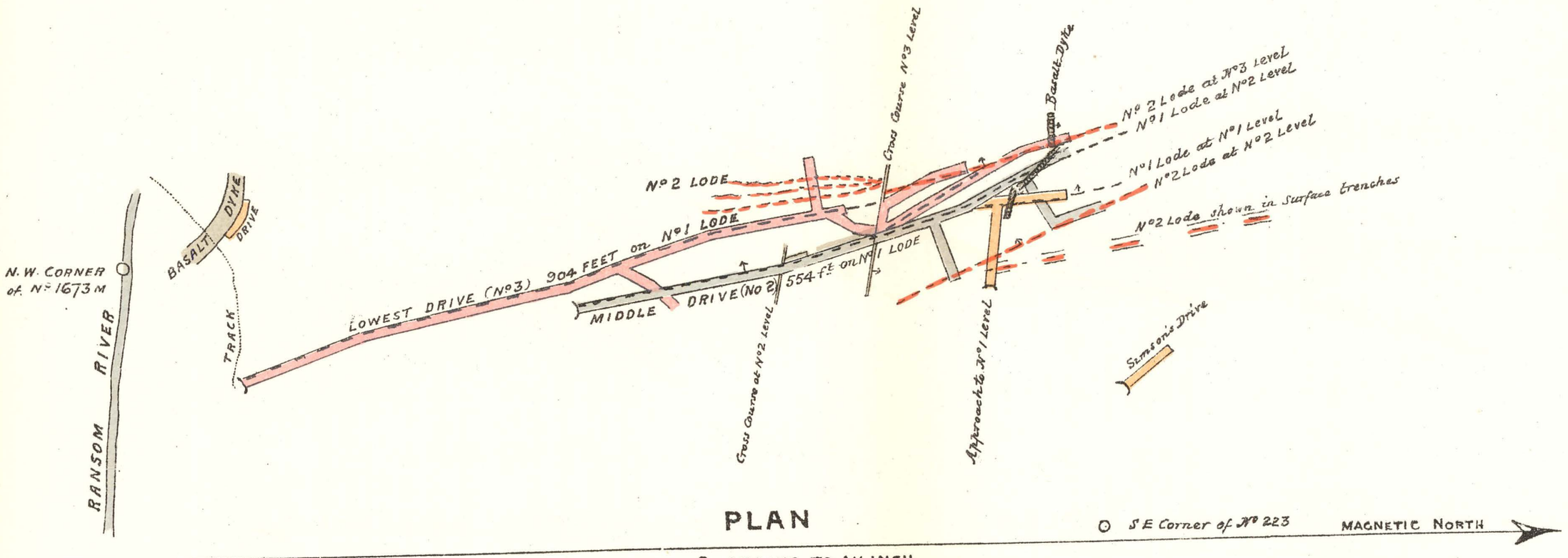
I shall now give a short account of my observations on each of the properties visited, with a few remarks on each.

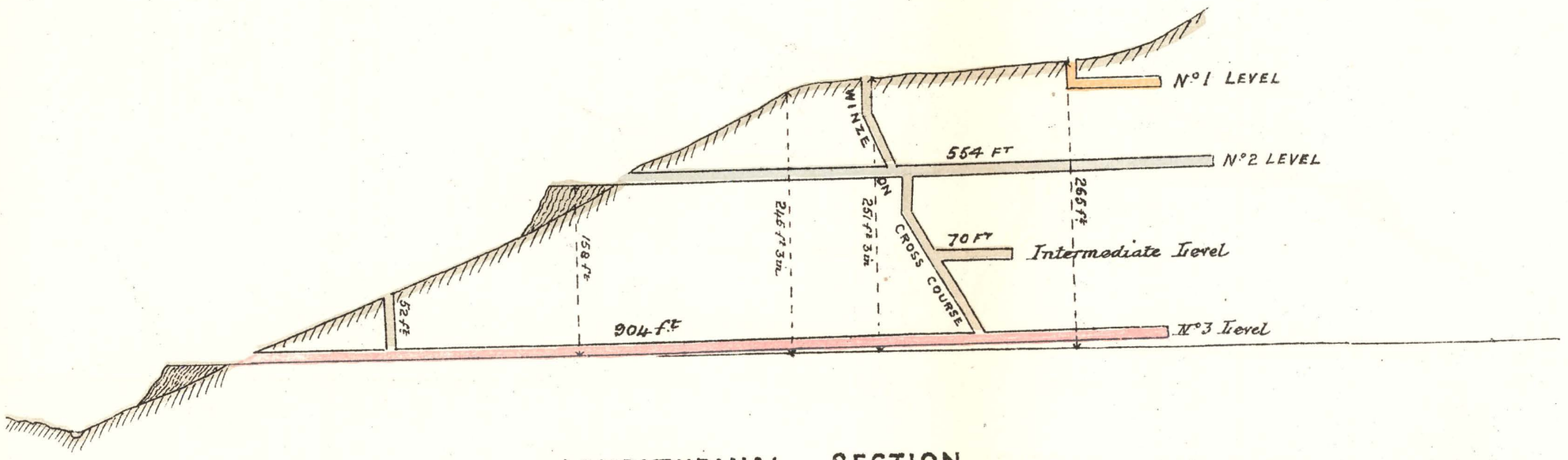
Lottah.—This property comprises 384 acres, and is situated on the southern slope of the Blue Tier range, on the head waters of the Ransom River. The ground slopes steeply, and can therefore be readily worked by means of adits. The Ransom River affords a good supply of water for tin dressing, though not enough for water power. Unfortunately, the ground does not permit of the water being easily caught in a reservoir higher up, or there would probably be plenty of water for power, as during rains the creek rises very much. Parts of the surface of the ground have been worked for alluvial tin ore with very good results. The Breakneck Creek gully is said to have been very rich; this is close to the lodes that have been opened upon, and probably derived much ore from them. There are two parallel lodes on which mining operations have been carried on, known as No. 1 and No. 2 lodes. Three levels have been driven, the lowest, along the course of No. 1 lode, being 904 feet in length. The middle drive, also on No. 1 lode, is 158 feet above the lowest one. Two cross-drives have been put in from this to the eastern side to cut No. 2 lode, and about 60 feet has been driven on the course of No. 2 lode. The middle and lowest drives have been connected by means of an inclined winze, which has been continued above the middle drive to the surface; this winze is sunk on a cross-course which heaves the lodes at the lowest level. A

UNDERGROUND WORKINGS

LOTTAH MINE

BLUE TIER





LONGITUDINAL SECTION

A Montgomery M.A
Inspector of Mines & Geological Surveyor
28th November 1889

short intermediate level 70 feet in length has been opened out to the north of the winze between the middle and lowest levels. Besides these works a short surface drive has been put in on the course of No. 1 lode 89 feet above the middle level; this is now fallen in, and I could not therefore examine it. About four chains to the eastward from the mouth of the upper drive there is another old drive in about 70 feet on a small vein; this drive, known as Simson's, is at present inaccessible. The No. 2 lode has been trenched upon and bared for about four chains to the northward from the mouth of the upper drive—its bearing on the surface is 10° W. of N. (magnetic). In the underground workings the compass gave the bearings as from 15° to 17° W. of N. wherever I tried them on this lode; the dip varied from 65° to 75° in a westerly direction. The No. 1 lode is about parallel to No. 2, but stands more vertical, dipping about 80° westerly. On account of the difference in inclination, No. 2 lode passes through No. 1 in the lowest level. No. 1 lode is here small and rather disordered, and more work must be done at this level before it can be seen what is the effect of the meeting of the two lodes. At the surface and at No. 3 level the No. 2 lode is better defined than the No. 1, but in the No. 2 level the reverse is the case, the No. 1 lode there being the better defined; continual alterations of this sort are to be expected in lodes. The accompanying plan and section showing the underground workings in this mine will serve to elucidate the above description. The map also shows the cross-course on which the winze above mentioned is sunk and a basalt dyke which cuts through the lodes in the northern part of the workings at all three levels; this dyke has a slight underlay to the northward, and its course is easterly and westerly, varying somewhat in the three levels. Another basalt dyke is met with to the westward of the entrance to No. 3 adit; a drive has been put in for about 30 feet along its N.E. side; it is about 15 feet wide. The dyke met with in the mine is from one to two feet thick; a similar dyke is found in the Wellington mine.

The lodes in the Lottah mine consist of from about one to about four feet of tin-bearing stuff, consisting of a main vein of quartz from 4 to 8 inches thick and several parallel quartz veins from 1 to 2 inches thick, separated from the main vein and from one another by bands of altered granite of a dark gray colour; both quartz and granite contain tinstone, molybdenite, &c., and very good patches have been met with. It would be hard to find finer specimens of tin ore than have been taken from this mine. Lying outside the mouth of No. 2 adit there is a heap of about 40 tons of stone saved while putting in the drive. The manager of the mine informed me that a tributer had picked this heap all over and obtained twelve tons (*sic*) of black tin simply by "bruising" and washing the ore. Now that the Full Moon Company have erected crushing and dressing machinery it would be well worth while for the Lottah Company to arrange to have this heap and another one that is lying outside the entrance to No. 3 adit crushed, so that an estimate might be made of the value of the ore extracted from the adits. The heap lying at the mouth of No. 3 adit contains eight or nine tons and shows excellent ore. This mine is not at present working, but there seems to me no reason, as far as the prospects in the mine itself go, why working should not prove successful. The mine is now sufficiently opened up to begin stoping from both No. 2 and No. 3 levels, and a comparatively trifling expenditure would show what the lode is worth now that the dead work is done. I think that it well deserves a trial, and can recommend it as a legitimate and promising mining venture.

About 10 chains to the northward of the present workings, and higher up the hill, a large body of white quartz has been met with, carrying occasional crystals of tin ore. Along with the quartz there is a great development of felspar in large pieces. Some of the quartz showed impressions of what had been large bunches of mica, and also contained cavities with crystals of quartz in them. The stone has not been exposed enough to render its nature evident, and I cannot say in what direction the quartz is running or what is its dip. It looks like lode quartz, and may be part of a large lode, but it might be one of the segregations of quartz and felspar not uncommon in granite. As it contains some tin ore, it is worthy of further prospecting, which would soon prove if it were part of a lode. A somewhat similar mass of quartz is found in the Full Moon Company's ground.

Anchor Mine.—This property comprises 280 acres of ground extending from the township of Lottah down to and across the Groom River. A good deal of alluvial ground has been worked on it, and still alluvial tin is being obtained. At the time of my visit thirteen men were engaged on the ground, sluicing through ground-sluices. The whole of the surface being worked was payable, the black tin being obtained, according to Mr. Robinson, the manager, at a cost of about £20 a ton. Near the Groom River the ground was deeper and more difficult to work. The shallow ground was from one to three feet in depth, and when bared revealed a large mass of the quartz-porphyry previously described, throughout the whole of which tin ore could be seen freely disseminated. As water is plentiful, in the winter at least, and can be obtained at a high enough level to give good pressure, it would be cheaper to "hydraulic" the ground than to sluice it. I could see no reason why hydraulicing should not be resorted to. In the flat below the battery alongside the Groom River there ought to be very good alluvial tin. The ground has not been bottomed on account of water, and is too deep to sluice away. It is said that the washdirt obtained from holes sunk in this flat has always been good. This ground could be worked cheaply by means of Perry's Hydraulic Elevator, a simple contrivance much used in the alluvial mines of New Zealand. It would probably pay very well.

A great deal of money has been spent on this property in the erection of a large crushing and dressing plant, unfortunately of a cumbrous and unsuitable description. A very good tramway has

been laid to the battery, the trucks running on to a wooden staging behind the battery and into tipping frames from which the stone is tipped into large wooden hoppers. From the hoppers the stone is fed by hand into the coffers of a 40-stamp battery. The feeding arrangement is very bad, and an automatic ore-feeder ought to be put in, such as Hendy's Challenge Ore-feeder, for example. The battery is of the ordinary description, but is in a very dirty state. From the battery the crushed ore went to four Lewis' Separating Tubs. As these were not at work I could not judge of their efficiency, but according to report they were not a success. The stuff was next treated on eight 22-foot Lewis' buddles, but these have been altered so as to be no longer self-discharging. The buddles were in pairs one above another, which is a bad arrangement, as the lower one is not properly accessible while at work. Besides these buddles there were three hand-buddles, 16 Alve's concentrators with ½-inch square gratings, and a number of slime tables. The machinery did not give satisfaction, and has been altered by successive managers, and allowed to fall into bad repair till now it is in a deplorable condition. I doubt if any of the concentrating appliances are now of any use, and would recommend them to be all cleared out and well-proved types of machinery erected in their place. The whole of the machinery is driven by means of a 60-foot overshot water-wheel with 4ft. 6in. breast. This is a fine piece of work, but it is a great pity a cheaper and more modern type of motor was not erected in its place. The water-race bringing water to the wheel is a good piece of work and of sufficient size to supply far more water than is required, being 4 feet wide in the bottom. Reviewing the machinery, I may say that there is a good water-wheel, a good tramway and set of hoppers, a good water-race, a fair battery, and a fair battery-house, the rest being useless.

The stone crushed was obtained from four or five faces or open quarries in the quartz porphyry. During the two years the battery was at work it crushed 18,427 tons of rock, and obtained 154 tons of black tin, or ·835 per cent. Taking the black tin as being worth £54 a ton, the average value of each ton of rock milled is 9*s*. 2*d*. Under the circumstances of ease in getting the rock and good water power, this ought to yield a good profit on treatment. The newly opened quartz porphyry, laid bare by sluicing operations, is to all appearance better than that worked before. From the large quantity of tin-bearing rock in sight, I am convinced that, with good management, this is a most payable property; but the arrangements must be such that the rock can be quarried and run into the battery at the lowest possible figure, and the crushing and dressing plant must be large enough to deal with a very large amount of rock. With proper arrangements, I think that the mining and milling expenses ought not to exceed four shillings a ton at the outside This would allow of the treatment of rock of half the value of that already milled at a small profit. In making this calculation I have taken no account of the tin that was lost in the tailings from the old mill. Having seen the appliances that were in use, I am quite prepared to believe the local reports that there was heavy loss; but as no regular assays of the tailings appear to have been made, I cannot form any opinion as to the amount of it. With better machinery the stone crushed would doubtless have given a better average yield.

The quartz-porphyry in this ground must be of very considerable width, having been stripped for about five chains up the hill without reaching the northern edge of it. The southern side, at its junction with the granite, has an east and west bearing, but it is impossible at present to say if this is the true bearing of the porphyry dyke. The tin ore in the porphyry appears to be more abundant in the joints of the rock than elsewhere. Little veins traversing the rock show now and then very good ore. In Perry's face a small leader of quartz, carrying a little tin and some talc and mica, is seen, bearing 5° N. of W., and dipping 35° to the northward. On the general map of the district accompanying this report I have marked the quartz-porphyry formation wherever I have met with it.

Full Moon Mine.—This is at present the busiest mine in the district, there being twenty men at work on it at the time of my visit. It comprises 262 acres of ground, lying on the north-western slope of the range, on the head-waters of the Wyniford River. Very rich alluvial tin has been obtained from this ground, it having at one time been one of the most famous claims in the district. This property contains deposits of tin ore of all the three sorts described, and more or less work has been done on all three of them. The alluvial ground has been well worked, but very little has been done to the lodes or to the dyke formation as yet. Two shafts, one 120 feet in depth, the other 60 feet, have been sunk to test the lodes. From the 120-foot shaft I am informed that about 700 feet of driving has been done in one direction and another; but the workings are now full of water, and the plans are said to have gone astray, so that I could get no accurate information as to the underground work. The heaps of stuff drawn from the shafts showed that the vein stuff must have closely resembled that in the Lottah mine, consisting of quartz with dark granite casing, and carrying tinstone, molybdenite, fluorspar, and copper pyrites. Loose stones of basalt lying about the heaps show that a dyke, similar to that in the Lottah, must have been encountered underground. In the vicinity of the shafts are a great number of small leaders of quartz, bearing from 15° to 65° to the W. of N., and having on the average a N.E. and S.W. course. Many of these have proved very rich on the surface, and have been worked, where soft enough, by tributers working the alluvial ground. One of the best defined veins has nearly the same strike and dip as the No. 1 Lottah lode. The best alluvial deposits of tin ore were found over these little veins, and were, without doubt, derived from them. Though the alluvial ground has already been worked over more than once, I think it would be advisable, as a prospecting measure, to trench across the course of the veins in

several places, so as to obtain more accurate information about them, which might direct subsequent mining work. At the same time I think it is highly probable that this trenching would show patches of untouched alluvial ground that would pay for the work. At any rate, this work would give data to prove if it would pay to systematically sluice over again the whole of the alluvial ground. There is very good hope, in my opinion, that this would prove payable, the ground being washed in ground sluices, fed from shallow dams constructed at intervals up the flat valley in which the wash is found.

About four chains to the south west from the 120-foot shaft there is an old working in which a hard quartz porphyry rock has been struck, containing a vein of about six inches of hard white quartz. The work done is not sufficient to allow of an accurate measurement of the strike and dip of this vein, but it appears to run nearly north and south, and to stand nearly vertical. I saw no tin ore in the quartz, but numerous specks of native bismuth were visible. This vein being of the true lode nature, and larger than the majority of the others yet discovered, is worth further prospecting.

It is impossible for me to give an opinion as to the payable nature of the veins that have been worked upon, as I could not examine them. Excellent specimens have been obtained from them, both on surface and in depth, but I could obtain no really reliable information as to the quantity of payable ore available. According to local report the ore obtained from the underground workings was tampered with or stolen, so that doubt is thrown on the record of a crushing that was made. All I can say is that the surface show is sufficient to warrant the expenditure of some money in prospecting the veins more thoroughly.

As in the case of the Anchor mine, the future of the Full Moon depends very greatly on the successful treatment of tin-bearing quartz porphyry. There is a considerable quantity of this rock laid bare in the flat ground just below the battery. The general direction of the course of the quartz-porphyry dyke is N.E. and S.W. as far as I could ascertain, and its width is probably three or four chains. Owing to the ground not having been trenched or tested in any way, I could not get observations to establish either the course or the width of the formation with any accuracy. In the cutting for the tramway to the battery the bearing of the edge of the quartz porphyry where it joined the granite was found to be 65° W. of S., and it also showed an irregular dip to the southward, as much as 58° in one place, but vertical in another.

