(No. 50.)

1893.

PARLIAMENT OF TASMANIA.

REPORT OF THE SECRETARY OF MINES FOR 1892-3:

INCLUDING REPORTS OF THE INSPECTORS OF MINES, &c.

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

TASMANIA.

REPORT

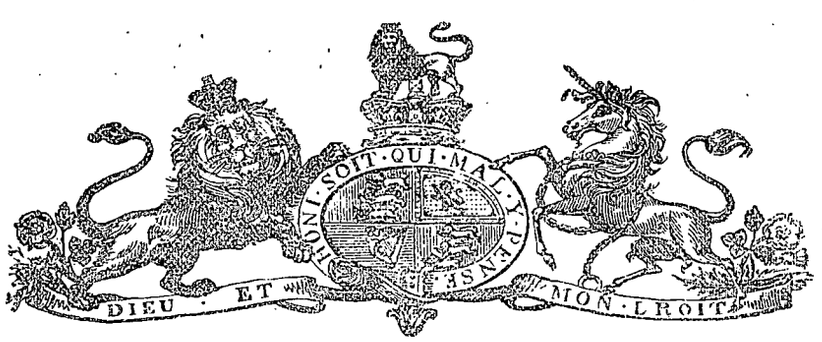
OF THE

SECRETARY OF MINES

FOR

1892-3,

INCLUDING THE REPORTS OF THE INSPECTORS OF MINES, THE GEOLOGICAL SURVEYOR, THE MOUNT CAMERON WATER-RACE BOARD, &c.



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1893.

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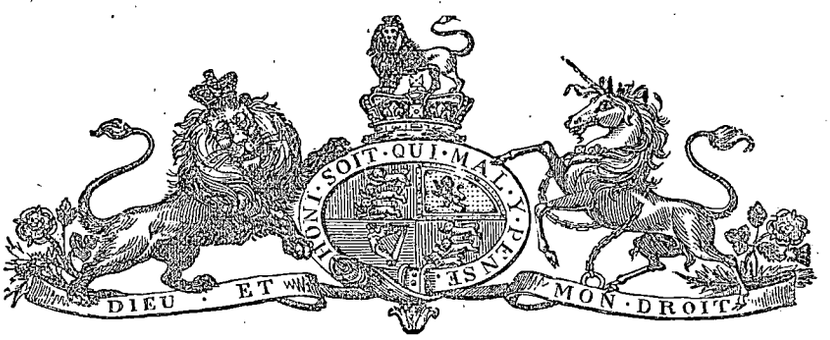


REPORT OF THE SECRETARY OF MINES.

Office of Mines, Hobart, 24th July, 1893.

SIR,

I HAVE the honor to submit my Report of the Mines Branch of the Lands and Works Department for the year ending 30th June, 1893.

Appended to this will be found Reports from the various Commissioners of the state of the Mining Industry in the divisions under their charge; the Reports of the Inspectors of Mines; the Annual Report of the Geological Surveyor; the Annual Report of the Mount Cameron Water-race Board; Reports by the Geological Surveyor upon—

The Discoveries of Tin Ore at Brookstead, near Avoca.
The Godkin Silver Mine, Whyte River.
Thureau's Deep Lead, George's Bay.
The Tin Mines of the Blue Tier, County of Dorset.
The Mount Lyell Mine, County of Montagu.
The Sandfly Coal Mine.
The Progress of the Mineral Fields in the County of Montagu (West Coast).
The Country between Mole Creek and the Mount Dundas Silver-field, and on the discovery of Coal at Barn Bluff.
The Silver-bearing Lodes of the Scamander District.
The Pandora Copper Mine.
Returns of the operations of the Diamond Drills, together with Tables showing the yields of Gold, Silver, 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.

It is satisfactory to note that, notwithstanding the financial crisis through which the colony is passing, rendering it difficult to obtain money for the purchase of machinery or to employ labour for developing mining property, the Mining industry of the country is not only holding its own, but during the year which has just closed has made a very substantial advance. The value of the output of Minerals and Metals has exceeded by £40,000 the output for the year 1891-2. Machinery to the value of £35,000 has been imported and erected, and progressive works such as tramways, shafts, and tunnels, with other works of development, have been carried on with much vigour in various parts of the colony, but notably so on the West Coast. In all quarters there is evidence of steady improvement, and there is every reason for believing that at no distant date there will be a large and important increase in the mineral export of the colony.

The disastrous fall in the price of silver will no doubt have the effect of closing down some of our lower grade mines; but there will remain many mines rich in lead, which, with the improved and more economical method of working now prevailing, will still be worked at a substantial profit.

Recent developments at Mount Lyell give promise of most important results. Dr. Ed. Peters, jun., M.D., M.E., an eminent metallurgist of the highest repute, has lately spent some months at the mine. In his report just issued he estimates the quantity of ore in sight at four and a half million tons. His figures for the average value of this ore per ton of 2240 lbs. are—Copper, 4½ per cent.; silver, 3 ozs.; gold, 2½ dwt. This ore, he asserts, can be worked at a net profit of £1 10*s.* 5*d.* per ton. Dr. Peters concludes his report with the words, "I will only say, in conclusion, that in the past 20 years I have never seen a mining and metallurgical proposition that promises so certainly to be a great and enduring property as this." If the practical result comes within measurable distance of what is here foreshadowed, the impetus given to trade throughout the colony by the successful working of this one mine alone will be immense.

Discoveries of gold in quartz and alluvial have been made at Bell Mount, some 24 miles N.E. of Sheffield, which bid fair to be of considerable value. Extensive deposits of tin have been found at Roy's Hill, Brookstead, and Ben Lomond, in good accessible country near Avoca, all of which are favourably reported upon by the Geological Surveyor. Other deposits have also been found at the Iris River, at North-East Dundas, and at the Stanley River, on the West Coast; whilst the known deposits of wolfram near the Pieman Heads, and nickel at Heazlewood and near Dundas, are reported as valuable and likely to be profitably worked. An extensive bed of cannel coal has been discovered at Barn Bluff; it is stated to be of good quality and of great value, but its locality is in, at present, difficult country. Other discoveries of various minerals and of minor importance have also been made.

The provision of the Regulation of Mines Act for issuing Certificates of Competency to Mine Managers after examination has been brought into operation. A Board of Examiners has been appointed, consisting of the Secretary of Mines (Chairman), the Geological Surveyor, the Engineer-in-Chief, the Chief Inspector of Machinery, and Messrs. Richard Provis and H. W. Ferd. Kayser. Regulations have been framed. Two half-yearly examinations have been held, at which 22 candidates presented themselves, of whom 4 obtained First Class certificates, 9 obtained Second Class, and 9 failed to pass; besides which 9 service certificates were granted without examination, and 3 certificates to persons holding equivalent certificates from England and elsewhere. The examination papers will be found in the Appendix to this Report.

Already the scheme has had a beneficial effect: for, whilst it has weeded out several incompetent men, it has encouraged others, especially young men, to work up to the standard and obtain a certificate, which cannot fail to be of lasting service to the holder. Some complaint has been made that the standard is unnecessarily high, but it is felt that to be of real use to the holder, and to obtain recognition in other countries, certificates should not be too easily obtainable. The knowledge required is only such as should be possessed by every man in charge of a mine.

The practice, which has too long prevailed, of lessees continuing to hold ground in disregard of the labour covenants of their leases, is gradually but surely passing away. Lessees have been warned that the holding of ground for purely speculative purposes will not be permitted, and that unless the labour covenants are fulfilled the leases will be cancelled. This is having the effect of causing those lessees who are unable to work their ground themselves to either let it on tribute or to give up their leases. This latter course, whilst it may possibly involve some loss of revenue in the shape of rent to the State, will render the land available to those who will utilise it and so do far more substantial good to the country than the mere payment of rent. Consideration is and should be shown towards lessees who in the past have expended large sums in the development of their leaseholds, and who may from circumstances beyond their control be temporarily unable to continue working.

A Bill is now before Parliament for the consolidation and improvement of the Mining Laws of the Colony. Various new provisions to meet the requirements of the industry are included, and should the measure become law without much curtailment, it will simplify procedure and give facilities which have become necessary.

The law which enables the holder of a miner's right to take up and mine for tin upon one acre of Crown land, which has hitherto been operative in certain proclaimed areas only, has lately been made applicable to all unleased Crown lands throughout the Colony. So far the privilege is not extensively made use of by miners, and it is yet to be seen if the extended application will confer the great benefits which have been claimed for it.

Gold. The yield for the year has been 37,303 ounces, against 47,906 ounces for the previous year, or a decrease of 10,603 ounces. The falling-off is chiefly attributable to the fact that the Tasmania Mine at Beaconsfield, owing to being engaged in sinking a main shaft, has only had an output of some 4000 ounces instead of its average of 10,000 ounces. The several fields have contributed as follows:—Beaconsfield, 4225 ozs.; Lefroy, 17,134 ozs.; Mathinna, 9929 ozs.; other localities, 6015 ozs. It is satisfactory to note that the new field at Warrentinna has yielded some 1200 ounces.