The rock has been pretty well prospected on surface by a long drainage trench, and by several pits and trenches. It is nearly everywhere tin-bearing, though care will have to be exercised in selecting the stone for crushing. To work economically it will be necessary to have a good many openings in the rock at work at the same time, so that payable ore may always be supplied to the battery. A careful record of the occurrences of good stone should be kept, in order that there may be data to discover if the impregnations of tin ore have any regularity that might lead to more economical working. At present I can see no sign of anything of the sort, the good stone and poor stone being scattered about among each other without any apparent reason or law. Very rich stone has been obtained from many parts of the formation, and with careful management I do not anticipate any difficulty in getting enough payable ore to keep the battery in constant work. The mill now in the possession of the Company is large enough to allow of thoroughly testing the ground, but in order to work to the best advantage it should be increased to five or six times its present capacity. The output from a small mill-treating low-grade ore may be too small to give a profit over expenses of mining, milling, and management, but when the amount of rock crushed is increased, and expenses per ton are reduced to a minimum by the use of labour-saving machinery, the same ore will frequently yield a profit.

The Full Moon Company have just finished the erection of a battery or mill of a type not yet common in this country, though in successful use elsewhere. It is a very neat and well arranged mill. The ore from the mine is drawn from below the battery by a short inclined tramway, which was not finished at the time of my visit, to a feeding floor, from which it is put into one of M. B. Dodge's (U.S.) "Giant" Rockbreakers, 10″ × 8″ aperture. Mr. S. W. Vale, of Messrs. Park & Lacy, of Sydney, who have supplied all the crushing and dressing machinery, informed me that this machine was reckoned to treat 50 tons of hard quartz in 24 hours, breaking it to 1½ inch gauge. It requires 4 horse power when working on hard quartz. Price £105 f.o.b. Sydney. This rockbreaker will in one shift crush enough stone to feed the Huntingdon mill for 24 hours. A large wooden hopper has therefore been placed beneath it to receive and store the crushed rock. From the hopper the stone is fed into the Huntingdon mill by means of an automatic "Challenge" Ore-feeder. This costs £45 complete, f.o.b., in Sydney. The Huntingdon "Centrifugal Roller Mill" is a machine now in common use in many parts of the United States, where it has given much satisfaction to those using it. It is recognised to be one of the most formidable rivals of the stamping battery, and is increasing in popular favour. The mill in question is five feet in diameter, and is capable of crushing from 20 to 25 tons of rock in 24 hours. The gratings are No. 8 diagonal slot gratings, equal to punched gratings of 140 holes per square inch. The mill costs £375, f.o.b., Sydney. The large ringdie can be removed when worn out and replaced with a new one, which costs £12 15*s.* in Sydney. The ringdies on the centrifugal rollers are of chilled steel, and cost £12 12*s.* per set. The crushed ore from the mill passes to the Frue vanners, of which there are three. These cost £140 in Sydney. A new style of Frue vanner has lately been brought out, which has the revolving indiarubber belt corrugated instead of plain. These new vanners cost £230 each, and are said to do the work of three of the old ones, but require the ore to contain a fair percentage of

heavy concentrates in order to do their best work. The three vanners in the Full Moon mill will be worked to their full capacity to take the material from the Huntingdon mill. They are to be worked at 200 strokes a minute to begin with. To drive all the machinery there is a 12 h.p. (nominal) Porter Engine with 9-inch cylinder and 12-inch stroke. This cost £90 in Sydney. It is provided with a Gardner governor, which in case of a belt breaking shuts off the steam and so prevents further damage. The engine is supplied with steam from a Tangye 12 h.p. upright boiler with 4 Galloway tubes, costing £130 in Sydney. The main driving belt is 10-inches wide, the mill and rockbreaker belts each 8 inches wide. Both mill and rockbreaker have fast and loose pulleys. The belts are of leather. The pulleys on the line of shafting are all of wood, made by the Dodge Manufacturing Company, U.S.A. These pulleys are very light, strong, and easily fixed, and are claimed to transmit 20 per cent. more power than iron ones. The whole of the machinery is thoroughly good and well set up. A small water-race has been brought in to the back of the battery to supply the boiler and machinery.

The mill was not quite ready to start work at the time of my visit, but Mr. Vale promised to let me have samples of the tailings and concentrates when work was started. I have since received from him three samples, which have been assayed by Mr. Ward, Government Analyst, with the following results:—Sample 1, of concentrated tin ore, was obtained from stone from the flat in front of the battery; this stone yielded 3 per cent. of concentrations; Mr. Ward's assay shows these to contain 56 per cent. of metallic tin. A good deal of molybdinite copper pyrites and quartz is visible in the sample, and it would require another dressing before going to market. Sample 2 was of dressed ore from fine sand; this was separated from the bulk of the crushed ore by means of a V box, and dressed on a vanner by itself; the result is unsatisfactory, as the dressed ore contains only 17½ per cent. of metallic tin. Sample 3 was of the tailings from the vanners; this is most satisfactory, as the analysis shows only minute traces of tin. Mr. Ward says, "No. 3 is all but absolutely free from tin." This shows what good work the vanners are capable of doing. I have no doubt that in a short time it will be found possible to dress the ore more thoroughly without losing anything of consequence in the tailings. The poor result in the case of the fine sand treated is most likely due to the vanner having been set to treat the general bulk of the sand and not adjusted for the treatment of very fine stuff, which requires a different speed and different number of strokes to be given to the belt. The rapid and simple working of the vanners must always recommend them in preference to the slower and more costly jigs and buddles, and a result of saving ore dressed to 56 per cent. in one operation without any loss in the tailings is one that any machine might be proud of. I have great hopes of this mill leading to a great revival of mining at the Blue Tier.

Haley's Lease.—This ground comprises 60 acres held by Messrs. M'Gough and Young. It has produced very good alluvial tin ore in its time, and still gives a living to its owners from this source. It is most noteworthy, however, as containing a very well marked dyke of quartz porphyry carrying tin. This dyke extends throughout this property and southward into Mr. Crowther's and the Ethel Company's holdings, and northward through the Blue Tier Company's ground into the Full Moon Extended—see attached map. Near the northern boundary a shaft 16 feet deep has been sunk in the porphyry, and some remarkably rich stone has been obtained from this. This shaft encountered very hard ground, and there was difficulty in keeping it free from water, so further sinking was abandoned, and the shaft is now full of water. The general course of the dyke is not far from north and south, and it is generally about a chain in width. The rock is similar to the tin-bearing rock of the Full Moon and Anchor holdings; the central portion appears to be the richest, but wherever I tried it the rock contained some tin, and many excellent prospects were obtained. Through the centre of the dyke there is for some distance a small quartz vein running the same course as the dyke itself; very rich tin ore has been got from this little vein at several places along it. From a hole on it about 30 feet long, 8 feet wide, and 20 feet deep, Budgeon and party obtained, it is said, about 5 tons of black tin, and from another about half the size of the last, from 5 to 6 tons were got. These holes were put down in soft parts of the rock where the tin ore was free enough for working in a sluice-box; where the stone required crushing machinery it was left alone. Another vein carrying in places very rich tin ore has lately been found running through the granite to the westward of the dyke and gradually coming into and crossing the latter; it has been exposed in several trenches, and seems to be a true lode, though it consists mostly of altered granite similar to that on the walls of the Lottah lodes, without much quartz; in one trench remarkably fine crystallised tin ore is easily obtainable; this vein should be prospected still further and, if possible, sunk and driven upon.

An adit has been driven upon the course of the dyke for about 245 feet, and two shafts, 29 feet and 41 feet in depth respectively, have been put down to make communication with this adit. The last 66 feet of the adit has been driven by some mistake into the granite country instead of along the dyke, so a branch drive 56 feet in length has had to be put in to follow it. Fair prospects are obtainable all along this drive.

As in the case of the Full Moon and Anchor mines, the treatment of low-grade ore in large quantity is the problem to be solved by the proprietors of this company. They have an immense mass of tin-bearing rock, which will have to be worked on a large scale and at the lowest possible cost. The ground is very flat, and will probably therefore require pumping machinery to work it to any depth; there is, however, enough stone above the level of the present adit to keep a battery

going for a long time, and by opening the dyke all along its surface it would be well prospected. I anticipate that there may be some trouble in getting enough water to supply a large reduction works here, and care will have to be taken to conserve it as much as is possible. I believe this property to be a good one, and a fair field for profitable investment; it certainly promises well enough to warrant a thorough trial.

Traversing the granite in this ground, as is the case generally with the whole district, are numerous small quartz veins, often carrying tin ore. Many very rich specimens of tin ore have been picked up in the alluvial ground, which have probably come from some of these. Extended trenching is desirable to prove the ground with respect to these veins, as a good lode may perhaps be found.

A basalt dyke is met with in the northern part of the ground, with a course about 30° W. of S. It is about 3 feet wide.

Blue Tier.—This company holds 260 acres of ground, which has proved very good in alluvial tin ore. A good deal of sluicing is still going on. Several small quartz veins have been found, and there are also, as seen on the map herewith, several occurrences of the tin-bearing quartz porphyry. The most important of these is part of Haley's dyke, above described, which passes through the easternmost part of the holding, and continues on into the Full Moon Extended Company's ground. This dyke has been cut across in three or four places by trenches, from which fair prospects are obtainable. In a few places very fair ore has been cut. As this is part of the Haley's dyke, I see no reason for supposing that it will prove any less valuable than the part which I have above recommended as worth investing in.

This company has much better water supply than the Haley's Lease or Full Moon Companies, and the stone would not have to be carried very far to be dressed. The dressing works for the Haley's Lease would be also more advantageously situated if on the Blue Tier ground, and connected with the stone by a tramway.

Full Moon Extended.—This company holds 80 acres on the line of the quartz-porphyry dyke, passing through M'Gough's and the Blue Tier properties just described. A large number of trenches have been cut across the dyke, showing it to still possess the same character as in the above. A shaft has been sunk to a depth of 34 feet on the dyke, the stone improving as the shaft got deeper. Some very nice ore was obtained from this shaft. The small pump used for keeping down the water proved quite incapable of performing its work, and operations had to be suspended. An adit was then begun from the Wyniford River towards this shaft. There would be 65 feet of backs above this adit at the shaft, and 99 feet in the highest part of the ground. The adit was driven 105 feet through hard grey granite country. The manager informed me that he struck the soft dyke formation in the end of this drive just before having to stop work. It is a great pity that this work was not continued.

The porphyry dyke was not visible in the Wyniford River as I expected, and the manager of this property informed me that he had never seen it anywhere in the river, but that it occurred further north again.

This company should make arrangements to get 100 or more tons of stuff from the various trenches crushed and dressed, so as to afford a test of the ground. If this trial should prove favourable, the adit should be extended and dressing works put up on the Wyniford River, which is here large enough to give a fairly good supply of water all the year round.

The property does not deserve to stand idle. A basalt dyke about 3 feet thick crosses the third trench north of the shaft, bearing 27° W. of S.

W. L. Crowther's Section.—This is 20 acres of ground lying to the south of Haley's Lease. It is very flat, and lies on the watershed between the Wyniford River and Crystal Creek, draining to the former. It is worked on tribute for alluvial tin ore, the ore being found in the shallow surface soil about two feet in depth. The tributer, Mr. Willing, told me he had got 7 tons of black tin in three months at a cost of £5 a ton. Owing to the flatness of the ground, the stuff has to be sluiced by hand in boxes. The tinstone is sharp and angular. Willing says that he considers that there is hardly an acre of this ground that would not pay to sluice if there was water to be had. The granite laid bare by the working of the surface is full of little quartz veins, often carrying good tin ore. The dyke formation found in Haley's Lease passes through this section, but nothing has yet been done to prove its value.

Ethel T. M. Company.—Haley's dyke passes south from Crowther's section into the Ethel Company's ground. About five chains south of their northern boundary a shaft has been sunk to a depth of about 60 feet, fair tinstone being met with throughout it. It is now full of water. Several trenches have also been dug exposing the porphyry. The dyke is here over a chain wide, and further south it is said to widen out to 9 or 10 chains, and to be traceable for three-quarters of a mile. Its course is still about north and south. Good prospects are obtainable from it in many places, and it always carries some tin ore, while really good stone is often seen in it. The head of a branch of the Crystal Creek has been worked for alluvial tin ore by tributers, exposing the porphyry for a considerable distance. Lower down the hill a party of tributers were working at the time of my visit hydraulicing with a $\frac{3}{4}$ in. nozzle. They had not a good pressure of water, but this was

owing to bad arrangements, as this ground falls rapidly and it is easy to get good pressure. They were also working far too narrow faces for this method of work, and, in consequence, had much trouble in moving large stones and trees, which, with wider working faces, they might go round. The whole of their sluicing arrangements were of a primitive description. There is no reason why this ground should not be easily dealt with by hydraulic sluicing, but some dams and races would have to be constructed. Better tail-races than those now in use on the ground are also required, for it is simply absurd to use a couple of boxes from 8 to 12 feet long, only fit for hand sluicing, as the only tin-saving appliance when hydraulicing. The sluicing operations have laid bare a good many thin tin-bearing quartz veins in this ground, as in other parts of the district.

In the lower part of this Company's property a tunnel was driven by the Lottah Company when this ground belonged to it. This adit is about 100 feet in length, and is driven to cut a small lode. This carries a great mixture of minerals, amongst which I noticed bornite, copper pyrites, indigo copper, wolfram, talc, and tinstone. The veinstone is quartz, but, as in the Lottah, there is a band of altered granite on each wall, and this appears to carry most of the tin ore. The wolfram is more in the quartz. This ore would be a very difficult one both to dress and to smelt owing to the number of heavy minerals.

Subsequently to my visit to this property I was told by Mr. C. Symons that there is a large quartz lode crossing the porphyry dyke about 10 chains south of the 60-foot shaft above mentioned, with a bearing 70° W. of N. This should be trenched on and prospected, as the almost universal occurrence of tin ore in the small quartz veins throughout the field renders it very probable that a strong quartz lode will also carry tinstone. At its crossing across the tin-bearing porphyry would be an especially likely place to find good ore.

Wellington.—Eighty acres of ground are held by this Company. Hydraulic sluicing had only been commenced the day before my visit, but a good start had been made. The nozzle in use was 1½″ in diameter, but was rather large, and was shortly replaced by a 1″ one. About 1½ sluice heads of water were being used, and this under a head of only about 40 feet. Much better progress would result from using higher pressure and more water. There is a large extent of shallow tin-bearing ground to be sluiced. The heavy trees on the ground are troublesome. If this venture proves successful a great deal more similar ground throughout the district can be worked in the same way, namely, ground that is shallow and too poor to pay by ground-sluicing, but of wide extent. The work of the Wellington Company will therefore be watched with interest.

Numerous quartz veins of from 1″ to 6″ in thickness as a rule are found throughout this property, and the sluicing will doubtless lay bare others. Some of these in the eastern section have been worked upon at some considerable expense. Two shafts, one 37 feet, the other 80 feet deep have been sunk, and an adit 494 feet in length has been driven. The first 370 feet of this adit were through hard granite, and the work is said to have cost about £2000. The remainder of the drive is in soft country. Two lodes were met with, No. 1 at 370 feet from the mouth of the drive, No. 2 at 407 feet. At 455 feet a soft decomposed sort of granite was met with, and the drive was continued in this to the face at 494 feet without passing through it. This soft granite carries a little tin ore, running, it is said, about ½ per cent. on the average of black tin. I cannot vouch for the correctness of this estimate, but the prospects shown to me render it probable enough, and from the ease with which it could be mined and dealt with, even this small percentage might be made to pay. The No. 1 lode has an E. and W. course, and is nearly vertical. The north wall is hard and well defined, and has a slight clay flucan. Next to this is a small quartz vein about 3″ wide; then there is soft decomposed granite for about 8 feet, said to have been tested and found to contain 1½ per cent. of black tin, and then on the South wall is another small quartz vein; these quartz veins are somewhat micaceous, and appear to be granite infiltrated with quartz in solution and thus altered, the felspar being removed at the same time that the quartz was deposited. The No. 2 lode is about 1½″ of quartz, with about 6″ of soft granite on each side of it, both carrying some tin ore. This lode runs about E. and W., and underlays a little to the North, so that it is not unlikely to join No. 1 lode in depth. It is quite likely that these lodes will become more solid and better defined at a greater depth. The shafts yielded some very good ore. On the surface the lodes make their appearance as several small veins carrying excellent tin ore. Several of these have been worked successfully by simple sluicing, the hard stones being thrown away. In the tunnel, about 16 feet before coming to No. 1 lode, a dyke of basalt 30 inches thick was cut through, and it was also met with in the side of the bottom of the 80-foot shaft. This dyke cuts through the lodes. Loose stones of basalt are found lying on the surface in quantity near the water-race that brings water to the hydraulic workings, showing that another dyke is somewhere in that neighbourhood.

Another of the tin-bearing quartz porphyry dykes passes through this property in a north-westerly direction, and is said to have been traced on the Kent Company's land. Very little work has been done on this. If the Full Moon Company is successful in making a profit from this sort of stone it will doubtless receive much attention wherever it is found throughout the district.

Giant.—This Company is working a little at its alluvial ground. A quartz porphyry dyke is found in its western section, bearing about 10° E. of N., and showing a little tin ore in the trenches that have been dug across it.

Other Holdings.—After examining the above properties I did not think it necessary to further

MAP SHOWING PORTION OF

THE BLUE TIER DISTRICT

COUNTY OF DORSET

SCALE 10 CHAINS TO AN INCH.

A. Montgomery M.A.
Inspector of Mines and Geological Surveyor
28th November 1889

REFERENCE

QUARTZ PORPHYRY. shown thus
LODES " "
BASALT DYKES " "

OFFICE OF MINES
NOV: 28 1889.

WYNIFORD RIVER
PROPOSED DAM SITE
GIANT
CREEK
CAMP
ADIT
CAMP
WELLINGTON
BLUE TIER
Stream
Basalt Dyke
SHAFT
SHAFT
FULL MOON EXTENDED
ADIT
Large Stones Porphyry Quartz
PROPOSED DAM SITE
Stream
Stream
MOON
FULL
SHAFT
SHAFT
120' SHAFT
80' SHAFT
Basalt Dyke
SHAFT
SHAFT
ADIT
HALEYS LEASE.
(McGaugh and Young)
PROPOSED DAM SITE FULL MOON
W.L. CROWTHER
SHAFT
BLUE TIER RANGE
ETHEL
LOTTAH
Quartz
Basalt Dyke
LAFFER RIVER
RANSOM RIVER
ETHEL
ADIT
CRYSTAL CREEK
ANCHOR
GROOM RIVER

explore the district, as from inquiries I found that the general character of it was similar to what I had seen. Besides, the ground not examined was not being worked, and I could not therefore get information about it on the spot.

Men employed.—I was sorry to see so few men employed on the large area of ground held by the various companies. The Full Moon and Anchor Companies alone were working with any vigour. From inquiries made, I found the number of men employed by the various companies to be as follows :—

Haley's Lease—two Europeans, three Chinese.
Lottah—one European (caretaker).
Full Moon Extended—no one.
Giant—one European (caretaker).
Blue Tier—eight Chinese.
Wellington—two Europeans, one Chinese.
Anchor—thirteen Europeans.
Ethel—three Europeans.
Crowther's—four Europeans.
Other Ground—eighteen Chinese.
Full Moon—twenty Europeans.

Or a total of 46 Europeans and 30 Chinese. This is a very small number of men for the extent of ground held. More vigorous working will be required before the Blue Tier regains its old position as a tin-producing district.

Conservation of Water.—Owing to the great height at which the tinfields of the Blue Tier district lie, the supply of water is only sufficient for sluicing purposes during the wet months of the year; and on the higher ground there is always difficulty in getting a good supply at a height sufficient to give pressure for hydraulic working, which, in my opinion, is now the great desideratum for the poor alluvial dirt still plentiful. I am confident that an immense area, yet untouched on account of its poverty, as well as much ground that has been already sluiced, could be worked by the hydraulic method with profit. I do not think that the conservation of the water in dams and reservoirs presents any very great difficulties; on the other hand, the configuration of the northern slope of the range is very favourable for the storage of water. The Blue Tier is one of the wettest places in the Colony, the mean rainfall from 1st January to 30th September for the last five years being 42·84 inches, an amount of fall only exceeded at Waratah and Corinna. The range itself gets a greater amount of rain than Gould's Country, where the observations are taken. Mr. R. S. Milles, the manager of the Full Moon mine, has observed the rainfall this year, and finds that in the six months between 14th April and 14th October, 1889, 48·40 inches of rain fell on the top of the range. This gives a very large quantity of water falling over the wide flat lying top of the mountain. Now, there are a great many places where low embankments will impound a wonderfully large quantity of water. The Full Moon Company have erected a small dam, which will give a large supply of water, and Mr. Milles informed me that he could impound 10 acres of water, or about 20,000,000 gallons, by raising this dam to a height of only 25 feet above the deepest point in the little creek. This embankment would be 288½ feet long, and have an average depth of about 13 feet,—quite a light work. The same gentleman has taken levels and measurements that show that on Wheal Tasman Flat a reservoir could be made with an embankment about five chains long and of about eight feet mean depth, that would contain something like 200,000,000 gallons of water. These figures give some idea of the ease with which large quantities of water may be impounded. There are many other places where smaller reservoirs could be made at a low cost, at different levels, almost to the top of the range. Lower down, along the Wyniford River and its tributaries, there are great numbers of good reservoir sites. One very good one is on the Giant Company's ground. Here there is a wide flat which has been worked for alluvial tin. The ground was so flat that there was great difficulty in keeping the workings free from water, and all the washdirt had to be washed in boxes, as there was not sufficient fall for ground-sluicing. At the lower end the valley narrows, and a dam about five chains long and not more than 25 feet deep in the middle would store the water in a basin probably 30 acres in extent. As the Wyniford in flood carries a large volume of water, there would be no difficulty in filling this dam.

A system of water storage on the Blue Tier would benefit all the tin-sluicing companies down the Wyniford River as well as the Blue Tier workers. In a short visit such as mine it is not possible to learn how much water could be stored, and exact data on which to base estimates of cost of storage and area of ground benefited can only be obtained by a careful contour survey of the district. Such a survey would be of great assistance to mining companies by showing exactly how far they would have to go to get water at any level, what fall they could get for tailings, and what distance they would have to drive in order to drain their mines to deep levels. This last is a matter of great importance for the future working of the field, as it would obviate the necessity for pumping machinery, with its constant heavy charges, if a deep adit were to take away the water. An adit a mile in length from the southern side of the range would drain the Lottah, Full Moon, Haley's Lease, and part of the Blue Tier ground to a depth of about 800 feet below the watershed. I do not know of anything that would do more towards directing mining operations into the most economical channels than a proper contour survey.

In conclusion, I have to say that I received the greatest courtesy and consideration from everyone connected with the mines of the Blue Tier district, and no trouble was spared by anyone to give me any information or to guide me to any part of it. I have particularly to thank Mr. Milles, Mr. C. Symons, and Mr. Thomas Budgeon for much valuable help.

I have the honor to be,
Sir,
Your obedient Servant,

A. MONTGOMERY, *M.A.*,
Inspector of Mines and Geological Surveyor.

The Secretary of Mines, Hobart.

REPORT ON THE STATE OF THE MINING INDUSTRY ON THE WEST COAST.

Inspector of Mines and Geological Surveyor's Office,
Launceston, 25th April, 1890.

SIR,

I HAVE the honour to report to you on the state of the Mining Industry on the West Coast of the Colony, as observed by me during my recent visit there.

MOUNT LYELL DISTRICT.

This was the first mining centre I went to. There is a fairly good cart-road from Strahan to Lynchford, and from the latter place to Mount Lyell there is a road wide enough for sledges. This part of the road is not well laid out, the grades being much too steep for anything but a pack-track. To make a cart-road of it numerous deviations from the present track will have to be made. I am convinced that true economy demands that the roads in these mining districts should be laid out so that they may develope from pack-tracks into cart-roads by simply widening and forming them from time to time. Easy grades are of much more importance than short roads, especially in a district where horses and horse-feed are very expensive. A bad road causes a very heavy tax to fall on an out-of-the-way place in the increased expense of obtaining all supplies. The difference in first cost of a good and a bad road is soon lost in the extra expense of transit over the latter, and it should be borne in mind that this extra expense is dead loss to the country. A country requiring a larger population to develope its resources cannot afford to employ its men in unreproductive work, and the extra labour involved by bad roads could be employed to advantage in other directions. The makeshift character of so many of the roads in the mining districts of the West Coast is such a charge upon the industry that I feel compelled to call attention to the falseness of the economy. An example of the extra expense involved by one or two bad grades is to be seen in the road from Reminé to Mount Zeehan. This is on the whole an excellent road, but there are one or two very steep grades in it which compel the employment of three horses instead of two for every cart that passes over it.

At Mount Lyell I examined the extraordinary deposit generally known as the "Iron Blow," worked by the Mount Lyell Gold Mining Company, and the alluvial claims of the Linda Company and of Messrs. Carlson Brothers and Delaney. There are other alluvial claims in the district, and there is also a place where native copper, said to be auriferous, has been found in some abundance, but I was unable to visit these. The Mount Lyell Company's gold-bearing deposit is of a most unusual character. It consists mostly of red oxide of iron (Hematite), sometimes micaceous. This iron ore is partly in hard solid metallic-looking masses and partly earthy and soft. Gold occurs in both sorts of the ore. Portions of the iron ore are hydrated and changed to yellow and brown oxides of iron. Iron pyrites is frequently found in this portion of the stuff. On the western side of the hematite is a large mass of iron pyrites, the relation of which to the rest of the deposit is as yet difficult to make out. In a drive into the working face a lode of copper pyrites was encountered, but this I did not see, as the drive was blocked up. In the lowest level yet driven into the ore-mass the red hematite is still found on the eastern side, and on the western side hard iron pyrites and a mixture of iron and copper pyrites with galena. A peculiar feature of the ore is the nearly entire absence of silica, its place being taken by baryte (heavy spar). A large open cutting has been worked in the outcrop, forming an irregular circular quarry 66 feet wide in the widest part, and having an average diameter of 42 feet. The face is about 50 feet high in the middle. The whole of this cutting is in the ore-mass, and on the western side of it lies the mass of iron pyrites above mentioned. No work has been done on this, and its extent can only be surmised from two to three surface trenches. It evidently extends over a large area. On the spur above the working face the outcrop of the hematite may be traced for about 100 feet, but trenching would probably trace it much further. The strike of the deposit appears to be as nearly as possible north and south, and extensions of it are said to have been found on this line a mile to the southward and for a long distance to the northward as well. The country rock is conglomerate and sandstone, probably of Silurian age at youngest. Silurian fossils are found in the neighbourhood, but I did not see any *in situ*, and cannot therefore be certain that they came from the conglomerate formation. The deposit is most likely a lode, the wide portion now worked being one of those bulges which are not uncommon. The pyrites on the western side of the cutting may possibly prove to be another lode coming into the hematite one. More working must be done before the relations of the pyrites and the hematite to each other are quite clear.

Gold is readily obtained in the prospecting dish by washing the softer parts of the hematite. The battery returns show that silver is also present in some quantity. Much of the gold is very fine and flaky, and is very easily washed out of the dish. The large amount of baryte present in the ore makes it very difficult to save the gold in washing off, and the prospect obtained from the tailings of the dish washed is nearly as good as the first one. The iron ore also is heavy. This heavy character of the gangue is greatly against the successful treatment of the ore in the battery, and in consequence there have been many complaints as to loss of gold. A small tailing-pit close to the battery, and two larger dams some little distance away from it, have therefore been constructed to impound the tailings for further treatment. Assays have, I am told, been made of the tailings from time to time in a desultory sort of way, but no attempt appears

to have been made to secure a regular and systematic sampling of the tailings in order to ascertain the exact amount of loss. This ought to be done in every battery, but most especially in such a one as the Mount Lyell Company's, where heavy loss of gold is to be feared from the nature of the ore. It is not enough to take occasional samples from the heavy tailings that accumulate in the settling pits, for the fine slime, constituting often 30 per cent. or more of the whole bulk, frequently is even richer than the sand, and all the slime escapes suspended in the water. To take a fair and accurate sample of the tailings from a battery a small portion of the stream of water and tailings issuing from the mill-house must be continuously or at regular intervals diverted into a special settling-tank large enough to give time for all the sediment to settle in it. At the end of a week an assay sample taken from this sediment, after mixing it thoroughly, will correctly represent the composition of the whole week's tailings. There are numerous mechanical sampling machines in use, mostly of American design, which act excellently. A simple and effective sampler can be easily made as follows :—The whole of the tailings from the mill are gathered into a launder. At any convenient place this launder is made to discharge into another one set about six inches lower down, so that the water drops in a small waterfall from the higher into the lower launder. Immediately under the fall are placed six or more small metal pipes, distributed as evenly as possible over the whole space on which the water falls. These pipes are placed vertically, with their tops, which are open, sufficiently high to be above the level of the water as it runs away in the lower launder. A small proportion of the whole discharge falls through these pipes into a shoot fixed underneath the lower launder (through the bottom of which the pipes pass). The shoot carries this small portion into a large settling-tank, where the sediment is allowed to accumulate as long as may be desirable. When the sediment is thoroughly settled the water is syphoned off, and the sediment is thoroughly mixed with a shovel, and a portion is taken from it to be dried and sent away for assay. The cost and trouble of the whole arrangement are trifling, and a thorough check on the efficiency of the battery is established. Such checks on the battery work are most necessary, even when the mill is working well, as any blunder or piece of carelessness on the part of those in charge almost inevitably results in loss of gold and consequent higher assay of the tailings, and an inquiry into the reason of the loss is at once instituted. Close attention to the work in hand and careful treatment are thus ensured. When the loss of gold in the tailings is great, efforts are sure to be made to reduce it, and to improve the gold-saving appliances; but when the amount of loss is unknown, as is the case without one exception, so far as I know, throughout the whole of the Colony, it is a very easy matter for the battery men to persuade themselves that nothing of consequence is lost. It is notorious that, as a rule, battery managers know absolutely nothing as to what they are losing.

From the manager of the Mount Lyell Company's mine I learned that 1530 tons of ore had been crushed in the battery for a return of 1480 ounces of bullion, about half of which was gold and half silver. He also told me that assays of the ore generally gave a return of silver that would be payable if it could be cheaply recovered. The battery treatment is not capable of saving silver except when in the native state or alloyed with gold. Chloride of silver can be amalgamated readily, but requires time. The other compounds of silver can mostly be amalgamated if treated for a long time in iron pans heated by steam, with salts of copper, common salt, and other chemicals. The ordinary battery treatment does not recover these compounds at all. In order to make the most of the ore, it will therefore be necessary at Mount Lyell to improve the treatment now in use.

The reduction plant at present consists of an eight-stamp battery with amalgamated copper tables and blanket tables, and one Wheeler pan. The manager was erecting shaking-tables and a small amalgamating device of his own, at the time of my visit. The whole battery was sadly defective. The same remark, I am sorry to say, would apply more or less to everything about the mine. The working face was in such a dangerous condition that I had to order the removal of several threatening rocks at once. The arrangements for getting the ore from the working face to the battery were also very badly arranged for economical working. The stuff from the face was wheeled in barrows for nearly a chain, and thrown down a pass directly into a truck, no proper hopper being provided. The loaded truck was then driven out by two men, being too heavy for one by himself, and tipped into a hopper at the head of a self-acting grade or wire tramway. I could see no reason for not bringing the tramway right up to the floor of the working face. The tramway was in a wretched condition—hardly any of the rollers would revolve, their axles being too thin, and allowed to project too much. At the bottom of the grade the trucks ran into a self-tipping arrangement constructed much too flimsily for its work: I was not surprised to see a truck jammed in it. From the tip the stuff runs right down on to the feeding-floor of the battery, interfering very much with the work of the feeder. A hopper ought to be provided to take this stuff. Underground, in the level driven on the lode, the same unworkmanlike state of affairs was evident, the drive being extremely crooked, without any apparent reason for its crookedness. It is only fair to the present manager, Mr. Crotty, to say that he had only taken charge of the mine two days before my visit, and cannot therefore be held responsible for the state of affairs, which he was doing his best to remedy.

The style of machinery that should be used for this ore requires to be selected with much consideration. If silver is present in payable quantity, as I was told it is, it is a matter of consequence to save it as well as the fine gold now lost. The treatment of silver ores by amalgamation depends on the nature of the compounds of silver present in them. The process most likely to give a satisfactory result is that of pan amalgamation. As the Company has a Wheeler pan in the mill, it would not be difficult to give this process a fair trial. The pan should, however, be worked in connection with a settler in order to do justice to the ore, as the pulp in the pan ought to be worked to the consistency of honey, and then thinned with water in the settler in order to recover the quicksilver and amalgam. As the pan amalgamation process does not appear to be well known in this Colony, a short outline of it may be necessary. It is designed to effect and ensure intimate contact of the precious metal with quicksilver. For this purpose the finely ground ore is mixed with enough water to form a "pulp" thick enough to prevent the easy settlement of quicksilver through it. The ore is crushed by means of stamps and passed over copper tables in the usual way, thus saving the heavier gold. From the copper tables the crushed ore passes into a series of six or

more large settling-tanks of sufficient size to prevent the loss of much sediment. From these it is shovelled into the pan, the muller of which is revolving. Enough water is added with the sand to thin it enough to allow the muller to work freely. The quantity of water added should not be so great as to prevent the ore from eventually working to the proper honey-like consistency. The muller is lowered so as to bear heavily on the bottom of the pan and grind freely. In the course of from one to two hours all the heavy sand is thus reduced to a fine slime, and the contents of the pan become "pulp." From 100 to 300 lbs. of quicksilver, according to the size of the pan, are now put into it, together with quantities of common salt and sulphate of copper (bluestone), which must be as determined by a few experiments. For a charge of quarter of a ton of ore in the pan, 6 lbs. of salt and half a pound of bluestone might be tried to begin with. If the bullion got from the pan is found to contain too much copper, say more than 20 per cent., the quantity of bluestone used to a pan charge must be reduced. But if the bullion contains less than 5 per cent. of copper, more silver would most likely be saved if a little more bluestone were used. In this process it is better to produce somewhat coppery bullion than to lose silver by reducing the quantity of bluestone too much. These chemicals, as the salt and bluestone are generally termed, may be added along with the ore when charging the pan. Some millmen also add the quicksilver immediately the ore has been introduced, but it is generally preferred to keep the quicksilver back till the coarse sand has been finely ground. While the grinding is going on steam from a boiler is injected into the pan, raising the temperature of the contents to boiling point. This greatly facilitates the amalgamation of silver. To prevent loss of heat the pan is furnished with a wooden cover. After adding the quicksilver the muller of the pan is raised a little so as not to grind any longer, and it now churns the quicksilver and contents of the pan together. This process continues for from two to four hours, at the end of which time fine globules of quicksilver may be seen thickly in the pulp adhering to a stick dipped into and withdrawn from the pan. The fine globules of quicksilver, circulating constantly through the whole mass of ore, come in contact with and amalgamate even very fine gold. The function of the chemicals is to convert compounds of silver which do not readily amalgamate into such as do so with ease. When the amalgamation is judged to have proceeded far enough, more water is added to the pan, and its contents are washed out into the settler, the stirrer of which is set revolving. In the settler the pulp is thinned with water sufficiently to allow the small globules of quicksilver and amalgam to settle to the bottom. The water, carrying the fine tailings suspended in it, is gradually run off by means of a number of nozzles set in the side of the settler at different heights. The settler is usually made large enough to take the discharge from two pans, and should work off its charge in the same time as is taken to amalgamate a charge in the pan. The quicksilver in the settler is generally drawn off by means of a syphon in the bottom of it after about an hour's working, and is squeezed through canvas to extract amalgam. The quicksilver is then ready in time to go back into the pan. This process has been used with great success for ores containing fine gold and compounds of silver, as well as for the latter by themselves. When gold alone is to be saved the use of chemicals and steam is unnecessary.

As amalgamation is one of the cheapest methods of treating gold and silver ores, and is, besides, an easily learned and easily understood process, it is generally found to give better financial results than more expensive processes or such as require special skilled knowledge, even when the latter save a larger proportion of the assay value. It is therefore wise, as a general rule, to exhaust the resources of this process before resorting to chlorination or smelting.

The sulphide ores at Mount Lyell could not be treated by any amalgamation process with any success without a preliminary roasting to get rid of the sulphur. Only the hematite ore is fit for the raw amalgamation process above described. I do not know if the pyrites contains enough bullion to be worth working. Very careful sampling of it would be required to give data to settle this point. If it should prove on assay to be valuable enough for treatment, the process of pyritic smelting would probably prove the best for dealing with it, and would have the great advantage that the hematite ores could be smelted with it as flux. Pyritic smelting, though well known to metallurgists, is almost unknown to the public generally, and a few words about it may not be amiss. If a mixture of auriferous and argentiferous quartz, oxide of iron, and pyrites, is smelted in a furnace the iron oxide and quartz unite to form a slag, while the pyrites and other sulphides that may be present melt and form what is called "matte." The matte is heavier than the slag, and is found as a separate layer beneath it when the molten contents of the furnace are run out. The matte is found to contain practically all the gold and silver in the furnace charge. In fact, the matte acts precisely as the metallic lead does in the ordinary smelting process. If now the matte is partially roasted so as to oxidise a portion of it, and this half-roasted material is again run down with siliceous ores in a furnace, a small quantity of matte, now very rich in bullion, is obtained. The treatment of this rich matte is generally entrusted to the skilled metallurgists of Europe, mattes being sold according to their assay value at Swansea and Freiberg from all parts of the world. This process would be very suitable for the ores found at Mount Lyell, and would most likely be found to be both cheaper and more effective than roasting the pyrites and then amalgamating.