Steady advance has been made in this branch of the industry during the year, principally at Zeehan. The yield for the year has been 103,390 tons of silver-lead ore and 500 tons of bullion, as against 1938 tons ore and 1000 tons of bullion for last year. Very considerable developments have taken place on the Zeehan field during the year. The progress of the Dundas field is much retarded for want of adequate machinery, the pumping appliances upon the principal mines there being quite unfit to do the work required of them. The mines in the Heazlewood and Whyte River districts are not so far proving themselves up to expectations. Silver.

The output for the year has exceeded that of 1891-2 by 222 tons. Discoveries of some importance, which are referred to elsewhere, have been made during the year. It is to be regretted that the large and rich deposits of lode tin at the Blue Tier are not yet satisfactorily worked. Much capital has been expended in erecting machinery, and although the stone is known to contain a payable percentage of tin none of the mines on this field have, so far, been profitably worked. Tin.

There has been a slight decrease of 1000 tons for the year in the output of coal. The cheapness at which foreign coal is now put upon the market has had the effect of reducing the demand for, and consequently the output of native coal, most of which is heavily handicapped by long railway haulage. The Seymour mines, which are close to the sea board, will, however, shortly be in full operation, and there is a prospect of the large and excellent deposits at the Sandfly, which is fairly close to market, being worked, in which case very little foreign coal will find its way into use here. Coal.

Production.

Mineral.	For the Year 1891-2.		For the Year 1892-3.		Increase.	Decrease.	Total Increase.
	Quantity.	Value.	Quantity.	Value.			
		£		£	£	£	£
Gold	47,906 ozs.	186,834	37,303 ozs.	145,482	...	41,352	
Silver.....	1938 tons	20,000	10,339 tons	103,390	63,890	...	
„ (Bullion)	1000 „	20,000	23 „	500			
Tin.....	4784 „	382,720	5006 „	400,000	17,280	..	
Coal	40,000 „	30,000	39,000 „	29,250	...	750	
Totals.....	...	639,554	...	678,622	81,170	42,102	39,068

TOTAL Area of Land applied for during Year ending 30th June, 1893.

Mineral.	No. of Applications.	Area.
		Acres.
Gold	158	1481
Silver	169	10,940
Tin	344	10,463
Coal.....	9	1525
Other Minerals	24	1340
Total	704	25,749

MINES Receipts for the Year ending 30th June, 1893.

HEAD OF REVENUE.	AMOUNT.
	£ s. d.
Rent under "The Gold Fields Regulation Act"	3556 12 0
Fees ditto	962 6 0
Rent under "The Mineral Lands Act".....	12,699 14 5
Fees ditto	1309 7 3
Rent of Diamonds Drills.....	111 13 6
Total	£18,639 13 2

DIVIDEND Tax.

Company.	For year 1891-92.		For year 1892-93.	
	Dividend.	Tax.	Dividend.	Tax.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Gold	52,750 6 3	1978 3 3	48,235 18 9	1808 17 5
Tin	81,140 9 9	3042 15 3	72,416 19 10	2715 12 11
Silver	10,304 14 0	386 8 0	438 8 0	16 9 3
Total	144,195 10 0	5407 6 6	121,091 6 7	4540 19 7

TOTAL Number and Area of Leases in force on 30th June, 1893.

MINERALS.	NUMBER.	AREA.
		ACRES.
Gold	501	4801
Silver	774	44,204
Tin	739	24,673
Coal	41	6290
Iron	11	622
Limestone	12	1673
Slate	1	200
Lithographic Stone	1	97
Mineral Paint	1	17
Shale	3	800
Ochre	4	161
Nickel	1	80
Wolfram	2	160
Marble	5	837
Galena	1	65
Precious Stones	1	80
Copper	1	80
Bismuth	1	56
Asbestos	5	147
TOTAL	2105	85,043

AVERAGE Number of Miners employed during the Year ending 30th June, 1893.

	Europeans.	Chinese.
Northern and Southern Division	643	...
North-Eastern Division	372	352
Eastern Division	441	187
North-Western Division	449	...
Western Division	851	...
	2756	539

MINING Companies registered during the Year ending 30th June, 1893.

Number of Companies.	Capital.
39	£88,687

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 Waterhouse, Warrentinna, and Mount Victoria. The Eastern District comprises the eastern portion of the Colony, and includes the tin-fields of Weldborough, Blue Tier, Gould's Country, Ben Lomond, and St. Paul's River, the extensive coal-bearing country around Fingal and Seymour, with the gold-fields at Mathinna and Mangana. The Western and North-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 deposits at Mount Bischoff, the River Iris, an extensive area of tin-bearing country at Heemskirk and Cox's Bight, the silver-fields at Heazlewood, Zeehan, and Dundas, the gold-fields at Mount Reid, Mount Lyell, and the Linda, with other more or less important mining centres. Division of the Colony.

The staff at Hobart has been reduced by the retirement of the Chief Clerk and one other Clerk; in other respects it remains the same. At the Launceston branch it is unaltered. Departmental Staff.

The Reports of these officers are annexed. The work of the Chief Inspector, who has charge of the more settled districts, is not of so arduous a nature as that of the officer stationed at the West Coast. This latter officer has to be continually moving about among the mines. The proverbial carelessness of miners renders constant watchfulness and supervision necessary. It is without question that the work done by this officer is of an especially useful character. It is with extreme regret that I have to record the loss through mining accidents of four valuable lives during the year. The Inspectors of Mines.

This officer (who also acts as Chief Inspector of Mines) has furnished comprehensive reports upon the various portions of the country which he has examined during the year. They are, in addition to his Annual Report, annexed hereto. The Geological Surveyor.

Details of the work done by these machines are appended. Diamond Drills.

The Report of the Board which has the control and management of this Race is annexed. The Board complain that the benefits which this work should confer upon the District supplied by it are not as fully made use of as they should be, and they suggest as a possible remedy that their powers should be somewhat enlarged by legislation. Mount Cameron Water-race.

It is a matter for regret that it has not so far been possible to obtain a small subsidy towards the establishment, at any rate in a humble way, of classes in some two or three of the principal mining centres, where miners may meet and be instructed in such matters as the determination of ores and minerals, the use of the blowpipe, assaying, mine surveying, and other subjects affecting the industry in which they are engaged. It is felt that in the interest of the Colony it would be true economy to facilitate the formation of such classes, and I would venture again respectfully to press the matter upon the consideration of the Government. Schools of Mines.

In conclusion, I submit that there is every warrant for asserting that the mining industry of the Colony is in a progressive condition, and it is in no way idle to predict that with the facilities which the anticipated new legislation will afford for ensuring that more attention shall be paid to *bonâ fide* mining than to scrip-broking and company-mongering, a great advance will be recorded at the end of the year upon which we are now entering.

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

F. BELSTEAD, *Secretary of Mines.*

The Honorable the Minister of Lands and Works.

APPENDIX.

No. 1.

COMPARATIVE Statement of Gold won during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, *and the first Half-year of* 1893.

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
1890	20,510	0	75,888
1891	38,789	0	145,459
1892	42,378	0	158,917
For the first half-year of 1893	18,436	0	69,135

No. 2.

RETURN showing the Quantity of Gold obtained from Quartz during the Years 1880, 1881, 1882, 1883, 1884. 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, *and the first Half-year of* 1893.

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
1890	17,829	„	64,184
1891	33,659	„	126,221
1892	34,386	„	128,947
For the first half-year of 1893	15,167	„	56,750

No. 3.

QUANTITY and Value of Coal raised during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, *and the first Half-year of* 1893.

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
1890	50,519	45,467
1891	43,256	38,930
1892	36,008	32,407
For the first half-year of 1893	21,918	17,926

No. 4.

COMPARATIVE Statement of Tin exported from Tasmania during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, *and for the first Half-year of* 1893, *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
1890	3209¼	296,368
1891	3235	291,715
1892	3174	290,083
Fer first half-year of 1993	1465½	131,563

No. 5.

RETURN showing the Number of Persons engaged in Mining during the years 1880 *to* 1892, *inclusive, and first Half-year of* 1893.

YEAR.	NUMBER.	YEAR.	NUMBER.
1880	1653	1887	3361
1881	3156	1888	2989
1882	4098	1889	3141
1883	3818	1890	2868
1884	2972	1891	3219
1885	2783	1892	3295
1886	2681	1893 (first half-year)	3304

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 1888.