Another process which those concerned in the Mount Lyell mine would do well to make inquiry about is that recently brought out by the Cassell Company, of Glasgow, and known as "Macarthur's Process." It is claimed for this process that it will extract both gold and silver from even the most refractory ores with great success. Cyanide of potassium is the solvent used to extract the metals. This is as yet an almost untried process, but it promises well enough to be worth watching. Works for trying it on a large scale were in course of erection at Waiorongomai, in New Zealand, some six months ago, but I have not yet heard what success attended the operations.

The peculiar nature of the Mount Lyell ore should make the owners take the precaution of having parcels of from one to five tons treated by various processes before finally deciding on the method of treatment and erecting machinery. The cost of such experimental trials would be nothing compared with the loss that would result from a wrong selection.

Before leaving this subject I would remark that the present battery site is not at all a suitable one, and that any new works put up by the Company would be much better placed on the flat-lying ground at the foot of the hill on which the mine is. A better supply of water could then be obtained, and there would be room for machinery which the present site does not afford. The mine is an extremely promising one, and ought to pay well when the difficulties of treating the ore are overcome.

All the alluvial claims at Mount Lyell had ceased sluicing for want of water at the time I saw them. For about nine months in the year they are able to sluice, but water runs short in the summer. The three claims visited have all done a good deal of work, and obtained a fair amount of gold. The bottom on which the auriferous gravel rests is a black peaty mud, full of roots, but this itself contains a little gold, and on Delaney's claim fair auriferous wash has been obtained below it. As the stripping of the surface gravel proceeds this black bottom will no doubt be prospected further, and it is quite possible that payable gold may be found beneath it. There is still a large quantity of wash-dirt to be sluiced in this neighbourhood. The Linda Company is hampered in its work by the difficulty of getting rid of the tailings, and is now constructing a long tail-race so as to work to more advantage. When this is finished it will allow the work to proceed on a much larger scale. The Carlson Brothers were also doing heavy dead-work, removing a large slip which had covered the wash-dirt. This was a really formidable work, and the energy with which it has been attacked speaks well for the pluck of the owners of the claim and their belief in its value.

Below the Linda Claim is an extensive swampy flat, through which the Linda Company's tail-race has been cut. From the configuration of the country this flat may be expected to be composed of alluvial materials of considerable depth, and gold is very likely to be found in it. It is quite possible that the streams which deposited the gravels in the claims higher up did not escape from this flat by the present outlet, but had some other channel. If this be so there should be an old channel or deep lead still to be discovered in this district. My visit was too hurried to allow me to test this conjecture in any way; but even if no lead exists, the country round here is promising enough to attract prospectors.

The black bottom on which the gravel rests is very full of segregations of pyrites, and a little vein of galena has also been found in it. Limestone has been cut in the Linda tail-race. The geological features of this upper part of the Linda Valley are of much interest, and I hope on a future visit to have time for their study and elucidation.

Queen River and Howard Plains.—From Mount Lyell I went to the new reef found by Messrs. Orr and Watson at the Howard Plains, now held by the Madam Howard Company. The track from Mount Lyell crosses several creeks running into the Queen River. Most of these have been worked for gold, and some have given very rich returns. So far reefs of value have not been found, but the presence of so much alluvial gold points to their existence. The character of the country, too—namely, old slates and sandstones, penetrated and overlaid by volcanic rocks,—is favourable for the existence of auriferous reefs, and in time they will, doubtless, reward the labours of the untiring prospector.

The ground held by the Madam Howard Company comprises four 10-acre sections, situated on the north side of the right hand branch of the Princess River. The reef crops out on a bare spur, and may be plainly traced on the surface for about ten chains. Strike 80° east of north, dip 58° southerly. Two small shafts, 40 feet and 25 feet in depth, were sunk on the underlay of the reef by the prospectors and connected by a short drive. About 13 feet has been driven westward on the reef from the 40-foot shaft also. As these shafts were not well constructed, the company's manager is sinking a new shaft a little further along the reef to the westward. The prospectors took from their workings about 20 tons of quartz, which was crushed in a small hand battery, and yielded 63 ounces of gold. The reef is of white friable quartz, so far very free from pyrites, and forms a solid body from 2½ to 3 feet in thickness. Fair prospects are obtainable from the stone in the prospecting shafts, and in the stone lying on the surface gold was pretty freely visible. The new shaft had not struck a solid reef when I saw it, but was only down 22 feet. The country rock is a grey sandstone, striking N. 47° E. and dipping to the N.W. at an angle of 75°. The reef cuts through the strata both in strike and in dip. The character of the country rock closely resembles that of the sandstones in the Beaconsfield District, and it belongs in all probability to the same Silurian formation. The property is situated favourably for working to a considerable depth by means of adits. A level about 270 feet long, driven from the gorge on the southern side, should cut the reef about 118 feet below the mouth of the new shaft, and a level 600 feet long would probably give 300 feet of backs. The battery would naturally be placed in the gully from which these drives must start. I cannot speak as to the possibility of driving the battery by water-power, but there is plenty of water for all other purposes.

A second reef, parallel to the prospectors' one, outcrops on the hill about three chains to the south of it. No work has been done on this as yet. It would be cut by the adits above mentioned. This property seems likely to turn out well; present appearances are all in its favour. Until it has been proved to a greater depth, however, investors should beware of putting too much faith in these. It is a great mistake to put a high value on a mine on the strength of a few tons of good stone from the outcrop. A mine has really no value as an investment until there is a quantity of payable ore in sight in it to guarantee interest on the money: till then it is a speculation. Investors in unproved mines should always be prepared to spend a good deal of money in developing them before expecting dividends, and should insist on seeing them opened before batteries and other surface works are undertaken. How often do we see crushing machinery erected only to be taken down again for want of something to crush? The King River and Macquarie mines, in this very neighbourhood, bear witness to the evil policy of prematurely putting up machinery.

As there was no work going on in the King River mine, and no one was in charge of it, I did not make any examination of it, though passing close to the workings.

Princess River.—Here three companies are at work, though not at present with any vigour. The Princess River Company and the Princess River Extended Company hold ground alongside one another, on a reef running through a high spur separating the Princess from the Queen River. The reef has been well tried by both, by means of adits driven from each side of the hill, but with poor results. Near the top of the hill and in the higher levels good stone was obtained; but lower down, though the reef looks strong and is well defined, it has not proved payable. The country rock is sandstone, quartzite, and slate, apparently much disturbed. Little more can be done on this reef by means of adits, and its further development will require pumping machinery of probably rather a powerful sort. The Princess River Company has a good 10-head battery worked by water-power. A little lower down the river the Princess River Prospecting Association have driven two or three short tunnels. In one of these a small reef has been cut, from which good prospects can be washed, and in some of the stone from this I saw gold freely. A crushing is being taken out to be tried at the battery, and, if this proves payable, a tramway is to be constructed to the battery. From another of the adits a strong stream of water has been constantly flowing for some time past, which augurs ill for the work of unwatering the mines below the level of the river. It is very much to be regretted that the enterprise of these companies has not been better rewarded. The most satisfactory feature is that the auriferous character of the formation has been proved, and that consequently there is good hope of better reefs being yet found.

MOUNT ZEEHAN DISTRICT.

The importance of this rich district requires a much more minute examination of it than the limited time at my disposal enabled me to make. I could not visit all the ground that has been taken up, nor see all the trenches and workings that have been made, but I saw enough to convince me that a great future is in store for this part of the Colony. The lodes are numerous, well defined, strong, and rich, and have every indication of being permanent in depth. I can see no reason for the croaking one often hears about this field having merely a "surface show." It is, doubtless, undeveloped as yet to any depth; but the richness, number, and extent of the good "surface shows" render it most improbable that equally good ore will not be found in depth. That there will be great variations in the quality of the lodes is to be expected; and it may quite well be that some of those that show the best on the surface may be poor when sunk upon, just as the converse is likely, namely, that lodes poor on the surface may become rich at greater depth. The lodes cannot be expected to be of uniform quality throughout, for such a character is unknown to mining experience; the rule being that the ore is distributed unevenly through the mass of the lode, sometimes forming thinner or thicker veins through it, sometimes in scattered grains throughout masses of gangue, and sometimes constituting for a considerable extent almost the whole thickness of the lode. We may expect to find "bunches" and "shoots" of ore in a lode, but we must not expect them to exist throughout its whole extent without interruption; and it is silly to fear that a mine has come to an end when the ore is found to give out, and be replaced for a time by worthless lodestuff. There is every probability of further exploitation discovering fresh bunches and shoots of ore. I make these remarks because timorous folk have felt scared at hearing that some of the Mount Zeehan mines have showed more carbonate of iron, barytes, and other gangue than galena when cut a little below surface. These barren portions are sure to exist in all the mines, and must be patiently driven through.

The belt of land taken up in the vicinity of Mount Zeehan is, roughly, eight miles long by four and a-half miles wide,—the longer sides of the rude oblong having a N.W. and S.E. direction. This is the strike of the principal lines of lode, of which there are several. The country rock consists of silurian grits, sandstones, and slates, having a general strike of from 65° to 70° to the W. of N., and dipping N.E. at high angles, from 65° to 80°. In many places the strata are much bent, and twisted and faulted. Some of the sections in the road cuttings between the Comstock mine and the township of Mount Zeehan show these features beautifully. The disturbing cause is seen in the presence throughout the field, in various places, of a volcanic rock which has been intruded through the slates and sandstones. Wherever I have seen this rock as yet it has been so thoroughly weathered as to have its original constitution quite obscured. It has been a felspathic rock without free quartz, and containing, probably, hornblende, so that it may have been a diorite or andesite. This rock is seen in great abundance on the road to the township, in the long hill leading down from the Comstock mine. Several dykes of it cross the road—one of them quite a quarter of a mile wide. In Balstrup's Section (1209M) and in Section 193-87 of the Argent Company it is seen again, also in the Silver Spray ground, Section 196-87, and some others. The presence of these igneous rocks may generally be detected on the surface by the unctuous reddish or brownish clay into which they decompose, which differs from the ordinary yellow clay of the district, in its being very free from sand. As being indications of former plutonic activity in the district, these rocks may be looked upon as favourable for the formation of mineral lodes, their intrusion having, doubtless, caused numerous fissures in the country rock, and been accompanied by hot springs and other thermal phenomena. Whether or not they are all dykes, or whether they have formed tuffs and lava flows, I cannot yet say. As the field is opened up their relations to the surrounding rocks will become manifest. It is quite likely that they may cut off, overlie, deviate, and otherwise affect the lodes in the adjoining slates and sandstones; so that every fact as to their influence for good or for evil upon these should be noted with great care by the miner.

On the road from Trial Harbour to Mount Zeehan another igneous formation is found for about two and a-half miles just before reaching the Comstock mine. This is a serpentine, especially on the eastern side of the formation, the western portion being more of an ordinary greenstone type and merging gradually into the serpentine. It is worthy of note that serpentine is also largely developed in the Heazlewood district, where, too, we find igneous decomposed rocks similar to those above mentioned. At the new Mount Dundas field, the same rocks are again found, namely, sandstone and slates, volcanic tufas, and serpentine. There is probably more than a mere coincidence in the fact of our three silver-lead fields having a somewhat similar geological structure. The coincidence extends even further than the country rocks, for

there is a general resemblance between Balstrup's lode at Mount Zeehan, Bell's and Godkin's lode at Heazlewood, and Webster and Bennett's lode at Mount Dundas, but especially between the two former.

The topography of the Mount Zeehan field is worth taking notice of, as it determines the nature of the mining operations, making it at once clear that the majority of the lodes must be worked from shafts and not from adits, and, in consequence, that winding and pumping machinery are necessary. Though the country is a good deal broken on the surface into hills and hollows, it is on the whole rather flat, and it is difficult to get any extent of "backs" on the lodes by means of adits. Many of the small hills, also, are of much disturbed rock—broken, slipped, and otherwise affected by movements of the surface portions. In these broken hills the lodes are not found to rise above the solid portion of the rock, and on driving into them along the lodes no height of backs can be obtained. This feature is very noticeable in the lodes known as Grubb's and M'Clean's. A consequence of it is that most of the outcrops have been found in low-lying ground, where the solid rock is close to the surface. Particular attention should therefore be devoted to the structure of the hills by the miner, as if they are of solid rock the lodes will probably rise into them, while if the rock is disturbed and broken they will most likely not rise.

The flatness of the country renders it swampy in wet weather, and as there is a somewhat large rainfall a great deal of surface water soon accumulates. The water-courses do not appear to carry off a great deal of water, and it seems certain that a good deal of the rainfall finds its way down into the rock, the high inclination of the strata favouring its doing so. The "Silver Queen" and "Mount Zeehan" mines find their pumps fully employed to keep down the water. I expect that other mines also will find that they will require rather powerful pumps.

The difficulty of prospecting the majority of the mines lies in this need of machinery for draining them, and the delay in opening them and getting out ore is mostly due to the same cause. The cost of landing machinery on the field is at present very great, the carriage from Hobart coming to £7 to £8 a ton, and owners naturally prefer waiting for the completion of the railway in order to reduce this prohibitive charge. But in the mean time a great deal of valuable prospecting could be done by means of the diamond drill. The lodes could be proved by this without difficulty to a depth of two or three hundred feet at least. The information gained by the borings would be of great assistance in laying out the permanent shafts afterwards, as the amount of underlay could be determined for some depth, whereas it can only be roughly guessed at from the short portion of the lode exposed in a shallow surface pit. I would strongly recommend the use of the drill in the present state of the field. It would soon settle the question as to the lodes continuing in depth.

There is a very common popular notion that requires to be eradicated, namely, that the ore raised from the mines is fit at once for the smelters. Such is not the case at all. By carefully selecting the best ore it is not difficult to get large quantities of galena requiring no further dressing, and the ease with which so much pure ore can be obtained is one of the most impressive facts in favour of Mount Zeehan as a most valuable and rich mineral field; yet the quantity of ore that requires dressing before going to the furnace is far in excess of that found pure. This is the case in every lead mine, and is only to be expected here. The bulk of the lode stuff is no more fit to go into the furnace without concentration than the crude tin ore from any of our tin mines. Lead ores ought to be concentrated and freed from gangue before smelting quite as much as tin ores. Though this is spoken of as a silver field it must be borne in mind that so far as quantity is concerned the mines are of lead, and that the metallurgical treatment is primarily for lead. In saving the lead we save the silver, and, conversely, if we throw away the lead by rejecting poor ore we are at the same time throwing away silver. Concentration works will therefore have to be provided for every mine of any magnitude, and the designing and construction of these should be the subject of most anxious care on the part of the owners, as on them the success of their operations will mainly depend. Expense should not be spared to make them thoroughly efficient, for a penny-wise policy in this respect can only end in disaster. In choosing a site for dressing works the main considerations are a plentiful supply of water and such an amount of fall in the ground as will permit the ore to fall from machine to machine without handling. The designing and erection of the works should not be entrusted to anyone but a man thoroughly skilled in this particular work, and it will be economy to procure such a man at any price. So many mines have failed through mistakes in the selection and erection of dressing machinery that the utmost care ought to be exercised by all owners to protect themselves in this most important part of their operations from the possibility of failure.

As winding, pumping, and ore-dressing machinery will be required to work all the mines on this field, it follows that a large amount of capital will have to be sunk before there is any possibility of a return. I do not think that shareholders sufficiently recognise this, or realise the magnitude of the task they have undertaken of bringing these mines to a paying condition. That they will pay well if rightly handled I have no doubt, but without the aid of foreign capital I fear that the resources of the Colony will not be enough to develope them. It is to our interest to meet foreign investors in a thoroughly liberal spirit. It is unfortunate that the capitalist rarely has a chance of taking up a mine for himself, but has to deal with speculators who have got hold of it only to sell at the highest figure they can extort. The holding of land for speculative purposes is a violation of the principle of the contract under which the State surrenders the national property in the mines to individuals on condition that they will make use of the gift. If they are not prepared to do so they ought to be made to give way to others who will. The speculative holder is one of the worst obstacles to the progress of the mining industry, for he blocks the genuine investor at every step.

I shall now proceed with a few remarks on the properties visited by me. As above stated, I was not able to visit all the mines, and it may be that some of those not mentioned by me may prove of greater importance than some of those visited. The account given below will, however, give a fair idea of the progress that has been made.

Silver Queen, (Sections 1666M, 1636M, 1637M, 1638M, 1639M, 1640M, 1641M, 1642M, 1643M, 1665M, in all 520 acres).—This mine has been energetically worked in spite of all obstacles, and now possesses winding and pumping machinery which has enabled work on the lodes to be carried on down to a depth of 105 feet. The principal workings are in section 1637. Here the main shaft has been sunk and also an air-shaft. Drives have been put in eastward and westward from the shaft. In the western drive, 275 feet in length, two lodes have been cut, and at the time I saw it there was in the face an undefined mass of iron pyrites, blende, and galena, which is probably part of a lode. The first lode cut, at 179 feet from the shaft, was rather small, and showed not much galena, but has not been driven on for any distance. The second lode, which is parallel to the first, was struck 95½ feet further westward. The lode was here from four to six feet in width, and consisted mostly of carbonate of iron, barytes, and galena, the latter forming a main vein which varied from two or three inches in width to as many feet, and several smaller veins. The air-shaft was sunk on this lode, and an excellent heap of ore was obtained from it. The course of these lodes is about 15 deg. to the E. of N. The eastern drive was in about 95 feet. A leader from four to six inches thick was cut in this, containing quartz, carbonate of iron, galena, blende, and iron pyrites, arranged in parallel bands symmetrically repeated from each side. The other lodes also show banded structure very plainly. As this type of structure is most characteristic of true fissure-lodes, it speaks well for the probable life of the lodes in depth. The eastern drive is being continued to cut another lode which crops out in the creek three or four chains to the north of the shaft. This outcrop shows good galena. On surface near the shaft the company owning this mine has built a number of houses for its employés and cleared some acres of bush, and also made a road and a tramway. In the large extent of ground held by it several other lodes have been found, on which no work has yet been done except some surface trenching. There are said to be as many as twelve lodes known in this property. The three lodes of the Montana Company (section 2154-87M) pass into section 1637 of the Silver Queen. In section 1666 a lode from 18 in. to two feet thick is found striking 15° E. of S., and with a dip to the eastward. The vein is composed of galena and carbonate of iron. A good deal of clean ore was obtained from this outcrop and sent away for sale. This is a very promising lode. It extends into sections 197-87 and 198-87 of the Silver Crown Company. Another lode is found in section 1643, close to the boundary of the Argent Company. Its course is 22° W. of S. It is about 24 inches wide, and is composed of quartz, iron oxide, pyrites, and galena. A lode bearing N. 7° E. has been cut on section 1637, supposed to be one of the Montana lodes. It shows some nice veins of galena. Other lodes have also been found. There can be no doubt that this company holds a valuable property, though it is questionable if it can work the whole of its large area by itself.

Montana, (Section 2154-87M, 40 acres).—This Company's ground has three lodes passing through it. The main workings are close to the eastern boundary. Here the lode shows splendid galena in a vein about eighteen inches to two feet thick. A nice stack of first-class ore had already been obtained from here, though the lode was only found about ten days before I saw it. This property should be a good one from present appearances, but requires pumping machinery to allow the lodes to be sunk upon.

Silver Crown, (Sections 197-87, 198-87, 199-87, 201-87, 736-87).—The two more easterly lodes of the Montana are supposed to unite in Section 736-87. The lode has been cut in a small shaft on the south boundary of this section. Some six tons of galena from this shaft were sent to Germany to be smelted, and yielded 114 oz. of silver to the ton. This shaft is on high ground, and a level is being driven from an adjacent gully to cut the lode about 90 feet below it. The drive was in 150 feet, and had 90 feet more to go, on 13th March. As the lode has in this case been cut in the high ground, the owners will be able to work some 90 feet in height of it without machine drainage. As above mentioned, the north-westerly lode found in Section 1666 of the Silver Queen passes into the Silver Crown ground, where it has been traced by means of trenches for some ten chains.

Western, (Sections 754-87, 755-87, and 756-87).—This Company has been working vigorously, and has in this respect shown a good example to many of its neighbours. Two parallel lodes, running N. 20° W., have been cut on the surface in Section 755. Two adits have been driven to cut them. The upper adit is 307 feet in length. At 118 feet from the mouth No. 2 lode was cut, about three feet in width, and carrying strings of galena from 3 in. to 6 in. wide. This lode has been driven on to the northward 45 feet. There are 28 feet of backs from the level to the surface. Ten tons from this lode gave a return of 75 per cent. of lead and 176 ounces of silver to the ton. At 287 feet No. 1 lode was cut, and has been driven on to the northward for 104 feet. It is from 4 inches to 9 inches wide. In the end of the drive it is now rather pinched and in hard slate country. Twelve tons of ore from No. 1 lode yielded 70 per cent. of lead and 102 ounces of silver to the ton. The mine manager told me he had about 22 tons of ore at grass from No. 1 lode, and 70 tons from No. 2 lode. The stacks showed very pure ore. The lower tunnel is from 40 to 45 feet below the upper one, and was in 278 feet on 13th March. At 79 feet from the mouth No. 3 lode was cut, running about N. and S., and showing from 12 to 18 inches of galena. This lode has been driven upon 150 feet, and shows well throughout. Eight tons of ore from it gave 61 per cent. of lead and 98 ounces of silver to the ton. It is estimated that this lower adit will cut No. 1 lode at about 475 feet, and No. 2 lode at from 655 to 680 feet. The country rock in the lower tunnel is slate and sandstone. In the upper one it is weathered slate from the mouth to No. 2 lode, and between No. 1 and No. 2 lodes it is a decomposed volcanic rock, charged with pyrites in places. This is no doubt a dyke, possibly of diorite, but the rock is so decomposed as to be impossible to be exactly named. From No. 1 lode to the end of No. 1 adit slate is again found. A fourth lode has also been found in this Company's ground in Sections 754 and 756. It is from 9 inches to 12 inches wide, and is composed mainly of carbonate of iron with a little galena; course 25° W. of N. It will be seen from the above that this Company, like the Silver Crown, is able to work to a depth of about 75 feet by means of adits, and thus will be able to get out a great deal of ore without much expense. The results of treatment of the ore so far are remarkably good.

Junction, (Section 819-87.)—This Company also holds Section 818-87, but as yet nothing has been

found on it. Near the southern boundary a lode showing from 12 in. to 18 in. of galena has been driven on for about 12 feet; course, N. 55° W., dip to N.E., rather flat. A small stack of good ore has been obtained from this lode. In the southern end of the trench leading to the drive the lode is split into several strings. In the N.E. corner of the property a vein running 7° W. of N., and showing 3 in. to 6 in. of solid clean galena, has been laid bare in a trench. If this vein continues it will pass into the Western and Montana properties. About 3 chains from the north and 4 chains from the east boundary a strong lode, two feet wide, striking N. 20° E., and dipping easterly, has also been found by trenching, but as yet has not been worked. The gangue here is quartz. A great deal more work must be done on these lodes before it is possible to form a just estimate of the value of this property.

F. R. Evans' Section, 1110-87.—About half a chain south of the Junction Section a lode running N. 20° W. has been cut in a surface trench, and some good ore was obtained. An adit has been driven about 200 feet to cut this lode lower down, but has been stopped without striking it. The country rock in the mouth of this adit is slate and sandstone, with strike N. 70° W. and dip N.E. 65°. About half way in a dyke is struck. This is soft and clayey, but belongs to the same series of intrusive rocks as the dyke above mentioned as occurring in the Western ground, with which it is probably connected. The adit should be extended through this dyke, and well into the slate on the other side of it.

Mount Zeehan, (Sections 559M and 909M).—This mine and the Silver Queen are the only ones yet regularly at work below the water level. The main shaft is 136 ft. 6 in. deep; and at 120 feet drives have been put in to the east and to the west. The eastern drive is 141 feet long, and cuts what is known as No. 3 lode at 113 feet. On this a drive has been made 24 feet northerly, and another 12 feet southerly. The lode is strong and well defined, but not rich in galena so far. I have already pointed out that this is no reason for undervaluing the mine, as poor places must exist, or even predominate, in every lode. The western drive is 252 ft. 6 in. long, and at 232 ft. 6 in. cuts No. 2 lode at the point where an air-shaft, now being sunk on it, will come in. This air-shaft was down 90 feet. The lode showed ore in greater or less quantities all the way down. In the bottom it was from 18 inches to 3 feet wide, and showed galena, carbonate of iron, and blende. This lode runs about 17° E. of N. On the surface it has been traced for six or seven chains, showing good ore. Another lode, known as No. 1, running N. 40° E., comes into No. 2 lode just at the air-shaft, and appears to be a branch of it, though it is quite possible that these lodes may fault one another. The relation of the north-eastern lodes to those running a north-westerly course has yet to be determined throughout the field. This No. 1 lode has been traced for 13 chains on surface. It is small, and winds about a good deal. About 90 feet south of the air-shaft a shaft 36 feet deep has been sunk on No. 2 lode. Here the lode was 5 feet wide, composed mainly of carbonate of iron and barytes, with veins of galena and some blende running through the veinstone. About a chain further south there is a strong outcrop, from which a ton of galena was taken to be sent to the London Mineral Exhibition. The lode is here about 2 feet wide. It appears on surface as a hard gossan with a little galena in it. About this place one of the Silver Queen lodes, which is found running N.W. through the N.E. corner of Section 909, ought to join or cross No. 2 lode. It may be called No. 5 lode. No. 4 is a small lode about 1 foot wide, striking N. 32° W., found crossing the main road about 3 chains to the east of No. 1 lode. Nothing has been done on it as yet, but it shows fair galena in the road cutting. No. 6 lode is found in Section 909, running a north-westerly course. It is better traced in the adjoining Section 943M. About 2½ chains to the eastward of No. 4 lode, and, like it, exposed by the road cutting, is a lode (No. 7) striking north and south, 18 in. to 20 in. wide, composed of gossan, lode-slate, and galena. No work is yet done on this. Yet another lode, No. 8, is found in Section 909, 5 chains S.W. from the N.E. corner. This lode strikes 25° W. of N., and is 18 in. wide, carrying a good deal of galena. It will be seen that this property has an unusual number of lodes running through it for its size. When they are opened up there should be good supplies of payable ore obtainable from them. The prospect for this Company is very good.

J. Smith's Section, 943M.—This ground lies to the south of that last mentioned. Surface trenching has revealed a lode from 3 in. to 18 in. wide, running 25° W. of N. from this section into Section 909, as above mentioned. The lode has been traced for 7 chains. A small shaft sunk on it yielded galena, said to assay over 100 ozs. of silver to the ton. About 2½ chains S.W. from this lode a tunnel has been driven on an irregular vein of ore for about 60 feet. In the mouth of the tunnel the vein strikes S. 47° E., and is composed of from 12 in. to 18 in. of gossan. At about 40 feet from the mouth of the drive the vein turns off to N. 42° E., and dips S.E. about 45°. The ground here gets hard, and the vein pinches to 3 in. in width.

Argent, (Sections 192-87M and 193-87M.)—Section 192-87 ought to prove a very valuable one, having no less than five lodes running through it. Of these, Nos. 1, 2, 4, and 5 belong to the north-easterly group of lodes, while No. 3 runs north-westerly. Nos. 1 and 5 are not improbably Nos. 2 and 3 of the Mount Zeehan Company's lodes, and No. 4 is also in the Silver Queen Extended's ground. The Argent Company has been busy for some time past with the erection of winding and pumping machinery to enable sinking to be proceeded with. Good progress has been made with this work. In conjunction with the Silver Queen Extended Company a tramway has been made in a substantial manner from the mines to the township. This will be of great service to both companies. The principal workings are on No. 4 lode. This strikes N. 30° E., and underlays easterly one foot in three. On the surface it crops out strongly, showing galena and gossan. It extends right through the section into section 909 on the north and into 1209M (Balstrup's) on the south, and is a strong, good-looking lode. The main shaft has been sunk 100 ft. to the eastward of it. About 2½ chains S.W. from this shaft No. 3 lode is found cropping out. This has a course N. 25° W., and is a strong banded lode from two to six feet wide, of galena, pyrites, siderite, baryte, blende, and quartz. It has been traced for 14 chains from where it runs into No. 4. Though this lode has only been bared in surface trenches, I liked its appearance better than that of most of the others, and should expect it to prove a most permanent lode. It is much more likely to be heaved by No. 4 lode than to

junction with it, and its continuation on the western side of the section should be searched for. No. 2 lode is not of much consequence as yet, and consists of outcrops of gossan and pyrites. The manager of the mine believes that it junctions with No. 3. The No. 1 lode has been traced for eight chains. It strikes N. 15° E., and underlays easterly. On the outcrop it shows good galena. One hundred and fifty-two bags of ore from this lode and No. 4 yielded 65 per cent. of lead and 92 ounces of silver to the ton, according to the mine manager. Only one trench has been cut on No. 5 lode. Its course is somewhat to the east of north, and it shows a little galena and copper pyrites. In section 193-87 an adit about 200 feet long has been driven in an easterly direction. The mouth of the tunnel is in volcanic rock resembling tufa, but I could not clearly ascertain whether it was a tufa or a decomposed dyke. We meet igneous rocks again in Balstrup's section to the south of this, and again in the Silver Spray ground. The Argent Company has a property that ought to pay well when opened up.

Balstrup's, (Section 1209M).—The No. 4 Argent lode is seen in this section in a trench 25 feet from the northern boundary, striking N. 10° E. It shows as 30 inches in width of gossan, containing a little carbonate of lead. The gossan is said to have given assays of 66 and 180 ounces of silver to the ton. The main workings on this section are not on this lode, however, but on one of quite different character from any of those above mentioned. The lode strikes S. 40° E., and appears as from 18 in. to 30 in. or more of quartz containing brown oxide of iron, clay, oxide of manganese, pyromorphite, pyrites, and, in places, chloride of silver. An adit has been driven on the course of the lode close on 1000 feet, but at 300 feet from the mouth it bears away towards the south and leaves the lode. I cannot understand the reason of this change of course of the drive. The last 120 feet of it is driven in hard slate strongly jointed. The first portion is in decomposed igneous rock. The contact of the slate and igneous rock is hard bricklike brown slate, as if altered by heat, and from this and other considerations I take the igneous rock to be a large dyke. The adit is driven under a high hill, the top of which is capped by an immense body of gossan, composed of oxides of iron and manganese. This is said to give on assay from one to ten ounces of silver to the ton. The gossan extends along the ridge of the hill in a north-easterly direction for a great distance. It would be a most useful flux for smelting siliceous ores. I think it is a pity that an adit was not driven about 50 feet below the outcrop of the gossan to prove its continuance in depth before the long low-level adit was undertaken. An outcrop of gossan does not necessarily prove the existence of a lode beneath it, and quite a small lode also may have a very large gossan upon it. Where any ferruginous rock has suffered decomposition, we may expect to find gossans in favourable situations, and it is quite possible that the gossan in question is derived from the dyke beneath it, and not from a lode. Hence the advisability of proving the presence of a lode by a shallow adit just below the gossan capping. Where veinstone, such as quartz, baryte, and calcite, and such vein minerals as carbonate, sulphate, and phosphate of lead, or green and blue carbonates of copper, are found freely throughout the gossan, there is almost a certainty of its being the cap of a lode; but a gossan such as is found here, almost entirely made up of oxides of iron and manganese, may result from other causes than the weathering of lode matter.

The siliceous vein on which the adit has been driven is reported to have yielded rich ore. Such being the case, it is a marvel to me why the owners have not done more to prove it and develope it. The ironstone deposit will be most useful when furnaces are erected in the district for smelting, especially as it contains a little silver.

Silver Queen Extended, (Sections 187-87, 188-87, and 189-87).—I must preface my remarks on this property by saying that I only saw portion of it, and on the appended map of the district I have not attempted to sketch those lodes that I did see, as I was unable to ascertain even their approximate position. Eight or more lodes have been discovered in the property, and I was informed that there was good reason to hope that some of those last found in the western sections could be worked by means of adits to some depth. In Section 189-87 good progress has been made with preparations for the erection of winding and drainage engines, the brace being already erected. Five or six lodes, of widths from a few inches to two and three feet, have been laid bare by trenching. Some of these show very good veins of galena. From one, a little to the south of the manager's house, some excellent pure ore was taken for exhibition. Without describing the veins or lodes in detail, I may say that my rather hurried look over this property gave me a most favourable impression, its lodes being both numerous and showing quantities of rich ore. When the surface is still further stripped from these lodes they should make a fine show. This eastern section must be worked from shafts furnished with good pumps.

Silver Spray, (Sections 195-87 and 196-87).—This ground is immediately south of the last described. A good deal of work has been done, but unfortunately without much success as yet. A lode carrying some galena was cut on surface, running N. 32° W., and underlaying 1 in 6 to the north-east. A drive 265 feet long was put in along this lode. The average width of the lode formation is 3 feet, and it has a fine well-marked footwall. A blank in the lode appears to have been met with, for the channel is filled with fragments of slate and "mullock," with only stray pieces of galena through it. On the surface the lode showed gossan with some pyrites and galena, and its outcrop has been traced uphill for 5½ chains, or to a height of 210 feet above the adit. This lode appears to rise with the hill, and if anything of value is found in it will therefore be easily worked for a time without machine drainage. The drive on the course of the lode should be carried on in the hope of coming to ore and solid veinstone. The country passed through is slate, divided by joints into large blocks, and much disturbed, vertically and horizontally bedded slates being found within a few feet of each other. About 130 feet from the mouth of the adit a branch drive to the right strikes a gossan lode about 3 feet thick, but pinched in the end of the drive to from 9 in. to 12 in. This lode strikes N. 25° W., and underlays westward, so that it will meet the first lode in depth. The lodes are about 25 feet apart. The drive on this second lode is 65 feet long, about 30 feet being on the course of the lode. So far the gossan has been poor in silver. Near the end of the drive on No. 1 lode a crosscut has been driven 46 feet to the left without cutting any more lodes; but another one, 86 feet to the right, has been more successful, cutting another gossan lode (No. 3) at 68 feet. This strikes N. 65° E., is about 30 inches wide, and contains a little silver and a trace of gold, but nothing payable.

Two gossan formations or outcrops on this property have attracted attention. One of these is 12 feet or more wide, and has been traced by trenches and outcrops for five chains on a course N. 80° E. The other is about four chains to the east of this, and runs about north and south. Both of these gossans carry a little silver, from 3 to 7 ounces to the ton. To cut the first of these an adit has been driven 260 feet at not more than about 40 feet below the outcrop. The drive is 150 feet past the line of the outcrop on the surface, but has not cut a lode, unless a small vein 2 inches to 3 inches wide, cut just under the surface outcrop, can be so regarded. This drive is entirely through volcanic tufas and breccias, enclosing numerous angular fragments of slate. A few quartz veins are cut in the drive. The experience of this Company in driving under a gossan outcrop ought to be attentively studied by the owners of Balstrup's and other mines, where faith has been reposed on similar formations of iron and manganese oxides.

Grubb's Lode, (1562–87 and 1580–87 Sections).—The workings on this lode are situated about the middle of Section 1562-87, close to the creek. Two adits have been driven, one on each side of the creek. The south one is on the course of the lode, and is in 260 feet. At 200 feet the lode dipped under foot, this being one of the cases where the lode has not been found to rise into the hill into which the drive has been put. The country is broken and weathered slate. In the drive the lode has ranged from 18 inches to 7 feet in width, and in parts has been all galena. About 70 tons have been exported from here, and there is a large stack of second-rate ore still on the ground. This contains a good deal of baryte, pyrites, and other gangue along with the galena. This is a fine strong lode so far as it is exposed, but pumps will have to be used to drain the workings on it. On the north side of the creek a tunnel has been put in 300 feet through soft yellow clayey slate, but the last 10 feet in hardish black slate. A lode of galena 12 inches to 18 inches wide was cut in this 25 feet sooner than the lode was expected, but it appears to be the lode, as further driving has not cut anything more. The country rock is much stained with carbonates of copper. The owners of this property will have to sink before they can prove it. The diamond drill would be useful here.