Nature of Lease.	In force on 30th June, 1888.		In force on 30th June, 1889.		In force on 30th June, 1890.		In force on 30th June, 1891.		In force on 30th June, 1892.		In force on 30th June, 1893.	
	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	957	32,231	1497	53,251	1303	49,463	1495	67,216	1857	89,962	1547	71,279
For coal and slate, at 2*s.* 6*d.* an acre rent	41	6045	38	4499	51	7636	45	7255	47	6874	57	8963
Under "The Gold Fields Regulation Act," at a rental of 20*s.* an acre	285	2812	270	2687	325	3088a. 2r. 20p.	245	2366a. 2r. 10p.	489	4606	501	4801
Water Rights, Mineral and Gold	140	852 sluice-heads.	204	1005 sluice-heads.	209	950 sluice-heads.	200	998 sluice-heads.	173	812 sluice-heads.	185	890 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, 1892, issued during the Year ending 30th June, 1893, cancelled during the Year ending 30th June, 1893, and remaining in force on 30th June, 1893.

Nature of Lease.	In force on 1st July, 1892.		Issued during Year ending 30th June, 1893.		Cancelled during Year ending 30th June, 1893.		In force on 30th June, 1893.	
	NO.	AREA.	NO.	AREA.	NO.	AREA.	NO.	AREA.
		Acres.		Acres.		Acres.		Acres.
Under "The Mineral Lands Act," for tin, &c., at a rental of 5*s.* an acre	1857	89,962	671	31,044	981	49,727	1547	71,279
For coal and slate, at 2*s.* 6*d.* an acre rent	47	6874	21	4452	11	2363	57	8963
Under "The Gold Fields Regulation Act," at a rental of 20*s.* an acre...	489	4606	223	2096	211	1901	501	4801
Water Rights, Mineral and Gold	173	812 sluice-heads.	36	151 sluice-heads.	24	73 sluice-heads.	185	890 sluice-heads.

No. 8.

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

YEAR.	AMOUNT.			YEAR.	AMOUNT.		
	£	*s.*	*d.*		£	*s.*	*d.*
1880	8944	5	11	1887	14,611	11	5
1881	20,936	5	5	1888	23,502	8	4
1882	23,077	1	9	1889	17,254	9	0
1883	15,439	14	5	1890	26,955	4	9
1884	6981	11	10	1891	37,829	16	5
1885	11,070	5	7	1892	17,568	18	4
1886	12,523	10	4				

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	3	13,609	0	0	510	6	9
1891	3	35,200	0	0	1320	0	0
1892	6	47,248	15	0	1771	17	6
1893, first half of	4	22,737	10	0	852	13	2

No. 10.

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
1890.....	10	87,187 10 1	3269 11 1
1891.....	8	83,598 1 6	3134 0 0
1892.....	6	69,616 19 10	2610 12 11
1893, first half of	4	40,500 3 3	1518 15 1

No. 11.

RETURN of Dividend Tax paid by Silver-Lead Mining Companies.

YEAR.	NO. OF COMPANIES.	AMOUNT OF DIVIDEND.	AMOUNT OF TAX.
		£ s. d.	£ s. d.
1891.....	4	10,360 0 0	388 10 0
1892.....	3	9023 9 0	338 7 3
1893, first half of	—	—	—

(No. 50.)

MINE MANAGER'S EXAMINATION.

September 5th, 6th, 7th, 1892.

QUESTIONS SET.

Section A—MINING.

I. It is assumed that you are desired to sink a main shaft, containing one pumping and two winding compartments, the pumping compartment to provide a ladder way. The amount of ore to be brought to surface is 150 tons in 24 hours; water to be pumped, 6000 gallons per hour; depth of shaft, 600 feet,—

(A.) What size shaft and what size compartments would you recommend?

(B.) What size timbers would you use in hard or soft ground?

(C.) What engine power would you require for winding and pumping, and what size column would you use?

(D.) What distance would you lift the water with the draw-lift before you exchange it for the plunger?

II. How many tons of ore are there in a stope 120 feet long, 80 feet high, 4 feet 6 inches wide, assuming 15 cubic feet to the ton?

III. What precautionary measures would you take if you were driving a level in very soft country, and what kind of sets of timber would you use if the side pressure were very great? Illustrate your answer by a sketch.

IV. What mode would you adopt for filling in old stopes?

V. What appliances would you adopt for hauling stuff after your mine is getting too deep for hand labour, and, say, for a shaft 400 feet deep, and by what means would you bring it from the working face to the shaft?

VI. Describe in detail any one system of mine drainage you are thoroughly acquainted with.

VII. What different systems of mine ventilation are you acquainted with? Describe the system you consider the most efficient and practical.

VIII. If you were driving a level toward an old shaft full of water, what measures would you adopt for the protection of the lives of the miners engaged in the work?

IX. State your opinion as to the difference between the action of dynamite and gunpowder in blasting.

X. If an accident happened in a mine under your control, and a number of men were imprisoned by a fall of debris, what measures would you adopt to rescue them?

XI. What is the meaning of the following mining terms:—Winze, crosscut, crosscourse, rise, sump, stull, underlie, wind-bore, H piece?

XII. Which material do you prefer for a pump-rod, iron or timber? State your reasons for your answer.

XIII. Given a lode known to contain a large quantity of low grade ore, which under ordinary circumstances will pay working expenses, but requires extremely economical management to leave a margin for profit, state in outline the system you would adopt to work it profitably. (Note: the Examiners desire to know your ideas of economical mining.)

Subject B.—MINING GEOLOGY.

I. What is meant by the terms "*sedimentary*," "*igneous*," and "*metamorphic*" as applied to rocks? To which of these classes of rocks do the following belong:—Marble, freestone, basalt, granite, mica-schist, diorite, slate?

II. What is a lode? Give shortly your views as to how lodes have originated.

III. Explain how deposits of alluvial tin ore have been formed.

IV. What minerals are most commonly found associated with *galena*, *cassiterite*, and *gold*?

V. What is a *gossan*? Explain how it is formed.

VI. Describe physical characters and tests by which you would recognise the following minerals:—Carbonate of iron (siderite), copper pyrites, cinnabar, stibnite, blend, chromic iron ore, wolfram, pyromorphite, gypsum, magnetite.

VII. Explain Schmidt's rule for the recovery of portions of lodes cut off by faults.

VIII. Explain the terms "stockwork," "dyke," "deep lead."

Subject C.—MINING SURVEYING.

I. Describe the method you would employ in surveying the workings of a mine worked from a single vertical shaft, to insure that the bearings under-ground should be to the same meridian as those on the surface.

II. In magnetic surveying underground what is the best method of obtaining correct bearings when there is much iron in the vicinity of several of the stations? Give an example showing how the erroneous bearings may be corrected.

III. A crooked winze connecting two parallel levels has been traversed by means of four lines, A, B, C, D, whose bearings, length measured on the slope, and angles of inclination to the horizon are as follows :—

Line.	Bearing, and direction of dip.	Distance measured on slope.	Angle of inclination.
A.	S. 10° W.	20 feet	65°
B.	S. 20° W.	25 feet	70°
C.	S. 5° E.	30 feet	75°
D.	S. 10° E.	32 feet	67°

what is (i.) the horizontal distance apart of the levels?
„ (ii.) the vertical distance between the levels?
Describe the instruments you would use in such a winze for taking the bearings and angles of slope of the lines.

IV. Plot the following traverse (i.) by angular protraction; (ii.) by co-ordinates, using any convenient scale not less than three chains to an inch :—

No. of Line.	Bearing.	Length of Line.
1	281° 40′	408 links.
2	167° 05′	683 „
3	210° 16′	795 „
4	72° 30′	580 „
5	134° 41′	483 „
6	27° 46′	1012 „
7	326° 55′	830 „
8	239° 26′	309 „

V. In chaining over steep hilly ground what precautions must be used to ensure accuracy.

VI. Give an example of entries in a level-book for an imaginary section along a piece of surface work, and plot or draw same on paper to any convenient scale.

Section D.—ORE-DRESSING AND SAMPLING.

I. What questions would you consider previous to erecting an ore-dressing plant in a mine under your charge?

II. What style of plant would you adopt under either of the following circumstances?
(*a.*) The ore is finely disseminated throughout the gangue.
(*b.*) The ore is mixed with the gangue in coarse veins.

III. When the ore is reduced to the size you consider necessary for treatment, what is the first process it should undergo?

IV. What steps would you take to ascertain the loss of ore after it has passed through your ore-dressing machinery?

V. How would you take a sample from a heap of, say, sixty tons of ore?

VI. Do you consider any other machine superior to the ordinary stamper for fine crushing? If so, describe it.

Section D.—SURFACE WORK.

I. A tramway embankment crosses a gully six (6) chains wide; it is 8 feet wide on top, and has slopes of $1\frac{1}{4}$ to 1; it is 1 foot deep at one end; 10 feet deep at 1 chain from last; 11 feet deep at 2 chains; 12 feet deep at 3 chains; 10 feet deep at $3\frac{1}{2}$ chains; 4 feet deep at 5 chains; and 2 feet deep at other end or at 6 chains. How many cubic yards are there in embankment, the cross-sections of ground being level?