Silver Duke, (Sections 1833-87, 1679-87, 1706-87, 1677-87, and 1678-87).—The southern continuation of Grubb's lode is expected to be found in Section 1679-87, and a drive has been made to cut it, but without success. The diamond drill would be useful in tracing the lode here, as the surface ground appears to be much disturbed, and the lode probably does not rise into it, so that a drive might easily pass over the lode. About 12 chains from the western boundary of the same section a somewhat peculiar galena deposit has been met with. An upper drive, 52 feet long, and a lower one, 152 feet long, have been driven on the course of the deposit, which strikes about S. 70° E., but appears to be turning more to the northward in the end of the lower drive. The deposit is as much as 40 feet wide in parts, and is composed of broken blocks of slate, sandstone, and grit loosely cemented together with cellular quartz and carbonate of iron, and containing scattered through the interstices between the lumps of stone cellular lumps of galena and mixtures of galena, blende, iron pyrites, and copper pyrites, with carbonate of iron and clayey matter. Green stains of carbonate of copper are rather plentiful. There is a good deal of galena throughout the mass, and it is quite possible that there is enough of it to be payable. But the occurrence is so irregular that no reliance can be placed on the continuance of the ore either in strike or under foot. It appears to me that the deposit results from a fracture in the rocks, possibly a fault fissure, being loosely filled with broken country matter, and then impregnated with metallic minerals from solutions travelling through this. The shape and appearance of the lumps of galena forcibly recall those of the segregated pieces of pyrites found throughout the black mudstone bottom underlying the Mount Lyell alluvial gravels above described. In these too, similar galena has been found. The quartz also has a cellular and granular character similar to that often found in clays, drifts, and faults. If my theory of the formation of this deposit is correct, it will not be safe to rely on its following the usual behaviour of true lodes. It may extend for a good distance both in strike and in depth, but the distribution of ore in it is likely to be very uneven. There is enough ore in it to make it worth exploring as long as this can be done at a low cost, but the prospect seems to me to be too doubtful to make it advisable to go to large expense in sinking on it. Perhaps as the drive is extended the deposit may take a more defined lode character, and in that case sinking would be advisable. This is one of the occurrences where we may state possibilities, but where every fact must be developed at the point of the pick.

In Section 1677-87, several small shafts and trenches have been sunk on what is known as M'Clean's lode, which has been traced south into this ground. The lode appears to be very small here, but shows galena, and has been traced for a long distance. As this is one of the longest and most promising lodes on the field, it would be well to prove it on the Silver Duke ground to some depth by boring, in the hope that it may widen out below. Testing the lode by sinking on it will involve the expense of pumping-engines.

Tasmanian Silver Mining Company, (Sections 1468-87, 1467-87, 1469-87, 1688-87, and 1470-87).—These sections are taken up along the line of what is generally known as M'Clean's lode. In Section 1469-87, a drive on the course of the lode has been put in 210 feet, but at 120 feet broken country was encountered and the lode was not found to rise into this, behaving in this respect like Grubb's lode. The lode is a fine strong one, and has shown at times as much as 5 feet in width of pure galena, whilst generally there is from 18 inches to 3 feet of galena in it. Course N. 33° W. On M'Clean's Creek, on Section 1468, the lode has been struck, carrying quartz and galena. It has also been found in Section 1467, about the middle of the section, and in 1470 about 3 chains from the south boundary. In the N.W. corner of Section 1470 it is again found as about 3 feet in width of lodeslate quartz and galena. The lode has therefore been traced throughout this property and into the Silver Duke ground on the south, a distance of close on two miles. As it shows a good deal of galena throughout, and has been rich where driven upon in the tunnel, there is no doubt as to its importance. It may reasonably be expected to prove one of the best lodes in the field. Like so many others, it will require machinery to drain it, adit drainage not being available. Another lode parallel to the main one has been cut in Section 1470, about four chains east of it. A shaft has been sunk on this No. 2 lode to a depth of 25 feet. It is about 18 inches wide, and carries blende, galena, and pyrites. As this lode underlays to the westward, while No. 1 underlays to the eastward, they should unite in depth somewhere about 500 feet from surface.

I noticed another outcrop of the igneous rock on the west side of No. 1 lode, about 8 chains from it, on section 1470.

South Comstock, (Section 803-87).—Close to the north boundary of this section a drive has been put in on a lode of mixed pyrites and blende, with a little galena. There was no one working here, so that I got no further information as to what had been done.

Comstock, (Section 712-87).—A fine lode is laid bare in a long deep surface trench along its course in this property. I was told that some 300 tons of ore had been raised from here, and exported at a good profit. A large stack of ore is still on the ground. The lode strikes N. 2° W. in the trench, and has a very slight underlay to the east. The lode is from 3 to 5 feet wide, and is a banded lode; the contents—galena, blende, iron pyrites, and copper pyrites, with gangue of quartz, siderite, and baryte—being arranged in layers parallel to the walls. This is one of the most characteristic features of galena and blende lodes in other parts of the world, and is a very favourable indication of permanence. The lode has been traced on surface for quite 10 chains, and is well defined throughout. I feel confident that it will prove a good lode, though the complex ore in it will necessitate elaborate dressing. This lode is one of the highest in the Zeehan field, and adit drainage to some depth is practicable. An adit is being driven from the creek in the South Comstock ground through hard contorted slate to cut the lode on the boundary between Sections 712 and 803. It was in about 200 feet when I saw it, and had to go in all about 450 feet. When this adit is finished there will be about 100 feet of backs ready to be taken out along the lode. Another small lode running N. 5° W. has been cut in a surface trench about 8 chains from the eastern boundary line. This shows galena and pyrites, but the trench has been partly filled, and I could not see much of this lode. The property on the whole seems to me a very good one, and has several advantages over its neighbours, such as the possession of a good water supply and the possibility of adit drainage, that will compensate for the possibly greater difficulty of rendering the ore fit for smelting.

Silver King, (Sections 217-87, 219-87, 220-87, 469-87, 223-87, 218-87, 468-87, 221-87, 222-87, and 470-87).—The main lode passing through this property has been traced for over 2 miles, from the Sunrise Prospecting Association's ground on the south to the Despatch Company's (Section 243-87) on the north, while the lode in the S.W. corner of 841-87 may also be part of it. On Section 223-87 the company is erecting winding and pumping-engines, and sinking a main shaft. These works are close to the terminus of the railway. Two small shafts, about 30 feet apart, have been sunk on the outcrop of the lode, and from these and surface trenches about 130 tons of ore have been got out and stacked. This ore contains blende and siderite in addition to galena, and would be the better of dressing before smelting. The outcrop is about 3 feet in width, striking N. 30° W., and underlaying westerly 1 in $3\frac{1}{3}$. In Section 470-87 the lode is cut just on the southern boundary. A drive on its course is being put in, and some good ore has been obtained. No height of backs is, however, obtainable without sinking. Another lode parallel to the main one is found 12 chains S.E. from the main shaft in Section 469. Here a small shaft was sunk on it 40 feet, but was soon flooded. The lode on the surface is 18 inches wide, and contains very good galena. Embolite is said to have been found in some of the ore from this lode. The main lode is again cut in the northernmost section of the property, here, too, containing a good show of galena. This company should have a bright future before it, the prospects being very good.

Silver Bell, (Section 480-87.)—This company is working on part of the Silver King lode, and has made a remarkably good show of ore. About half a chain from the northern boundary a shaft, 40 feet deep, has been sunk on the lode, and about 10 chains further south another, 43 feet deep, has been put down. From the latter drives to the north, 37 feet, and to the south, 20 feet, have been made. From these workings a splendid stack of first-class ore has been secured. Some five or six chains further south an adit has been driven on the course of the lode to the northward at as low a level as could well be got, but this is only sufficient to give 43 feet of backs at the highest point in the lode. The drive has been in splendid ore from the first, the lode being from 30 inches to 4 or 5 feet in thickness, and often almost pure galena. It is well defined, and with a good clear footwall. The manager informed me that he had about 250 tons of first-rate ore on hand, and about 200 tons of second-class stuff. If the lode continues in the level as well as it has been this company should have no difficulty in paying for the sinking machinery out of the ore raised. The lode looks well all along the surface, so that there is every reason for the owners to congratulate themselves on the prospects of the mine.

Bell and Hall's, (Sections 419-87, 422-87, 421-87, and 420-87.)—This ground is quite undeveloped, but has a very promising looking gossan outcrop upon it carrying carbonate of lead, galena, blende, calcite, siderite, quartz, and other lode minerals. Embolite crystals are said to have been found on it. There can be no doubt that this is the outcrop of a lode. It strikes to the N.W., and following on this line about 8 chains we come to another outcrop of gossan, also carrying carbonate of lead. The outcrop appears to be from 12 to 30 feet wide. The ground is very flat and low-lying, so that next to nothing can be done on the lode without sinking. So far as one can judge from a mere outcrop, this lode ought to be a good one. I do not think I have seen a more promising "surface show" in the district. It ought not to lie idle for long.

MOUNT DUNDAS DISTRICT.

Great hopes are entertained that the difficulties as to drainage met with at Mount Zeehan will not be encountered in this new field, and consequently that some of its mines may be opened up and put on the dividend-paying list without much preliminary expense. The rugged character of the country, its steep hills and deep gorges, make it very suitable for mining operations, while it has further advantages in the possession of a good water supply and fairly good timber. A very large number of claims have lately been pegged out on this field, which lies about four and a half miles to the eastward from Mount Zeehan township. A road is in course of construction from Mount Zeehan to it, which will prove a great benefit. Not much work has yet been done on the lodes discovered, which is not surprising considering that all supplies have as yet to be carried on men's backs to the claims. The small amount of

development makes it premature to form any decided opinion as to the future of the field, but the prospects are encouraging, and numerous further discoveries may reasonably be anticipated. Many of the present claims are taken up on outcrops of gossan, which may or may not turn out to be lodes. Time and work must decide. I visited only a few of the claims, but saw enough of the field to satisfy myself that a detailed examination of it twelve months hence would be quite soon enough to give an idea of its value. Till some work has been done to prove the lodes their prospects must be very much a matter of speculation.

Webster and Bennett's, (2305-87 and 2306-87).—These prospectors have taken up two 80-acre sections, not yet shown on the maps, on the line of a strong gossan outcrop, striking N. 20° W. As the outcrop can be distinctly traced in a definite line up hill and down dale for quite half a mile, there can be little question as to its belonging to a lode. The gossan is composed of limonite, hematite, oxides of manganese, quartz, and a little kaolin and pyrites. It is on an average from 15 to 20 feet wide, and assays are said to have given from 3 to 12 ounces of silver to the ton. The line of lode is intersected by two creeks from which adits may be driven on the course of the lode, proving it very easily. One adit has been begun, but so far is still in gossan. From 100 to 700 feet of backs can be got on different parts of the lode by adits from the creeks. As far as yet proved the lode has been worthless except for flux, but it is well worth prospecting in the hope of coming upon valuable ore. If such is found in it, the working facilities are so good that it should be a good mine. The hill to the south of the adit shows volcanic tufas and breccias in places. The country seen in the creeks is sandstone and slate.

Mellor's Section, 1724-87.—In this ground two outcrops of iron and manganese gossan have been found, both running about N.E. and S.W., but badly defined. I did not like the nature of either of these gossans, and think they ought to have been deeply trenched through or driven upon at a shallow level before trying to cut them at considerable depth, as is now being done. A tunnel is being driven to cut one of them at about 250 feet below the outcrop. This will have to go about 500 feet, and the 132 feet now driven have been through hard slate and sandstone country. A quartz reef which crops out on the hill-side should be cut by this adit before the lode supposed to underlie the gossan is met with. To test the other gossan outcrop a drive has been begun, which will reach the line of the surface deposit in about 150 feet, and will then be about 100 feet below the surface. The presence of serpentine rocks in close proximity to the eastern boundary of the section creates a suspicion that the iron ore may have come from them, in which case it would be a mere surface deposit. The work in progress will settle the question in time, but it would have been wiser to have driven a shallow level first. The ground is most favourable for such a course.

Lambie and Davies' Sections, (2298-87 and 2297-87).—These two prospectors have been more fortunate than the preceding in finding galena ore on the surface in three places. In the north part of 2297-87 a lode (No. 1) is cut alongside a creek. It strikes N. 35° W., and underlays N.E. about ½ to 1. It is composed of from six to ten inches of galena with crystals of cerussite (carbonate of lead) and baryte, and is exposed by a trench for about two chains. This lode lies almost in the bed of the creek, and cannot be worked by an adit at the place where it has been struck. In the south-east corner of the same section, about 8 chains from the southern and 4 chains from the eastern boundary is another lode (No. 2), which may perhaps prove identical with No. 1. Its course is N. 45° W., and the lode is from 24 inches to 30 inches wide where cut, and shows about 8 inches of galena. The gossan capping contains crystals of carbonate of lead. The lode is running right into a high hill, and a level driven along its course would have good backs above it. In the north-east corner of the same section, about 8 chains from the east, and 4 chains from the north boundary, is a very large outcrop, bared for quite 12 feet in width, and traced up-hill for quite a chain. It carries galena, gossan, and carbonate of lead. Its apparent course is about N.W. and S.E. This has every appearance of being a strong lode. A little to the south of it a branch lode, 4 feet wide, carrying galena and green pyromorphite, and running N. 10° W., is cut across on surface. These lodes can be splendidly tested by driving right into a big hill on their course. About a chain from the western boundary of the section there is a huge gossan outcrop, carrying chromate of lead. Nothing has been yet done on this, but it deserves to be prospected. The property has a very good prospect before it, and will be much heard of before long.

Page's Section.—Fine crystals of chromate of lead have been found in a gossan outcrop in a section whose number I could not identify. The outcrop is a large one, but nothing has been done to it beyond chipping off a few pounds of samples. I had heard so much about the splendid prospects of this lode that the reality was disappointing. "Indications" and talk do not make a mine, however good the one and tall the other; and a prospector finding a lode like this should do something to open it before presenting it to the public.

There is a considerable quantity of serpentine in parts of the Mount Dundas field,—some of it of very good colour. When the district is opened up it is very probable that serpentine fit for ornamental purposes will be found. So beautiful a stone ought not to lie neglected. Very pretty serpentine rocks are also found in the Heazlewood District, and are worthy of attention from lapidaries and architects.

MOUNT HEEMSKIRK DISTRICT.

From inquiries made at Zeehan and Trial Harbour, I ascertained that nothing of consequence was being done on this tin-field; and that it was almost, if not quite, deserted. It was therefore not visited on this occasion.

THE SPECIMEN REEF, HALL'S CREEK.

For a year or more past no work has been done in the mine on this reef, the energies of the owners being directed towards the erection of a battery and the construction of water-races, dams, and tramways. These are now finished, and crushing should begin as soon as there is water enough. Two levels have

been driven on the reef, and a winze has connected them, so that the ground is ready for stoping. Some extremely rich stone has been obtained from this mine,—the gold being mostly mixed with oxides of iron and manganese in black lumps, locally called "clinkers." Carbonate of iron and iron pyrites are somewhat common in the quartz. It has never been possible to give this reef a fair trial until now, for want of a battery. A few months' work in the mine will now afford a good test of the value of the portion open. There has been so much gold got in the surface portion of the mine that there is good hope of payable quartz continuing to be found below. The reef is small, but there are considerable natural facilities for sending the quartz to the battery, which will serve in some measure to make up for this. A tramway has been made from the mouth of the lower level to a shoot leading to the battery. This comprises six heads of stamps, driven by a 24-ft. water-wheel. After the ordinary copper tables, one of Alves's Amalgamators and Concentrators has been provided. As might be expected from the inaccessibility of the place, the battery is full of makeshifts,—a berdan liner, for example, serving for the entire berdan. Storage for tailings ought to be provided. The battery will do to test the stone for a time, but something much better will be required for regular work. Better modes of access to the claim are also urgently required, so that stores and tools may be taken to it in reasonable time and at reasonable cost. The owners propose to try to find a suitable line for a track directly through to the Heazlewood, which seems practicable enough, though the country is dreadfully broken by deep ravines,—that of the Savage River being the worst.

HEAZLEWOOD DISTRICT.

The geological features of this district are of great interest, and deserve a much closer examination than I was able to give them on this occasion. The central portion of the field is composed of silurian sandstones and limestones, and these are flanked on the western side by a wide belt of serpentine, and on the east by greenstones. The serpentine rock is a metamorphosed highly crystalline plutonic rock, in places inclining to gabbro, but requiring minute and extended microscopical and chemical examination to determine its original nature. Schiller-spar is somewhat common in it, and parts of the rock containing this mineral are very beautiful. Fine crystals of chromite occur plentifully in a creek running through the Heazlewood and South Heazlewood Companies' ground, evidently derived from the serpentine. It appears also to contain a good deal of nickel, as much of the veinstone in the Heazlewood lode is stained bright green by traces of nickel compounds, and the hydrated carbonate of nickel (zaratite) has been found in joints of the serpentine in sufficient quantity to induce hopes of its proving of commercial value. From an examination of the occurrence of this ore on Sections 2124-87 and 2125-87, I do not think that there is much chance of the ore being obtained in quantities sufficient to pay. It is found in joints of the serpentine, and nice specimens are readily obtained; but I saw no sign of a true lode of it, or any indication that it was present in workable quantity. The sections taken up for nickel are on the top of the high hill, north of the Heazlewood River from the Heazlewood Bridge.

There appear to be two main lines of lode in this district, one extending through the Heazlewood Extended, Heazlewood, and No. 1 South Heazlewood Companies' holdings, and the other traversing those of the Whyte River, Bell and Smith's, Godkin Extended, and Godkin Companies. Outside of these two main lines the only workings of consequence are those for gold, near the Castray River. Alluvial gold has been worked by sluicing, with fair results, in past years in several of the creeks running into the Whyte River. An old bed of the Castray River runs to the north-west through Sections 1937-87 and 1060-87. This has been sluiced with very good results up to a certain point, where it became poor. At this point prospecting has discovered the gold in its matrix, and the operations now in progress are to work this. It is a fine grained brown sandstone bed striking about N.N.W., and dipping easterly 30°. The bed is about 2½ feet thick, and lies between clayey beds. The gold is rounded and waterworn. A great deal of magnetic iron sand is with the gold when panned out from this stuff. Very good prospects are obtainable throughout the whole of the bed so far as it has been tried. I cannot yet say what is the geological age of this auriferous sandstone, not having made a sufficient examination of the neighbouring silurian rocks to determine its relation to them. A considerable extent of it has been proved auriferous, and it is well worth trying. The prospectors had a small hand-power battery, with which they crushed a few tons of sandstone, the yield being very good. I should recommend any company taking this ground in hand to make sure of having a sufficient amount of pay-dirt in sight before erecting crushing machinery, as from its nature the deposit may be expected to vary very much in quality. For crushing the stone I fancy a sort of puddling machine would be sufficient, or a Dodge Pulveriser. This last is a sort of iron churn, which rapidly disintegrates any soft rock like the sandstone in question. Such a machine would be much cheaper and do much more work than a stamping battery. A battery of light stamps running very fast, and with a short drop, would be much preferable to an ordinary quartz-mill for this sort of stuff. Great attention will have to be paid to the amalgamation of the gold, as loss will be liable to occur from its fineness, from its becoming coated with clay, from its being naturally coated with iron oxide, and from the turbidity of the water used, this last resulting from the amount of clay in the sandstone. Long blanket strakes, well attended to, will probably prove the most efficient gold-savers. The workings are on Section 74-88.