II. In order to stop a flow of water into the workings of a mine a dam is constructed across a tunnel, and the water is allowed to accumulate behind the dam until it reaches a shaft 500 feet away and rises 10 feet up such shaft. The tunnel is 4 feet by 6 feet, and grade from dam to shaft is 1 in 50. What is the pressure of water against the dam?

III. A beam breaks with a load of one ton hanging from centre. What load, evenly spread over same beam, would break it?

IV. Required the horse-power to drive a thirty-head of stamps,—lift of stamps, 10 inches; weight of each stamp, 850 lbs.; number of drops per minute, 90.

V. A steam piston of four-feet stroke has an initial steam pressure of 70 lbs. per square inch cut off when the piston has completed one-fifth of the stroke. What will be the pressure when the stroke is completed?

VI. A safety valve is loaded to 75 lbs. per square inch by a direct weight of 454 lbs. How much would you take off to reduce the pressure to 62 lbs. per square inch?

Section E.—BOOK-KEEPING.

1. Make specimen pages of a day-book and ledger, showing examples of the manner in which you would enter up items of expenditure for wages, fuel, mine supplies (candles, tools, explosives, &c.), plant, and repairs to machinery in a mine.

SECTION F.—MINING LAW.

1. An accident having occurred to a miner in a mine whereby he is injured or killed, what is the duty of the Mining Manager under "The Regulation of Mines Act, 1891"?
2. What are the provisions of "The Regulation of Mines Act, 1891," with regard to keeping plans of mines?
3. What safety appliances are required by "The Regulation of Mines Act, 1891," to be used in connection with raising and lowering men in shafts by the aid of machinery?
4. What books are required by the above Act to be kept by a mining manager?
5. Describe the steps necessary to be taken in making application for a mineral lease.
6. State how a Section *held under lease* under "The Mineral Lands Act" should be marked.
7. Describe mode of marking off a "lessee's timber reserve."

MINE MANAGER'S EXAMINATION,

6th, 7th, and 8th March, 1893.

QUESTIONS SET.

SECTION A.—MINING AND ORE-DRESSING.

1. In taking charge of a mining property of, say four hundred acres, which contains a valuable lode already proved to be productive to a depth of 2000 feet, and having an average underlie of about one in ten—
   - (*a*) What system would you recommend for working?
   - (*b*) Where would you place the main shaft, or the shafts, in case of more than one?
   - (*c*) How would you lay out your stopes?
   - (*d*) What drainage system would you adopt?
2. What means would you employ to find the lode again should you have lost it through a disturbance of the strata?
3. What timbering would you adopt, (*a*) when the principal pressure is downward, and (*b*) when it is side pressure?
4. What impurities would you expect to find in the air of a badly ventilated part of a metalliferous mine, and how would you determine their presence? What precaution against injury by foul air would you adopt before entering a disused shaft or winze?
5. What is understood by the term "Hydraulic Mining," and when is this system of particular value?
6. Describe the best and cheapest method to prospect for the continuation of an alluvial lead before sinking the shaft. When the nature of the ground and depth of lead is ascertained, what is the next step, and what is necessary to prepare for the proper working of the mine?
7. Write a specification for sinking a 12′ 0″ × 4′ 6″ shaft 100 ft. perpendicularly from surface in fair working ground, and opening out to the lode at that depth, the lode being 30 ft. distant. The specification to include sizes of all timber necessary for the completion of the work.
8. Under what conditions would you recommend the adoption of Rock-drilling machinery for sinking $\frac{\text{and}}{\text{or}}$ driving?
9. Describe the square set system of timbering adopted in some mines where the lodes are large.
10. Is a process known to you by which durability of timber is increased? If so, explain it.
11. How would you treat dynamite which has become frozen?
12. Describe the arrangements you would adopt in winding—(*a*) To prevent over-winding; (*b*) to prevent the cage falling in the event of the rope breaking. What ratio would you observe between the diameter of the pit-head pulley and the diameter of the wire-rope working over it?
13. Would you subject the ore coming from a silver-lead mine all to one process to effect the separation of the ore from the gangue, or would you treat the ore in different ways? Give your reasons for what you recommend, and state what machinery you would employ.
14. What steps would you take to ascertain the loss of ore in the process of dressing without employing scientific means? How would you take samples to secure an average of such loss?
15. What machinery do you prefer in each case for crushing, grinding, and pulverising? State your reason for your answer.
16. What minerals are most difficult to eliminate in the dressing of—(1) Tin ore; (2) Galena? What are the most refractory in the amalgamation of gold?
17. What is a Spitzkästen, and how does it operate?
18. Describe in detail any one slime-dressing appliance you are acquainted with.

Section B.—MINING GEOLOGY.

1. Explain the terms *Dip*, *Underlay*, *Strike*, and *Outcrop*, as applied to lodes; also *Gossan*, *Syncline*, *Anticline*, *Strata*, *Dyke*, *Breccia*.
2. Describe the following kinds of rock:—*Dolerite*, *Schist*, *Quartzite*, *Granite*, *Dolomite*, *Diorite*, *Gneiss*, *Freestone*, *Slate*, *Quartz*, *Porphyry*.
3. How would you classify the various sorts of ore deposits? Define each class, and give examples.
4. Give briefly your views as to the mode of formation of fissure lodes.
5. What is the composition of each of the following ores:—*Wolfram*, *Cassiterite*, *Siderite*, *Cinnabar*, *Galena*, *Embolite*, *Stibnite*, *Hematite*, *Cerussite*, *Pyromorphite*, *Copper Pyrites*, *Malachite*, *Blende*, *Pyrolusite*, *Ruby Silver*, *Molybdenite*?
6. What is a *Deep Lead*? Explain how Deep Leads are formed.
7. What useful minerals are most commonly found as stratified deposits?
8. Explain the formation of alluvial "Terraces" or "Terrace Drifts."
9. What rock formations are most prolific in useful metallic minerals?

Section C.—MINING SURVEYING.

1. A shaft A is 432 feet N. 73° 30′ W. of another shaft B: both A. and B. being vertical shafts. From a point C underground a cross-cut is to be driven straight to shaft A. The traverse connecting B and C is as follows:—

   From B, line 1, bearing 195° 15′, distance 80 ft. 4 in.
   „ 2 „ 270° 45′ „ 120 ft. 0 in.
   „ 3 „ 284° 30′ „ 176 ft. 6 in.
   „ 4 „ 289° 15′ „ 153 ft. 6 in., to C.

   What is the distance from C to A, and what should be the bearing on which the cross-cut is driven?
2. Points A and B in two different levels in a mine are connected by the following traverse through stopes, the distances being measured on the slope:—

   From A, line 1, bearing 102° 00′, distance 20′ 6″, on slope of 32° 00′
   „ 2 „ 152° 20′ „ 26′ 3″ „ 50° 30′
   „ 3 „ 87° 45′ „ 32′ 9″ „ 27° 00′
   „ 4 „ 110° 30′ „ 23′ 0″ „ 42° 00′, to B.

   What is—(i.) The distance from A to B on the plan of the mine?
   (ii.) The bearing of the line connecting A and B?
   (iii.) The vertical distance between the two levels?
3. The underlay of a reef is 1 in 6. What is its angle of dip?
4. How would you proceed in surveying underground workings in order to ensure that the bearings taken in the mine should be to the same meridian as those on surface, supposing that the only entrance to the mine is through a single vertical shaft?
5. Two levels on a quartz reef are 50 feet vertically apart. How many tons of quartz are contained in a block 100 feet long between these levels, the average thickness of the reef being three feet, and its underlay 1 in 3?
6. Give longitudinal section for a tramway-cutting, on a grade of 1 in 33 (assuming lengths and levels). Give three cross sections on same for tramway 10 feet wide, and with 1 to 1 slopes, the slope of ground being at an angle of 22½ degrees. Give example of level-book from which sections given could be plotted.
7. Explain method of laying out a curve with a radius of 5 chains, and give calculations.
8. Describe method of laying out a water-race with spirit-level for a fall of 5 feet per mile.

Section D.—SURFACE WORK.

1. What is the horizontal thrust against a reservoir dam 100 feet long, with a depth of 10 feet of water against the dam? Shortly describe construction of dam, both for a rocky gully and for an alluvial bottom in forest land.
2. A pipe, 12 inches inside diameter, has a fall of 264 feet, then rises 132 feet and again falls 400 feet. What is the pressure per square inch at bottom end when pipe is full of water?
3. State some of the conditions which good winding-engines should fulfil, and which modern winding-engines have succeeded in fulfilling?
4. What weight will a pair of steam-engines lift (non-condensing)—steam pistons, 11 in. diameter; stroke, 14 in.; pinion-wheel on crank-shaft, 13 in. diameter; spur-wheel on winding-drum shaft, 4 ft. 2 in. diameter; winding-drum, 4 ft. diameter; steam pressure, by gauge, 45 lbs. per sq. in.; allow 25 per cent. for friction.
5. A mining safety-cage and ore weighing 2 tons has to be drawn from a mine 327 feet deep in 10 seconds; what effective horse-power will be required; allow 15 per cent. for friction?
6. Two seams of ore are to be worked and raised from two different levels in the same mine-shaft; the drums for both levels are to be on the same winding-gear shaft; the one level is 186 ft. deep, the other is 225 ft. deep; both ropes to be coiled in 15 revolutions of the drum-shaft: what will be the diameter of each drum, the drums to be of the spider construction, flat ropes 1 in. thick?

7. A steam-engine, when pumping from a depth of 375 feet, indicated 1380 horse-power; the efficiency of the engine was ·8, and the pump ·85. What will be the delivery in gallons per second?
8. What do you understand or mean when you quote absolute steam pressure upon a safety-valve or steam-piston.

Section E.—BOOK-KEEPING AND MINE ACCOUNTS.

1. What books do you think necessary to be kept by a mining manager in charge of a mine for the proper keeping of the mine accounts? Make specimen pages of each, showing the form in which you would enter the various items.

Section F.—MINING LAW.

1. What is the duty of a mining manager under "The Regulation of Mines Act, 1891," in the event of a workman being seriously injured by an accident in the mine of which he has charge?
2. What are the provisions of the above Act with regard to ladder-ways in shafts?
3. What safety appliances are required by law to be employed when men are raised and lowered in shafts by means of cages?
4. What books are required by the above Act to be kept by the mining manager of a mine?
5. What are the regulations as to storage and use of explosives in mines?
6. What is the duty of any employé in a mine who may discover any appliances or part of the workings to be unsafe?

REPORTS OF COMMISSIONERS.

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

The revival of mining industry on the Lefroy gold-field, to which I alluded in my last annual Report as causing great excitement at Lefroy, has during the last twelve months proved to have been genuine, and results have fully justified the expectations then formed. The two principal mines on the reefs known respectively as the "New Pinafore" and "Volunteer" have been supplemented by two others on the same lines of reef, which up to the present afford promising indications. The undertaking in search of a deep alluvial lead, by means of one of the Government diamond drills, succeeded in putting down four bores, the last proving the existence of a "wash" of over 3 feet in thickness and of satisfactory character; but the operations ceased without further proof as to its auriferous nature for want of the requisite capital to sink a shaft on the spot. The undertaking which I formerly reported as commenced ostensibly for the purpose of deep sinking on the Chum line of reef, and which excited strong hopes that at length this once rich reef would be tested at a depth never before attained at Lefroy, has not resulted in any attempt at deeper mining than had already been accomplished. The yield of gold from Lefroy for the past twelve months was 15,548 ounces, value £60,200. The quantity for the previous year was 14,219 ounces, which shows a satisfactory tendency. There are at present 38 men engaged in prospecting on the field. **Lefroy.**

The returns of gold yield for Beaconsfield for the past twelve months would, *primâ facie*, indicate an exhaustion of its supply, but the circumstance is entirely owing to the temporary, though long protracted, suspension of actual work on the lodes of the Tasmania mine, which has hitherto constituted the chief factor in the gold production of the Colony. The work for the last twelve months has principally consisted in "dead work," sinking the main shaft to a depth sufficient for an extensive development of the mine before resuming the actual work on the lodes, and these preliminary works will yet occupy a further space of two or three months. The enterprise of the Ballarat Association in testing the auriferous character of the deep alluvial formation along the eastern base of Cabbage-tree Hill, which had sunk a shaft 420 feet through hard rock, and proceeded to drive to the alluvial channel, was stopped by an influx of water when within some 100 feet of the formation. This necessitated the acquisition and erection of powerful pumping machinery, and this work was completed several weeks ago; but the water is very slowly yielding to the operation. And thus has been retarded the solution of a question of great interest and importance. **Beaconsfield.**

There are two other undertakings at Beaconsfield in an incipient stage, one of which, if carried out, will be of very great importance to Beaconsfield. An Association has been formed to bring in water from Supply River, a distance of about eight miles, in sufficient quantity to treat, by the mode of ground-sluicing, a large tract of auriferous country, not payable by the ordinary process and under the deficiency of water. The other project is by a company formed to treat the "tailings" and *detritus* which have for a number of years past been discharged from the battery of the Tasmania G. M. Co. into the mouth of the Middle Arm Creek and onwards into the west arm of the Tamar, forming extensive mud flats covered by the sea at high water. Competent examination of the matter is said to have revealed the presence of sufficient pyrites and free gold to justify the project.

The failure of the sometime hopeful field of Middlesex Plains has recently been succeeded by the discovery of many very rich auriferous spots in the neighbourhood of "Bell Mount," about 20 miles S.W. from Sheffield. There are now about 60 men on the field, 40 of whom are said to be making about £3 a week each on an average, some of them making from £5 to £6. Some 10 or 12 miles further to the S.W., at the base of Mount Stormont, another discovery of gold is reported. **Middlesex and Bell Mount.**

The once extremely rich gold field of Lisle, after many years of all but abandonment, has recently undergone a partial revival, finding employment for some 50 men, who are reported to be making from £2 to £3 a week. **Lisle.**

Commissioner O'Rielly, in charge of this Division, reports as follows upon the state of mining in the North-Eastern Mining District:— **North-Eastern Division.**

Although the prospects of the Mount Victoria Gold-field have not advanced during the past year as anticipated they would at the time of my last annual report, yet, on the whole, there are grounds on which to look forward for a material improvement during the coming year. Experienced miners hold faith in its future advancement, and a good deal of steady mining and prospecting work is being done by them. The Mount Victoria Company's claim is let on tribute to three parties of tributors, in all 15 men, whose industry and venture will, it is to be hoped, be amply rewarded with successful and profitable returns from their crushings. **Mount Victoria.**

At Mount Horror and Branxholm a good deal of *bonâ fide* mining work has been done during the past year, and on the whole the claims give fair promise of moderately remunerative returns. **Mount Horror & Branxholm.**

The Derby Gold Mining Company have for several months kept their battery in full work; the returns from their crushings, although not rich, yet pay small dividends, and are considered satisfactory.

Four of the claims held in these localities have been let to mine on tribute, but there has not yet been time to have any crushings made from them. A good deal of preparatory work has been done, and a quantity of quartz raised and stacked ready for crushing.

There are four claims on which no work is being done at present.

On the whole the prospects of these localities appear hopeful and satisfactory, and a large increase in the quantity of gold won may be looked for during the coming year.

Waterhouse.

At Waterhouse, mining operations are not carried on at present. It is much to be regretted that this gold-field has been so long neglected, for it does not appear to me to have had as yet a fair trial during the past. I have no doubt that it would well repay those who would invest a moderate sum in prospecting there.

Quartz crushed	2908 tons.
Gold won	1541 ounces.
Average number of men employed	75

There has been an increase of 1441 ounces of gold won during the past year over the quantity raised during the previous year.

Upper Cascade River, Ringarooma, and Mount Maurice.

The state of mining in the localities of the Upper Cascade River, Ringarooma, and Mount Maurice remains in about the same condition as described in my last annual Report. I cannot look forward to any improvement or enlargement in the extent of mining operations in these parts of the District, as the known richest deposits are pretty well worked out. Some few claims have been taken up under Miner's Rights, the prospects being considered very good. But little is being done at Mount Maurice: the deposits of tin ore there being poor. The late fall in the price of tin will render mining in this locality unprofitable. I am not aware of any steps being taken during the past year to mine the tin lodes on two of the claims in the Cascade River locality. About 20 Europeans and 30 Chinese are engaged in mining on 20 claims.

Branxholm.

I cannot report any material improvement in the state of mining in the Branxholm locality during the past year, the number of men engaged in mining being about the same as in the previous year,—viz., 44 Europeans and 47 Chinese. The "Arba" claim is mined by 17 Europeans on wages, and continues to yield satisfactory returns of tin ore. Considerable enterprise has been exhibited in the development of this mine during the past year, a tunnel having been constructed through granite rock for some distance, at a heavy cost, as a tail-race to enable the mine to be worked at low levels without the necessity of lifting the wash-dirt by machinery, and thus ensuring economy in the cost of producing the ore. I understand that the most modern hydraulic mining appliances for raising tin ore will soon be provided for this claim. The "Ormuz" Company's mine is now worked by a party of tributors, and so far as I could learn in my visit there a few weeks since, they were quite satisfied with the yields, and doing very well.

The "Ruby Flat" claim is mined by a party of 43 Chinese, who have, during the past quarter, raised 21 tons of tin ore. The yields from several small claims in this locality are considered satisfactory.

Brothers' Home.

A considerable extent of mining has been done at "Brothers' Home" during the past year in the principal claims, and a large output of tin ore secured, the yields being considered very good. About 160 European miners are employed on wages.