Heazlewood S.L. Mine, (Sections 1309M and 1310M).—The owners of this property have done a great deal of work in prospecting it on the surface and by means of shallow workings, with somewhat variable success. It has been demonstrated that a main lode extends in a north-north-westerly direction through both sections, and several small veins parallel to the main lode have also been discovered. On these latter no work to speak of has been done. In the southern section (1310M) the main workings are not far from the south boundary. A lode (known as No. 4) cut in the creek near this has a very promising-looking outcrop of galena and gossan, but has not yet been worked; course, N. 18° W. The main line of lode has two branches in this part of the holding, forming parallel lodes about 18 feet apart, running about N.N.W. through serpentine country. Between the two lodes the country is full of veins of calcite, and much infiltrated with lode matter, so that the two lodes may almost be considered to be one. A crosscut has been

driven across both lodes a distance of 141 feet altogether. On the course of No. 2 lode a drive has been made for 308 feet. The lode varies from a few inches to three or four feet in thickness of galena, blende, iron pyrites, calcite, calcedony, and quartz, but rarely shows more than two or three inches of pure galena. The lode has a beautifully banded structure. Some of the quartz and calcedony is coloured beautifully green with silicate of nickel. Though the workings have not yet reached payable quantities of ore in this part of the mine, the prospect is so encouraging that the drive should be vigorously carried on, as good bunches of ore may be cut at any time. In order to cut the lodes at greater depth a low-level tunnel was begun further down the creek than the workings just described, but was discontinued after being driven 160 feet.

On the northern section (1309M) the lode has been much richer in ore. Some hundreds of tons of ore have been taken out of it by means of shallow drives, shafts, and under-hand stopes. The lode is from 6 to 14 feet in width, and is well defined from the serpentine country enclosing it. The galena forms a vein in the lode from 2 to 3 inches wide as a rule, but now and then widening out into good bunches. A good deal of blende accompanies it. The bulk of the veinstone is altered country rock, carbonate of lime, and calcedony, all coloured green by silicate of nickel. A main shaft, 68 feet, and an air shaft, 70 feet deep, have been sunk on the lode, which is here vertical, and an adit (349 feet long) has been driven to the air-shaft. The manager proposes to drive a level about 110 feet below the bottom of the main shaft from a valley lying conveniently near the line of lode. This adit would cut the line of lode in about 100 feet, and would be directly under the ore body proved on surface in about 600 feet, so that besides prospecting a long piece of new ground it would give nearly 140 feet of backs on the portion of the lode known to contain ore. This most useful and necessary work should be pushed on. If the drive on the lode on the south section were continued to beneath the northern workings, the manager informed me that it would be about 1700 feet in length, and would be 310 feet below the surface. A better prospecting and developing work could hardly be devised. It would open the lode along its entire length, and cut any ore bodies existing in it, while at the same time draining it. In the present state of the tracks in the district no pumping machinery can be got on to the ground without constructing some four or five miles of road, and natural drainage of the mine is therefore of great consequence.

The appearance of this mine does not warrant me in predicting for it great future success, but it is decidedly too promising for the lode to be left alone. There is a very good chance of success, and whether it turns out well or badly in the end, I can only say at present that it is a legitimate mining venture.

No. 1, *Heazlewood, South,* (Sections 1619 and 1620M.)—In these sections the Heazlewood lode has been followed by surface trenches, but with poor success, only small ore veins being found. Some of the ore contains chromate of lead as well as carbonate and sulphide. Much deeper work must be done in this ground before it is clear that it possesses a payable lode. In Section 1937-87, on the Castray River, a vein of galena has been found, which is supposed to be portion of the Heazlewood lode. If the connection can be proved there is good hope of payable ore being found anywhere along the line of lode from the Castray River to the Heazlewood.

Heazlewood Extended, (Sections 4-87M and 825-87M.)—This company has done a lot of prospecting, and has found several lodes which are more or less promising. The Heazlewood main lode has been traced right through the ground and into Section 1596M, across the Heazlewood River. On surface it has as yet shown no quantity of good ore. To the westward from it there has been found a rather flat-lying lode, showing stains of blue and green carbonates of copper, and containing, it is said, both silver and gold. A tunnel has been driven 400 feet through serpentine country to cut this at a low level, but has not yet reached it. Another small prospecting tunnel, in about 60 feet, has cut some small veins containing chromate of lead. On the main lode a shaft has been sunk 40 feet, and a drive has been made across the lode, which is here 14 feet wide. The lode stuff is mostly calcite, containing very thin veins of galena, blende, and copper pyrites. To the eastward of the main lode a small lode carrying galena has been found, which should run into the main lode across the Heazlewood River. Where this is cut on surface the vein of galena is only about half an inch thick, but 73 feet lower down, where the lode is cut by an adit 250 feet long, there is about 3 inches of fine clean ore. A drive has been put along the course of the lode for 140 feet, the clean galena being from 2 to 4 inches thick throughout it. A nice heap of ore has been taken from this lode. A new tunnel has been started from the river to cut this lode, and should soon reach it. The deep valley of the Heazlewood is very favourably situated for working these lodes, as it cuts right across them, and it is therefore possible to drive in at once on the course of the lodes. This seems to me the best policy for this company to adopt, to prove their lodes by driving on them, cross-cutting at the same time at intervals. Something much better than is now visible must be got before any returns will come to the owners.

Whyte River Company, (Section 1083-87.)—The country rock in this section is entirely different from that which encloses the Heazlewood lodes, being a decomposed igneous rock, possibly diorite. Two adits have been driven through this, there being about 80 feet of vertical distance between them. The lower tunnel was in 110 feet when I saw it but had not reached the lode. A small vein was, however, cut near the entrance, showing blende, galena, and pyrites.

The upper tunnel was driven some time ago by a party prospecting for gold, in order to cut a quartz reef which is seen on the surface. At about 80 feet from the mouth they passed through what is now recognised as a lode without apparently noticing it, and went on for another 70 or 80 feet. The lode is from 5 to 6 feet wide, composed of broken country rock impregnated with chromate and carbonate of lead and oxide of antimony. This stuff is reported to give excellent assays for silver. At a greater depth the lode will probably contain more quartz and be better defined. It is similar in occurrence and appearance to the lodes in Bell's and Godkin's properties, and may be portion of the same lode.

W. R. Bell's Sections, (887-87M and 44-87M).—Immense quantities of gossan, carrying a little silver, are found in a line running about N.W. and S.E. from these sections down to the Whyte River. This has come to be called "Godkin's" line of lode, but ought to be known as "Bell's," as Bell's discovery was

prior to Godkin's. That the large outcrop of gossan covers an equally large lode I very much doubt, but the regularity of its strike over hill and valley, and the regular presence of more or less silver throughout it, point to its origin from a fissure of some sort. As work opens the deposit to view, its true nature will become clear; but at present I am inclined to believe that the gossan indicates the outcrop of an igneous dyke, of the same decomposed character as the rock found in the Whyte River Company's mine above mentioned, and that the lodes are formed in fissures in this dyke. In Bell's ground the dyke is clear, breaking through silurian limestone, which is found on both sides of it. A surface trench and shallow drive cutting through the dyke stuff reveal brown and red clays, with numerous veins of oxides of iron and manganese. In parts there is so much of these that the clay becomes almost a gossan. In this trench a lode about four feet thick, consisting of quartz mainly, but much coloured with iron and manganese oxides, has been cut through. Chloride of silver is freely visible in many stones from this lode. On either side of the lode the dyke stuff is extremely decomposed, and much blackened by oxide of manganese. I was told that the dyke stuff contained a little silver. This lode strikes N. 60° W. in the trench, and underlays S.W. about 1 in 6. All the surface immediately over the dyke is covered with gossan. Several other cuttings into the gossan formation have revealed the igneous clay lying beneath it. A tunnel was being driven at the time of my visit through hard limestone, in order to reach the dyke. When this has been driven right across the latter it will give a good idea of how much of it is payable.

A lode of blende in quartz, striking N. 45° W., and dipping to the N.E., is cut in a trench near the creek, and again a few chains away. This is from 6 to 8 feet wide, and looks like a strong lode. Its value has not yet been ascertained. The blende is reported to contain cadmium. This lode ought to be prospected, as it may contain galena. Thin veins of galena have been found in the limestone, which is a very congenial matrix for this ore, and a strong lode traversing it might be rich in it.

Godkin's Extended, (Section 1076-87).—The gossan outcrop found on Bell's sections continues through Smith's (916-87M) and into this one. An adit has been driven a distance of 445 feet to cut the line of the gossan at a depth of 250 feet. The drive was through soft sandstone and slate, and again into hard sandstone. At 412 feet a lode of blende, some 14 feet thick, carrying, it is said, 11 per cent. of lead and 73½ ounces of silver per ton, was passed through. This lode was of a cellular loose character. It has not yet been driven on, but should be. In the face a strong stream of water was struck, and hopes were entertained that the lode was not far off. I have not since heard if it has been found. To the north of this main tunnel and over a hill from it a shaft has been sunk to a depth of 83 feet, through soft sandstone stained with manganese oxides. Some of this stuff is said to have given a little silver on assay. An adit, 105 feet in length, has been driven towards the shaft in a south-westerly direction. The first 65 feet of this is through clayey matter stained with oxides of manganese, and then hard sandstone is met with. To the north of this adit, and a few chains distant, the decomposed dioritic rock is again met with.

Godkin's, (Sections 1599-87M and 1615-87M).—The main features of this property resemble those of Bell's section. The dyke in this case lies between sandstone and limestone. Strong outcrops of gossan lie over the surface of the ground, some parts of it giving very fair assays. A good deal of driving has been done to prove the ground. What is known as No. 1 tunnel has been driven about 300 feet right through the dyke. The first 100 feet consists of much stained very much decomposed dioritic rock containing a little silver. About 30 feet of this is stained very much, and contains a great deal of iron and manganese oxides and some quartz. This portion assays well for silver. One or two rich veins of phosphate of lead carrying chloride of silver were found through it. The remainder of the drive is through dioritic clays, and in the face sandstone makes its appearance. The dark rich portion of the dyke is the only part of it that can be said to be lode-matter, and it is not definitely formed into solid lode-stuff, but is only broken country rock (mullock) infiltrated with minerals from the lode solutions. In parts quartz lodes are likely to be found, as in Bell's. About 40 feet north of the mouth of No. 1 tunnel a shaft has been sunk 60 feet on the edge of the dyke. At 40 feet limestone was struck. About 30 feet to the south of the mouth of the tunnel an air-shaft has been sunk to meet an adit coming in at a lower level. For 36 feet the shaft passed through dioritic clay, and then struck loose broken limestone. The tunnel to meet this shaft is known as No. 4. It runs in from the creek in a direction N. 10° W. About 200 feet of it was driven through dioritic clays, and then 30 or 35 feet through limestone. It is to be continued to cut the main dyke and lode. Another drive, No. 3, has been put in about 90 feet, some little distance higher up the hill than No. 1. This passes through about 12 feet of the dioritic clay, and then goes through beds of sandstone and slate, among which I noticed also a thin bed of coarse grit. These beds strike N. 30° W., and dip S.W. 42° near the mouth of the tunnel, but much steeper in near the face. The end of the drive is in hard white sandstone. No lode was cut in this drive. In the northern of the two sections held by this company (1599-87M) there is yet another drive running about N. 80° W. This is about 100 feet long. It passes through 12 feet of dioritic clay, then 33 feet of mullocky lode stuff containing white clay and oxides of iron and manganese. Some silver chloride was also found in this. The lode-stuff here resembles that in No. 1 tunnel. The remainder of the drive is in sandstone, striking N. 30° W. and dipping S.W. 87°.

Taking all the properties on the line of this dyke into consideration, it may be said that while they all have been proved to contain silver, not one of them is yet opened sufficiently to warrant any glowing estimate of their value. The long distance over which silver-bearing material has been found, and the occasional occurrence of veins of quartz carrying chloride of silver, and of phosphate and chromate of lead, induce one to believe that there must be one or more true lodes along the line of dyke. But these lodes have still to be developed. In the meantime the erection of works for recovering the silver is quite premature, as the nature of the ore to be dealt with is yet uncertain. Galena may be found in the lodes in quantities to make smelting the best mode of treatment for all the ore; or it may be that the quantity of lead ore may be insignificant, and that the Lixiviation Process may be sufficient to extract the silver. Until a great deal more work has been done, and both quantity and quality of the ore have been proved, no reduction works need be thought of. The metallurgical treatment of the ore is far too important a matter to be lightly decided on. As both limestone and ironstone exist plentifully in the district, smelting is the most obvious method of dealing with the ore, provided that sufficient lead ore can also be obtained.

But the supplies of lead ore in sight, taking the Heazlewood line of lode into account as well, are not sufficient as yet to warrant the erection of furnaces. While, therefore, the prospects of the district quite warrant a large expenditure in opening up the mines, it is only fair to warn investors that a considerable time must elapse before they can hope to receive dividends.

PROSPECTS OF THE WEST COAST GENERALLY.

It is impossible to travel over the ground covered by the above report without being convinced of the vast importance to the Colony of this western portion of it. The difficulties in the way of prospecting are so great that one must admit the probability that the discoveries already made are only a small fraction of the total mineral wealth, and that as the country is opened up the yet unexplored portion will be also found to be rich. From the Arthur River to the Gordon valuable minerals have been found—gold at the Specimen Reef, at the Long Plains, in numerous branches of the Pieman River, at the Howard Plains, Queen River and its branches, and at Mount Lyell, and generally right throughout the whole country side; then we have tin ore at Mount Bischoff and at Mount Heemskirk, silver and lead ores at the Heazlewood, Mount Zeehan, and Mount Dundas, and other minerals of less importance also in various parts. And these have all been found in the midst of some of the most dense and impenetrable forest on the face of the earth, through which the prospector cutting his way has infinitely greater chances of missing than of striking the mineral deposit he is looking for, and where all his food and supplies have to be laboriously carried on his back. Can we be wrong, then, in looking upon the present discoveries only as an earnest of many more to come when the bush has been opened by tracks and there are fifty prospectors out where hitherto there has been but one? The Great Western Range yet holds its treasures intact, but we may soon expect to hear of successful assaults upon its fastnesses. The prospector—pioneer of the wildest wastes—is still pushing on; neither hardships nor danger can daunt his persevering courage. Though the swollen river sullenly roar across his path, though frightful scrubs entangle him in heartbreaking toils, though the inclement sky pour ceaseless rain upon him, yet do they not prevail to drive him back. Forward, still forward, is his resistless march, till the conquered crag glows red in the blaze of his cheery camp fire, and the gloomy valley re-echoes the ring of his axe. The rough places he makes smooth, and into the dismal dens he lets light, till the beaten demons of the mine fly affrighted and yield to him their long-guarded treasures. All honour to the undaunted heart that faces and overcomes the wilderness! He well deserves the grateful thanks of his country.

I have the honor to be,
Sir,
Your obedient Servant,
A. MONTGOMERY, *M.A.*,
Inspector of Mines and Geological Surveyor.

The Secretary of Mines, Hobart.

APPENDIX.

"NOTES ON MATTE SMELTING FOR SILVER."

Under this title a short paper appears in "The Engineering and Mining Journal" of February 8th, 1890, written by Mr. F. L. Bartlett, a well known American smelter, and from it the following remarks on the process are taken:—

"It has always been my belief that not enough attention is paid to the smelting of argentiferous ores without the use of lead. American smelters have not, as a rule, appreciated the idea that silver and gold can be concentrated and saved by the use of sulphur, iron, and copper as well as by the use of lead. There are many places in the West where silver ores occur in quantity, and of a fairly good quality, but are bare of lead; such ores do not always contain copper, but as a rule do, and usually run from 1 to 3 per cent. in that metal.

"In my own practice I have found no difficulty in saving gold and silver by smelting, either when copper was present, or when the ore contained only iron pyrite.

"Experience has shown that a small percentage of copper enables one to make a much higher concentration of the silver and gold present than is the case when the matte must be made wholly of sulphide of iron. When no copper or lead is in the ore, it has not been possible in my work to run the matte higher than 70 or 80 ounces of silver per ton, and make clean slags, *i.e.*, slags containing less than 1 ounce silver; but with copper, even as low as ½ per cent. in the charge, the silver can be run up to as high as 200 ounces; and with 3 per cent. copper in the charge, it can be run up to 700 ounces. Moreover, if the charge runs higher in copper than 2·5 or 3 per cent., no additional advantage is had; on the contrary, there is likely to be more loss of silver, therefore 3 per cent. may be considered the limit of the *best* results. The reason for this is, I believe, to be found in the fact, that when an ore containing a small percentage of copper is smelted, a very high degree of concentration can be made without forcing copper into the slags; thus, with an ore containing 3 per cent. of copper, a concentration of 20 to 1 can be made, and the matte then only contains 55 to 58 per cent. of copper, while slags from such ore will rarely contain more than one-tenth to one-twentieth per cent. of copper. If the ore ran 10 per cent. in copper, a concentration of not more than 5 to 1 would be possible, and even then the slag would be likely to run from ¼ to ½ per cent. copper, which means loss of silver.

"The ores most suitable for matte smelting in the blast furnace are those containing considerable iron or manganese, and the sulphur contents must be regulated by partial roasting when high, or by the addition of raw sulphurets when low, since the amount of sulphur present determines almost exactly the quantity of matte made."

Mr. Bartlett then proceeds to quote from notes received by him from Mr. Herbert Lang, Manager of the Porphyrite Silver Mining Company of Mineral City, Idaho. Mr. Lang writes :—

"At the Porphyrite Company's smelting works we use a 36-inch Bartlett water jacket, with outside settling wells, and run off the melted products continuously. The proportion of ore smelted to matte produced is 20 or 25 to 1, an excessively high rate of concentration, but, under the peculiar conditions prevailing at this isolated camp, more profitable than a greater proportion of matte would be. The silver extraction is quite satisfactory, our slags assaying, week in and week out, only about 1½ ounces of silver per ton. The loss in flue dust probably amounts to 2 per cent. We use a blast of 6 to 8 ounces pressure, generated by a No. 6 Sturtevant fan, which requires about 10 H.P.

"Our mines produce two general classes of ore, denominated oxidised and sulphide ores. The former are well represented by the following :—

* *Analysis of Oxydised Ore.*

Moisture	10·00
Copper	3·00
Silica	40·20
Sulphur	0·79
Oxides of iron	28·63
Oxides of manganese	1·35
Alumina	7·31
Lime	1·56
Magnesia	0·57
Cobalt, nickel, zinc	0·60
Oxygen and carbonic acid, &c.	5·52
	99·53

* Such ores carry on an average 40 ounces of silver—no gold.

Analysis of Sulphide Ore.