The "Krushka Brothers," the first claim mined in this locality, continues to produce large yields of tin ore, and from present appearances will continue to do so for many years.

Main Creek, Moorina, and Wyniford River.

The state of mining on the Main Creek, Moorina, and Wyniford River localities remains in about the same state as described in my last annual Report. There are but a few claims mined at the Weld River, and also the Frome River, the yields from which are reported remunerative. At Main Creek but two claims are worked at present, which yield fairly good returns. In the Wyniford River locality there are eight claims mined, principally by Chinese. The "Garibaldi" mine still continues to produce a large output, being mined by a party of Chinese, 30, on tribute.

Bradshaw's Creek.

The "Pioneer" claim at Bradshaw's Creek is partly mined on tribute by Chinese, and also by European miners on wages. The prospects of this mine remain very good, there evidently being a considerable extent of good wash or deposit to operate on, and extensive preparations are being made by new appliances to raise the ore in a more economical manner than done in past years.

Mount Cameron.

There are now 46 claims mined in the Mount Cameron district, which produce a large output of tin. Most of the above claims are held by working miners and mined by their own labour, the large claims held by companies being mined on tribute, principally by Chinese. About 57 Europeans and 116 Chinese are engaged in the above occupations.

Mining for Tin under Miners' Rights.

There are 21 Europeans and 14 Chinese raising tin ore under Miners' Rights in the Mount Cameron part of the district who have won about eight tons of tin ore during the past three months. So far as I can learn, the privileges thus conferred for mining have worked very well here, and will in the course of the coming year be more largely availed of throughout the district, and thus tend to have the mineral lands more thoroughly prospected, the quantity of tin ore raised considerably enlarged, and the mining population much increased.

Mount Cameron Water-race.

It is much to be regretted that the Mount Cameron Water-race Board are prevented by Section No. 3 of the Act 52 Vict. No. 23, from supplying water free of charge, so long as there is surplus water flowing to waste, to miners engaged in prospecting operations, as was done previous to that measure being enacted. This restriction of the action of the Board appears to me to be a "heavy blow and great discouragement" to the best interests of the Board financially, and also to the progress and prosperity of the mining industry in the locality.

There has been for some time a quantity of surplus water flowing to waste from the race that would be used in prospecting operations if granted as formerly by the Board, and thus would new discoveries of payable deposits of tin ore be made which would bring about an enlarged demand for the water, and consequently increased revenue to the Board.

In consequence of the charge of ten shillings per head of water being now made, prospecting operations have, except in very few instances, ceased to be carried on, the cost being made too heavy thus for such work; but few, if any, new claims are being opened up, and as the old established claims are gradually worked out the Board will experience a considerably reduced demand for the water, with a materially lessened revenue. I would beg leave to recommend that the Hon. the Minister of Lands and Works be requested to introduce a measure to Parliament with a view to repeal the section of the above Act referred to, and also that the Board should be allowed more power in regulating the scale of charges for the use of the water.

It appears to me that the future financial success of this costly public work will very much depend upon the above amendments in its legislation being sanctioned and given effect to.

Number of Claims mined and Men employed.

There are about 100 claims mined in this district, principally on tribute, some few on wages by Europeans, and also by lessee working miners; the average number of men employed being 300 Europeans and 370 Chinese, which shows an increase of 50 European miners over the number employed during the previous year, and a decrease of 5 Chinese for the same period.

Considering the large extent of land, in the whole, now under lease, the number of men employed appears small, and shows that in several instances the labour conditions are entirely disregarded by lessees. Although it appears to me desirable, this is a difficult matter to reform, for indiscriminate forfeiture under such circumstances would in some cases impose a hardship, and have a baneful influence eventually on the best interests of mining.

Tin Ore raised.

The total output of tin ore from the North-Eastern Mining District for the year ending 30th June, 1893, amounts to 1730 tons 5 cwt., being an increase of 25 tons 11 cwt. over the previous year's yield, and an increase of 75 tons 4 cwt. over the quantity raised during year ending 30th June, 1891.

Taking into consideration the general depression that has prevailed throughout the Colony during the past year, and the scarcity of capital for investment in mining pursuits, the yield for the past year of tin ore is very satisfactory.

I think from the above that it may be fairly stated that a great deal of sound and legitimate mining work has been done during the past year, and that the prospects of the future are hopeful of permanent and steady progress.

Eastern Division.

Mr. Commissioner Dawson reports:—

I have really nothing very special to report as to mining in general in this disirict.

Tin.

Lottah.

The Anchor mine is arranging for working upon a more extensive scale, but it will be some time before the arrangements are complete.

Ben Lomond.

There is much prospecting going on in this locality, and practical miners are of opinion that there is a great future before this field. The developments at Rix Hill promise to be of very considerable importance.

Brookstead and Roy's Hill.

Some developments are taking place here, and a considerable output of tin may shortly be looked for.

Miners' Rights.

Applications to mine for tin under Miners' Rights have not been numerous up to date.

Gold.

Mathinna.

This gold-field continues to hold its own. There is a good deal of prospecting done in this district.

Coal.

Mount Nicholas and Cornwall.

These mines continue to put out much about their usual quantity. During the last few months there has been a slight increase.

Seymour.

The company at work here have gone to considerable expense in constructing a tramway and erecting a jetty to facilitate the loading of coal, and several shipments have been made. The quality of the coal is about the same as that at Mount Nicholas.

Remarks.

Without being too sanguine, I am of opinion that throughout my district we have arrived at a stage which may fairly be called "legitimate mining." Men are now realizing the fact that they must be satisfied with reasonable wages. The days for bogus mining are, I am glad to say, a thing of the past.

North-Western Division.

Mr. Registrar O'Neill reports:—

The Mount Bischoff Tin Mining Company's mine continues its regular output.

Tin.

The West Bischoff mine is in full work, and the yields are satisfactory. The Stanhope mine is also turning out fair average results.

Some work is being done in alluvial Tin in the vicinity of the West Bischoff and Stanhope, with good results. The Phœnix Alluvial has ceased work in consequence of the large percentage of pyrites.

A fair amount of tin is being raised at Mount Balfour.

Silver.

The Godkin mine is in work, but are not sending away ore.

The Heazlewood is in work and raising ore, but with what results I am not in a position at present to say.

The Washington mine has ceased working owing to want of funds. The management of this mine informs me that a short time ago they were negotiating with a Melbourne syndicate to work the property, but, owing to the present low price of silver, nothing definite has been reached.

At the Silver Cliff mine ore is being raised, with very satisfactory results.

The general opinion here is, that to develop and work the Heazlewood silver-field a very large capital is required, and that is what the proprietors of the different mines on the field have not. The public here are not sanguine as to the future of the field, unless large capital is brought to bear.

Gold.

At the Castra Gold Mine some crushing has been done, but with poor results.

In alluvial gold mining fairly good results have been obtained in the vicinity of Long Plains; but at Heazlewood, Castra, and also, I am informed, at the Hellyer, the different prospectors have met with but indifferent success.

Western Division.

Mr. Commissioner Fowell, in charge of this Division, says:—

Considering the progress of the Mining industry in this district during the past year, it is satisfactory to note that in spite of the general depression still existing in this and the neighbouring colonies, the

Zeehan.

principal mines at Zeehan have continued to carry on their work of development with highly satisfactory results.

Concentrating machinery has been introduced and worked upon five of the mines, and the Western mine will soon have completed a very large plant of the same nature.

That satisfactory results obtained at the mines are proved at a depth bear out the fact as to their being true fissure lodes.

Dundas.

At Dundas it is much to be regretted that, in consequence of the inefficiency of the pumping machinery on the principal mine, development is retarded, which would have been avoided had the money which has been spent to no purpose in endeavouring to overcome the water been laid out in the first instance in obtaining suitable machinery.

Heemskirk.

It is satisfactory also to report that the revival of prospecting for tin about Mount Heemskirk has continued during the year, and two claims, the New Cumberland and West Cumberland, give promise of being worked immediately.

North-East Dundas.

At North-East Dundas alluvial tin has been discovered, and is likely to give employment to a considerable number of men.

There is also a lode upon the Commonwealth Company's ground which is reported to be rich in mineral.

This portion of the district is in great need of a railway or tramway, and cannot be developed without.

Mount Lyell.

The great event of the year has been the placing beyond a doubt the richness of the deposit at Mount Lyell.

Dr. Peters' careful examination and world-wide reputation is a guarantee of the great value of this portion of the district. Not only is the deposit of value in itself, but the working of it will cause the opening up of the neighbouring portion, which, without it, might have remained dormant for years.

Queen River.

Gold mining has somewhat revived in the neighbourhood of the Queen River. Upon the lease originally held by the Princess Gold Mining Company two crushings of 80 tons each have yielded satisfactory results.

There is a vast tract of country in the southern portion of the district to be prospected. Of its great mineral wealth an idea cannot yet be formed, but that there is a great future before it I have not a doubt.

REPORT OF THE CHIEF INSPECTOR OF MINES.

Inspector of Mines Office, Launceston, 4th July, 1893.

SIR,

I HAVE the honor to forward to you my Annual Report as Chief Inspector of Mines for the year ending 30th June, 1893.

Mining Accidents.—I regret to have to report an increase in the number of mining accidents recorded, 29 persons having been injured or killed, as against 19 in the previous year and 27 in the year ending 30th June, 1891. Of the 29 persons 4 were killed, 11 seriously injured, and 14 slightly injured. Some of the latter cases need not have been reported at all, as the Regulation of Mines Act, 1891, only requires accidents attended with serious injury to any person to be notified to the Inspector of Mines; but mining managers very properly prefer to report even trivial accidents rather than run the risk of being held accountable for not giving notice of them, as apparently trifling injuries sometimes develope serious results later on.

The causes of accidents come under the following headings :—

Falls of Rock, Coal, and Timber in Workings.—"Falls of earth" are generally the commonest cause of mining accidents, and last year 11 persons were injured by them—1 Chinese and 5 Europeans seriously, and 5 Europeans slightly. Four of the serious accidents occurred to men working in shallow alluvial ground, while three, which occurred in underground workings, were hardly worth recording. The number of accidents every year in shallow alluvial claims shows that men are less careful in them than when working underground.

Falls down shafts and winzes.—Two fatal, 1 serious, and 4 non-serious accidents are attributable to this cause. One of the fatal accidents was due to foul air, which caused the man to fall from the windlass bucket, and need not have occurred if ordinary prudence had been exercised by the deceased. The other fatal accident was primarily due to imprudence on the part of the man killed in attempting to traverse the mine without a light; whether he fell from the ladders while descending the shaft, or tripped and fell into it from the plat, is, however, unascertainable. A boy broke his leg by falling from a ladderway, but could not tell how he came to lose his hold. Two of the non-serious accidents arose from using the windlass and rope instead of the ladderway, contrary to the Regulation of Mines Act, Section 19, Sub-section xxi. : the men were therefore themselves to blame.

Falls of material down shafts.—Two men were killed while sinking shafts at Zeehan by timber falling upon them. In both cases much carelessness was exhibited by the workmen engaged, and the management of the mines also is not free from blame, as no attempt had been made to provide a pent-house, as provided by Section 19, Sub-section xviii. of the Act.

Explosions.—Two serious accidents resulted from explosions, and one man was also slightly injured. Using undue force in charging holes with rack-a-rock was in each instance the cause of the accidents, and the injured men have only to blame their own folly for their hurts.

Fall from a quarry.—One man sustained a severe shaking by falling from the top of a quarry at Mount Bischoff. A rope was provided as a safeguard, but he threw it off for a time, as it was in his way, and while thus unprotected stumbled or stepped by inadvertence over the face.

Truck Accidents.—Two men sustained broken limbs, one by being thrown from a truck which had got out of his control going down an incline, and the other by being struck by a truck which had got away on an underground incline.

Fall of a Derrick.—One man got his leg broken by a derrick falling upon him while being lowered. There was much carelessness on someone's part in this affair, but after making enquiry I could not get satisfied as to whether the injured man or his mates were to blame, and gravely suspect that I was not able to get at the truth of the matter.

Caught in Gearing.—One man lost portion of the fingers of his left hand from this cause.

Breaking of a Rope.—While taking down some machinery one man received slight injuries by the breaking of a rope.

It is satisfactory to note that with the exception of the fatal accidents through falls of materials down shafts the accidents are generally such as could not be prevented by greater care and supervision on the part of the managers of the mines, and are either unavoidable mishaps or else due only to want of prudence and foresight on the part of the sufferers.

Observance of the Provisions of the Regulation of Mines Act, 1891.—While this Act is in general well observed, there are some portions of it which do not receive sufficient attention; viz.—

Section 8, which provides for the names and addresses of mining managers being registered. This is almost totally disregarded by owners and secretaries of companies in spite of frequent reminders, and it begins to seem necessary that legal proceedings should be taken if this section is not to become a dead letter.

Section 14.—This section is not complied with as strictly as it ought to be, though there is great improvement as compared with former years. The acceptance of plans of the mines made by mining managers who have obtained certificates of competency under the Act has led to much greater attention being paid to keeping the surveys up to date, and has relieved several companies of the expense of employing an authorized surveyor twice a year or oftener.

Section 19, *subsection* II.—In going through the mines I have frequently had to comment upon loose observance of the regulations as to storage and handling of explosives. The carelessness of miners in leaving dynamite and detonators lying about loose is very reprehensible, and sure sooner or later to lead to bad accidents. Warnings, however, seem to be thrown away on many miners, and stronger measures may have to be resorted to.

Subsection XVIII.—It has been very generally overlooked by managers of mines that they are bound by this to provide cover overhead to men engaged in sinking shafts wherever it is possible to do so, and, as above said, two fatal accidents have resulted from neglect of this precaution.

Subsection XXI. This is another section which the Inspectors find themselves continually compelled to draw attention to, it being constantly overlooked that the rope and bucket are not a permissible means of ascending and descending in shafts, and that ladders must be used even in small prospecting shafts and winzes (subsection XLI).

Subsection XLIII.—The books required by the Act are often not kept as they should be, the mining manager's diary being often made to serve all purposes. This, however, is being gradually put right. It is often forgotten that a copy of the whole Act must be kept at the mine as well as one of Section 19.

The Inspectors have been trying to remedy the above shortcomings by drawing attention to them whenever observed, and hope before long that no mining manager will be able to plead ignorance of the provisions of the Act in palliation of breaches of its observance. As the present Act has only been in force for a year and a half, it has not been thought desirable to institute prosecutions in many cases where slight offences against it have occurred.

Complaints from Miners.—Only one complaint has been received by me from a miner working in a mine as to the bad state of the workings: this was a complaint as to the ventilation. On examination I found that in one part of the mine the ventilation was rather poor, but that steps were being taken to remedy it as fast as possible under the circumstances, and that the mine was in general well ventilated.

Mines visited.—Owing to pressure of work as Geological Surveyor I have not been able to go round all the mines in my district during the year, but have visited as many as circumstances would permit, and have found them on the whole in good and safe condition.

Mr. Harrison, Inspector of Mines at Zeehan, will forward his report on the West Coast mines separately.

I have, &c.

A. MONTGOMERY, *M.A.*, *Chief Inspector of Mines.*

The Secretary of Mines, Hobart.

REPORT OF THE INSPECTOR OF MINES AT ZEEHAN.

1*st July*, 1893.

SIR,

I HAVE the honor to forward you my Report on the working of the Regulation of Mines Act during the last twelve months.

Accidents. There have been ten accidents reported to me during this time; three of them, I am sorry to say, proved fatal; in each case it happened to men engaged in shaft sinking.

Ventilation. The ventilation of the mines in most instances is very good, and in no case can it be called bad.

Machinery. There are now about 25 mines worked by machinery. They are mostly new plants, and the managers seem anxious to keep them in as good order as possible. There are also a large number of mines being worked by adits and shallow shafts. All engine-drivers on the field are now compelled to hold certificates. This rule must give satisfaction to both proprietors and miners, as it prohibits ignorant and unsteady men from taking charge of machinery.

Safety appliances. Cages and ropes have been submitted to practical tests at various times during the year. One rope was condemned.

Magazine. Explosives stored in magazine are clean and in good condition.

Prosecutions. Proceedings were taken against two miners working in the Western Mine for neglecting to report an accident to the mining manager. The case fell through, as the Bench decided it was not the duty of the men to report, as they were working for a contractor. Proceedings were also taken against the manager of the Tasmanian Crown Mine for neglecting to have his shaft fenced off at the adit level. A verdict was obtained against him, which was appealed against and thrown out upon technical grounds owing to an informality in the information.

General remarks. This field has made rapid strides during the last six months; fresh finds are being made in nearly all directions. The falling off in the gold returns from the Ring River District will be far more than

equalised by the increased output of tin from the Heemskirk and Dundas fields, while the very satisfactory manner in which the bottom levels of the principal silver mines are opening up points to the permanency of the district.

I wish to express my thanks to the Secretary of the Miners' Association for the assistance rendered me, also to the managers who, in nearly every instance, meet me in a courteous spirit.

I have, &c.

J. HARRISON, *Inspector of Mines.*

The Secretary of Mines, Hobart.

ANNUAL REPORT OF THE GEOLOGICAL SURVEYOR.

Geological Surveyor's Office, Launceston, 8th July, 1893.

SIR,

I HAVE the honor to submit to you my Annual Report for the year ending 30th June, 1893.