Moisture	4·00
Silica	27·77
Sulphur	6·18
Copper	1·20
Iron, as oxide and sulphide	17·78
Alumina	4·80
Zinc	1·73
Lime	11·00
Magnesia	0·63

(Oxygen, combined water, carbonic acid, and various unimportant constituents not estimated.)

"By a suitable mixture of these ores, and by adding limestone as flux, we obtain a slag of the following percentage composition :—

Analysis of Slag.

Silica	37·05
Ferrous oxide	17·66
Manganous oxide	7·85
Lime and magnesia	28·72
Alumina	7·43
Sulphur	0·38
Zinc oxide	0·41
Copper	0·10
	99·60

"Accompanying this slag there is, as before remarked, a matte carrying about 36 per cent. copper and several hundred ounces of silver, with a trace of gold. This we sack, and ship east to market."

Mr. Lang then goes on to describe some features of the furnace manipulation, and concludes :—

"Making the rather acid slag shown by my analysis, we are not able to smelt the maximum amount due to this size furnace. We average 14 tons' charge each 12 hours' run, while running only one shift, which corresponds to about 30 tons daily. For experimental purposes, and making a more basic slag, we have, for some hours, smelted at the rate of 40 to 50 tons per day, which demonstrates sufficiently that our furnace is at least equal to any other well known make in capacity. We smelt on an average eight and a half tons of charge to one ton of Connellsville coke."

THE NEW DRESSING WORKS OF THE ST. JOSEPH LEAD COMPANY, AT BONNE TERRE, MISSOURI.

The *Engineering and Mining Journal* of June 22nd and 29th, 1889, has an illustrated description of the above dressing works taken from a paper read by Professor H. S. Munroe before the American Institute of Mining Engineers. Being built in 1883, this mill is a comparatively modern example of American modes of dressing lead ores. The new mill, which has a capacity of 800 tons a day, was built in consequence of older sheds having been burned down. The old mill had at one time or another contained almost every known form of dressing apparatus, and "the new mill represents the results of fifteen years' study and experiment in the old structure, and is a shining example of 'the survival of the fittest,' both in apparatus and in method of treatment."

Outline of Method of Treatment.

"The method of treatment may be outlined as follows:—The ore is crushed by jaw-crushers and rolls, and screened dry through a 6m.m. screen. The sands passing through the screen are thoroughly mixed with water, and elevated by centrifugal pumps to distributors, and divided among the Parsons' jigs without any previous sizing or classification. The tails ("chats"), after passing over the two sieves of these jigs, receive no further treatment, and are conveyed by launders to the "chat-tanks." Coarse galena and raggings are skimmed by hand from the jigs at intervals, leaving always a sufficient bed to ensure good hutchwork. The hutchwork that comes through the sieves of the Parsons' jigs pass through a series of spitzkasten. The heavy galena mixed with some sand and slime settles in the first box of the series, from which it is fed to a trunking-machine. The pure galena from this machine falls into railroad cars and goes to the smelting works. The tails from the trunking-machine, together with the sands settling in the second box of the spitzkasten, are elevated by the centrifugal pumps, and divided between the Hartz three-sieved jigs. The tails of the Hartz jigs receive no further treatment, going directly to the chat-tanks. Galena and pyrites are skimmed from the sieves of these jigs. A bed of galena is, however, maintained on all three sieves, so as to insure a rich hutchwork. The hutchwork of these finishing jigs is nearly pure galena, and goes to the galena boxes on the lower floor, which are emptied from time to time, and the galena, loaded on cars, goes to the smelting works.

The fine slimes settling in the third and fourth boxes of the spitzkasten are united, and raised by centrifugal pumps to the distributors, feeding the first row of Parsons' Rittinger tables. The middlings from these tables are treated on the second row of tables. The tails from all the tables flow into the chat-tanks, and the heads run into galena boxes on the lower floor, from which they are loaded into cars.

The raggings, containing from 12 to 20 per cent. of lead, which are skimmed from the Parsons' jigs, are recrushed by fine rolls and elevated without screening to a line of Hartz three-sieved jigs. These raggings contain considerable pyrites."

The paper then goes on to describe in detail the various machines used and their arrangement, the description being made clear by numerous illustrations, for which we must refer those interested in the subject to the original paper.

There are ten sets of crushing and screening apparatus in the mill, each treating about 80 tons in twenty-four hours. Each set consists of a 7-inch by 15-inch Blake crusher, lever pattern, with corrugated jaws; a pair of Cornish rolls, 14 inches by 30 inches, with chilled tires; a revolving screen, 3 feet diameter by 8 feet long, with six millimetres perforated steel plates, a bucket elevator for the material coarser than six millimetres, and a centrifugal pump.

The jaw-crushers are set to crush to about 38 mm. or $1\frac{1}{2}$ inches, and the rolls to crush to about 16 mm., or $\frac{5}{8}$ inch. Of the material passing through the rolls at any time, about one-third is too coarse to pass through the screens, consequently the ore passes through the rolls one and a half times. While the perforations of the screens are 6 mm. in diameter, not more than 2 per cent. of the screened product is coarser than 4 mm.

Each crusher was found to cost about £21 a year for repairs, and each pair of rolls about £30 10*s*. New screens came to close on £33 a year.

The Parsons' jigs used for the preliminary jigging of the sands coming from the rolls are two-sieve under-piston jigs, each sieve 24 inches by 39 inches (or 22 by 27 inches in the clear). For convenience the jigs are made double, *i.e.*, four sieves, or two jigs, are united in one machine. There are 9 jigs, $4\frac{1}{2}$ machines, for each set of crushing apparatus. Each jig treats, therefore, about 9 tons in 24 hours. The ore dealt with contains on an average 8·93 per cent. of lead. The hutchwork saved from the jigs contains 22·3 per cent., and the raggings, or coarse sand and galena 16·54 per cent., while the tailings contain 1·53 per cent. By this jigging treatment, 800 tons of ore a day are at once reduced to 136 tons requiring further dressing, namely, 30 tons of raggings, crushed and treated on the three-sieve jigs, 66 tons of fine sand also treated on three-sieve jigs, and 40 tons of slime treated on side-bump tables. The hutchwork is next classified in a series of four spitzkasten or pyramidal boxes. The coarse sand in the first box is dressed in the trunking machine to nearly pure galena. The tailings from this and the sand from the second box are treated on three-sieve Hartz jigs of the ordinary side-piston type. The hutchwork of these contains 74 per cent. of lead, and the tailings 5·24 per cent. The fine slimes from the third and fourth spitzkasten are treated on double Rittinger side-bump tables, 3 feet by $7\frac{1}{2}$ feet, built in pairs. There are 16 pairs of double tables in the mill, or 64 tables in all. Of these 32 are head tables and 32 are used for treating middlings. They treat $2\frac{1}{2}$ tons per double table in 24 hours.

The average loss in the tailings in this mill in 1887 was 2·13 per cent. of lead, or 27·4 per cent. of the total amount of lead in the ore. The cost of dressing amounted in the same year to 36·4 cents per ton, (about 1*s*. $6\frac{1}{4}$*d*.) divided as follows:—Labour 13·4 cents, repairs 10·0, supplies 3·5, coal 9·5—total 36·4 cents.

SILVER SECTIONS

MOUNT ZEEHAN

SCALE. THIRTY CHAINS TO AN INCH

Note:- Approximate position of lodes shown by red lines {Being roughly sketched and not surveyed these lines are not guaranteed to be accurate}

PINE CREEK

MT AGNEW

MT ZEEHAN

MT DUNDAS

MAIN ROAD TO ZEEHAN

SCOTTS TRACK

WENTY RIVER

THE COLORADO

BRITANNIA

SILVER QUEEN EXTENDED

SILVER QUEEN PROPRIETARY

TASMANIAN SILVER MINING CO. LIM.

DARK PROSPECTING ASSOCIATION

MT CLEAN'S CK.

TOWN OF ZEEHAN

SECOND BRANCH OF HENTY

THIRD BRANCH OF HENTY RIVER

HENTY RIVER

DUPUY'S LINE OF RAILWAY

OFFICE OF MINES HOBART

MAY 1890

APPENDIX B.

DIAMOND DRILLS.

Statement of Work done.

Year.	*Locality.*	*Direction of Bore.*	*No. of Bores.*	*Total Distance bored.*	*Average Cost per foot, exclusive of Labour and Fuel.*
	No. 1 Drill.			feet.	£ s. d.
1882-3	Back Creek—For Gold	Vertical	7	1330	0 10 9
1883...	Lefroy—For Gold	Ditto	4	1011	0 5 3
1884...	Tarleton—For Coal	Ditto	1	401	0 5 6
1886 ..	Longford—For Coal	Ditto	2	1585	0 4 0½
1886-7	Harefield Estate—For Coal	Ditto	1	725	0 6 5
1887...	Cardiff Claim, Mount Malcolm—For Coal	Ditto	1	562	0 17 11¾
1888...	Killymoon Estate—For Coal	Ditto	1	504	0 4 7¾
1888-9	Seymour—For Coal	Ditto	5	2266	0 7 8½
1889-1890	Beaconsfield (Phœnix G. M. Co.)—For Gold	Ditto	1	781	2 0 2
1890...	Beaconsfield (East Tasmania G. M. Co.)—For Gold. (In progress)	Ditto	1	391	0 19 0
	Total	...	24	9456	
	No. 2 Drill.				
1882...	Beaconsfield—For Gold	Horizonta , underground	1	68	No record.
1883...	Mangana—For Gold	Ditto	1	546	0 15 1
1884...	Guy Fawkes Gully, near Hobart—For Coal	Vertical	1	612	0 5 6
1885...	Malahide Estate, Fingal—For Gold	Ditto	5	1397	0 5 6
1886...	Carr Villa, near Launceston—For Coal	Ditto	1	571	0 5 4
1886-7	Waratah—Mt. Bischoff Alluvial T.M. Co.—For Tin	Ditto	7	1548	0 6 1½
	Waratah—Mt. Bischoff T.M. Co.—For Tin	Ditto	7	841	0 11 8
1887...	Ditto—Ditto	Horizontal, underground	1	53	0 7 8
1888...	Old Beach—For Coal	Vertical	1	593	abt. 0 10 9
	Campania—For Coal	Ditto	1	600	0 7 7½
	Richmond—For Coal	Ditto	1	500	0 5 1¾
1889...	Back Creek—For Gold	Ditto	4	787	0 8 5½
	Total	...	31	8116	

Aggregate number of bores 55
Total distance bored ..... 17,672 ft.

W. H. GLOVER, *Commissioner of Gold Fields.*

Launceston, 30th June, 1890.

DIAMOND DRILL, No. 1.

REPORT of Strata passed through in boring for the Underlay of the Tasmania Reef in the Phœnix G.M. Co.'s Ground at Beaconsfield.

Commenced boring, June 26th, 1889; completed, March 29th, 1890.

Strata.	Depth of each Stratum bored through.	Total Depth.
	ft. in.	ft. in.
Alluvial surface matter	4 6	4 6
Hard, brittle, whitish, fine-grained Sandstone, with very indistinct fossil impressions. Several very thin quartz veins throughout this country. Rock yielded very little core, being very much jointed and very brittle	368 4	372 10
Rather fine-grained, black, somewhat crystalline Sandstone, containing specks of Pyrites and a few small quartz veins. Much jointed. Gave very little core	119 8	492 6
Light gray Sandstone, with occasional bands of gray Slate. Impressions of fossils numerous, but rarely perfect. Occasionally gave a few inches of core	213 0	705 6
Reef Quartz often highly impregnated with Iron and Copper Pyrites, and showing visible Gold	24 6	730 0
Dense dark blue Sandstone carrying Pyrites	50 7	780 7
TOTAL	780 7	780 7

No. 1.

COMPARATIVE Statement of Gold won during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, *and the first Half-year of* 1890.

YEAR.	QUANTITY.	VALUE.
	ozs. dwts.	£
1880	52,595 0	201,297
1881	56,693 0	216,901
1882	49,122 6	187,337
1883	46,577 10	176,442
1884	42,339 19	160,404
1885	41,240 19	155,309
1886	31,014 10	117,250
1887	42,609 3	158,533
1888	39,610 19	147,154
1889	32,332 13	119,703
For first half-year of 1890	13,415 0	49,635

No. 2.

RETURN showing the Quantity of Gold obtained from Quartz during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, *and the first Half-year of* 1890.

YEAR.	QUANTITY.	VALUE.
		£
1880	34,345 ounces	130,622
1881	45,776 „	174,956
1882	36,215 „	137,183
1883	36,672 „	138,060
1884	30,540 „	114,630
1885	33,266 „	124,234
1886	25,004 „	87,516
1887	33,427 „	123,453
1888	34,156 „	126,139
1889	33,069 „	116,517
For first half-year of 1890	12,156 „	47,065

No. 3.

COMPARATIVE Statement of Tin exported from Tasmania during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, *and for the first Half-year of* 1890, *compiled from Customs Returns only.*

YEAR.	TONS.	VALUE.
		£
1880	3954	341,736
1881	4124	375,775
1882	3670	361,046
1883	4122	376,446
1884	3707	301,423
1885	4242	357,587
1886	3776	363,364
1887	3607½	409,853
1888	3775¼	426,321
1889	3764	344,941
For first half-year of 1890	1543¾	141,092

No. 4.

QUANTITY and Value of Coal raised during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, *and the first Half-year of* 1890.

YEAR.	QUANTITY.	VALUE.
	TONS.	£
1880	12,219	10,998
1881	11,163	10,047
1882	8803	7923
1883	8872	7985
1884	7194	6475
1885	6654	5989
1886	10,391	9352
1887	27,633	24,870
1888	41,577	37,420
1889	36,700	33,030
For first half-year of 1890	20,796	18,716

No. 5.

RETURN showing the Number of Persons engaged in Mining during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, *and first Half-year of* 1890.

YEAR.	NUMBER.
1880	1653
1881	3156
1882	4098
1883	3818
1884	2972
1885	2783
1886	2681
1887	3361
1888	2989
1889	3141
For first half-year of 1890	2731

No. 6.

RETURN showing the Number and Area of Leases held under "The Mineral Lands Act" and "The Gold Fields Regulation Act," in force on 30th June of each Year since 1885.

Nature of Lease.	In force on 30th June, 1885.		In force on 30th June, 1886.		In force on 30th June, 1887.		In force on 30th June, 1888.		In force on 30th June, 1889.		In force on 30th June, 1890.	
	NO.	AREA.	NO.	AREA.	NO.	AREA.	NO.	AREA.	NO.	AREA.	NO.	AREA.
		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.
Under "The Mineral Lands Act," for tin, &c., at a rental of 5*s.* an acre	1011	43,511	627	24,077	656	22,892	957	32,231	1497	53,251	1303	49,463
For coal and slate, at 2*s.* 6*d.* an acre rent	29	3999	38	5487	62	10,665	41	6045	38	4499	51	7636
Under "The Gold Fields Regulation Act," at a rental of 20*s.* an acre	207	1976	110	1077	149	1474	285	2812	270	2687	325	3088a. 2r. 20p.
Water Rights and Mining Easements	—	—	93	759 sluice-heads.	107	773 sluice-heads.	140	852 sluice-heads.	204	1005 sluice-heads.	209	950 sluice-heads.

No. 7.

RETURN of the Number and Area of Leases under "The Mineral Lands Act" and "The Gold Fields Regulation Act," in force on the 1st July, 1889, *issued during the Year ending* 30*th June,* 1890, *cancelled during the Year ending* 30*th June,* 1890, *and remaining in force on* 30*th June,* 1890.

Nature of Lease.	In force on 1st July, 1889.		Issued during Year ending 30th June, 1890.		Cancelled during Year ending 30th June, 1890.		In force on 30th June, 1890.	
	NO.	AREA.	NO.	AREA.	NO.	AREA.	NO.	AREA.
		A. R. P.		A. R. P.		A. R. P.		A. R. P.
Under "The Mineral Lands Act," for tin, &c., at a rental of 5*s.* an acre	1497	53,251 0 0	525	22,837 0 0	719	26,625 0 0	1303	49,463 0 0
For coal and slate, at 2*s.* 6*d.* an acre rent	38	4499 0 0	19	4077 0 0	6	940 0 0	51	7636 0 0
Under "The Gold Fields Regulation Act," at a rental of 20*s.* an acre	270	2687 0 0	176	1555 1 3	121	1153 2 23	325	3088 2 20
Water Rights and Mining Easements	204	1005 sluice-heads.	44	147 sluice-heads.	39	202 sluice-heads.	209	950 sluice-heads.

No. 8.

COMPARATIVE Statement of Net Revenue from Mines, being Rents, Fees, &c. paid to the Treasury.

YEAR.	AMOUNT.		
	£	*s.*	*d.*
1880	8944	5	11
1881	20,936	5	5
1882	23,077	1	9
1883	15,439	14	5
1884	6981	11	10
1885	11,070	5	7
1886	12,523	10	4
1887	14,611	11	5
1888	23,502	8	4
1889	17,254	9	0

The above Statement does not include Stamp Duties upon Transfers of Leases and Registration of Companies, or the Tax payable upon Dividends, from which sources large sums are derived.

No. 9.

RETURN of Dividend Tax paid by Gold Mining Companies.

YEAR.	NO. OF COMPANIES.	AMOUNT OF DIVIDEND.			AMOUNT OF TAX.		
		£	*s.*	*d.*	£	*s.*	*d.*
1880	5	65,852	17	2	2467	16	0
1881	4	99,250	0	0	3721	17	6
1882	5	55,825	0	0	2093	8	9
1883	5	63,168	10	0	2368	16	4
1884	4	39,400	0	0	1477	10	0
1885	2	61,250	0	0	2296	17	6
1886	3	41,125	0	0	1542	3	9
1887	2	66,750	0	0	2503	2	6
1888	2	65,375	0	0	2451	11	3
1889	4	28,000	0	0	1050	0	0
1890, 1st half-year of	1	6750	0	0	253	2	6

RETURN of Dividend Tax paid by Tin Mining Companies.

YEAR.	NO. OF COMPANIES.	AMOUNT OF DIVIDEND.			AMOUNT OF TAX.		
		£	*s.*	*d.*	£	*s.*	*d.*
1880	11	64,755	0	0	2428	6	3
1881	13	102,418	0	0	3840	13	6
1882	12	108,935	0	0	4085	1	3
1883	9	98,837	2	6	3706	7	9
1884	4	60,169	0	0	2256	6	9
1885	4	92,644	0	0	3474	3	0
1886	5	108,849	10	0	4081	17	1
1887	6	128,753	0	0	4828	4	8
1888	10	148,638	17	2	5573	19	10
1889	6	100,850	0	0	3781	17	6
For first half-year of 1890	5	40,350	0	0	1513	2	6

WILLIAM THOMAS STRUTT,
GOVERNMENT PRINTER, TASMANIA.