During the year I have forwarded to you the following Reports :—

On the Mathinna Gold-field.
On the Discoveries of Tin Ore on the Brookstead Estate.
On the Alacrity Mine, Denison Gold-field.
On the Godkin Siver Mine, Whyte River.
On Thureau's Deep Lead, near George's Bay.
On the Tin Mines of the Blue Tier, County of Dorset.
On the Discoveries of Coal at Barn Bluff, and on the Progress of the Mineral Fields of the County of Montagu (Mount Dundas, Mount Zeehan, Mount Reid, Mount Heemskirk, Mount Lyell, &c.) Interim Report.
On the Mount Lyell Mine, County of Montagu.
On the Sandfly Coal Mine.
On the Progress of the Mineral Fields of the County of Montagu. (Final Report).
On the Country between Mole Creek and Mount Dundas Silver-field, and on the Discovery of Coal at Barn Bluff.
On the Silver-bearing Lodes of the Scamander River District.

The report on the Mathinna Gold-field was published in last year's Report of the Secretary of Mines. I have also made short visits to the Mount Nicholas Coal-field, Beaconsfield, and Golconda in connection with other work, and have acquired information likely to be useful to me in future more detailed examinations of these districts. I have also visited the Pandora Copper Mine, near Frankford, and shall shortly send you a report upon it.

Diamond Drills.—Both drills have had partial employment during the year. At the close of last year the No. 1 Drill was employed in boring at Lefroy for a deep alluvial lead: four bores in all have now been made, and sections of the strata passed through in Nos. 2, 3, and 4 are forwarded herewith; that of No. 1 was sent with last year's report. No gold was found in any of the bores, but it was proved that the ground was getting deeper going eastward, and it is probable that the gutter, or bottom of the buried valley, is not less than 300 feet below the surface. The Nos. 1, 2, and 3 bores show a marked correspondence in the strata passed through, showing that down to the level of the bottom of the third bore the ground consists of horizontal layers of alluvial matter and basalt, which indicates that the gravels yet met with are those that have been deposited during the period of subsidence while the old valley was being gradually filled up, and are therefore not likely to contain payable gold. Their barrenness affords no guide whatever as to the richness or otherwise of the gutter, and I still think that there is great reason to hope that a payable lead will in time be found in this deep ground. The No. 4 Bore was considerably to the south of the other three, close alongside the No. 4 Bore of 1883, about which there was some doubt as to whether the bedrock had been reached, and in which it was said that gold had been found. The new bore proved that the bottom was some seven feet deeper than was reached by the old one, but the gravel yielded no gold on washing. But little importance, however, should be attached to the fact of not finding gold in gravel pierced by a diamond drill, for the chances are infinitely against the bore striking the deepest part of the gutter, and the distribution of gold even in rich leads is, besides, notoriously irregular. All a diamond drill should be expected to demonstrate is the depth of the alluvial ground and the thickness of the layers of gravel: the real prospecting must be done by underground mining as a rule.

For the Lefroy Deep Lead Syndicate the four bores put down cost £770 6*s.* 1*d.*, and the total distance bored was 978 feet 10 inches: the cost of boring per foot thus amounting to 15*s.* 9*d.* This high cost was due to the very rubbly nature of the scoriaceous basalt passed through in the first three bores, which led to numerous fracturings of diamonds and slow work. In sampling the gravels also there was much time lost and considerable loss of diamonds.

The No. 1 Drill was next employed by the East Pinafore Company to bore in the bottom of their shaft to ascertain the depth of basalt and alluvial matter still to be passed through before reaching the Silurian rock, and also to test the latter for the New Pinafore reef. This bore was continued to a depth of 508 feet from the surface, or 316 feet 11 inches from the bottom of the shaft: total cost of bore, £162 3*s.* 3*d.*: cost per foot bored, 10*s.* 3*d.* The reef was not cut, however, and the probability is therefore that the bore was in the footwall country. The bore, though unsuccessful in striking the reef itself, has thus given the company important assistance by indicating in which direction they ought to drive from the bottom of their shaft in order to cut the lode, and may thus yet prove to have been a good investment.

The No. 1 drill has been returned to store in Launceston, and is now awaiting employment.

At the end of last year the No. 2 drill had just finished its second bore for coal at Langloh Park, near Hamilton. Two more bores have since been made, the total distance bored by the four bores being 1249 feet 4 inches: cost of boring per foot, 5*s.* 3¼*d.* The average thickness of workable coal passed through in the bores, adding together the seams of workable size, may be taken as ten feet. The area proved by the bores is about 300 acres, which, at ten feet thickness of seams, would contain about 4,800,000 tons of coal. The seams are not very thick, and could be worked on the long wall system without loss by having to leave pillars, so, allowing a loss in working of one-fourth, we should have, say, three and a half million tons of coal in the proved area. In a district where the coal measures are so much disturbed by greenstone intrusions as around Hamilton, it would not be safe to calculate on the extent of the field being much greater than is actually proved, but it is probable that there is not less than a square mile (640 acres) over which the seams would extend. In last year's report, analyses of the coal from No. 2 Bore were given, and I now quote some that have since been made by the Government Analyst of samples from No. 4 Bore :—

Langloh Park Coal Field—No. 4 *Bore.*

	No. 1 Seam.	No. 2 Seam.	No. 3 Seam.	No. 4 Seam.
	Per cent.	Per cent.	Per cent.	Per cent.
Ash	15·80	14·20	15·6	16·40
Moisture	6·40	5·30	5·4	6·20
Sulphur	0·58	1·03	0·7	0·85
Loss at red heat	24·17	25·60	21·2	23·65
Fixed Carbon	52·95	53·87	57·1	52·90
	100·00	100·0	100·0	100·00

Mr. Ward adds the following note, "None of these coals forms a true coke. The fireclay fuses somewhat easily before the blowpipe to a white enamel, and was not further examined."

The percentage of ash in this coal is higher than is at all desirable, especially in the analyses from No. 2 bore, but it would be useful for many purposes if brought into the market.

After lying idle for seven months, the No. 2 drill has again found employment, and has gone to Southport to bore for coal in that neighbourhood.

I have, &c.

A. MONTGOMERY, *M.A., Geological Surveyor.*

The Secretary of Mines, Hobart.

No. 1 DIAMOND DRILL.

Report of Strata passed through in boring for Gold at Lefroy for the Lefroy Deep Lead Syndicate.

BORE No. 2.

Boring commenced, 17th June, 1892; finished, 10th August, 1892.

Strata.	Thickness.	Total Depth.
	ft. in.	ft. in.
Surface shaft	14 0	14 0
Blue clay	1 0	15 0
Hard rubbly basalt	57 4	72 4
Hard brown clay	1 9	74 1
Rubbly basalt	2 4	76 5
Brown clay	0 10	77 3
Rubbly basalt	8 7	85 10
Blue clay	1 10	87 8
Brown sandy clay with slate and quartz pebbles and decayed wood	6 3	93 11
Grey sandy clay and decayed wood	8 7	102 6
Brown clay with carbonaceous matter	21 9	124 3
Basalt, honeycombed, 6 ft. 1 in. „ very hard, 69 ft. 8 in.	75 9	200 0
Black clay	1 0	201 0
Brown clay and carbonaceous matter	3 3	204 3
Coarse gravel, floating reef, and decayed wood	10 8	214 11
Brownish sand	2 6	217 5
Coarse gravel, floating reef, and wood	2 11	220 4
Soft sandstone showing quartz veins	22 6	242 10
No gold found in the bore.		

Compiled from the Foreman's weekly reports.

BORE No. 3.

Boring commenced, 23rd August, 1892; finished, 10th October, 1892.

Strata.	Thickness.	Total Depth.
	ft. in.	ft. in.
Surface shaft	8 6	8 6
Hard rubbly basalt	68 0	76 6
Brown clay	2 5	78 11
Rubbly basalt	5 9	84 8
Brown clay	2 0	86 8
Brown clay, fine gravel, floating reef, and wood	6 5	93 1
Fine sandy clay and wood	6 6	99 7
Brown clay and carbonaceous matter	29 2	128 9
Basalt, honeycombed. 38′ 8″ Ditto, hard 41′ 0″ Ditto, soft 1′ 1″	80 9	209 6
Black clay	2 0	211 6
Brown clay	0 6	212 0
Gravelly wash, floating reef, and decayed wood	10 3	222 3
Brown sandy clay and wood	2 6	224 9
Coarse gravel, floating reef, and wood	3 9	228 6
Blue sandy clay	4 10	233 4
White sandy clay	2 0	235 4
Brown sandy clay and wood	3 4	238 8
Sandstone (boulder)	5 0	243 8
Gravelly wash and floating reef	7 5	251 1
Soft sandstone bottom	15 5	266 6
No gold found in the bore.		

Compiled from the Foreman's weekly report.

BORE No. 4.

Boring commenced, 5th November, 1892; finished, 11th January, 1893.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface clay } Surface shaft	9	0	9	0
Basaltic boulders } Surface shaft	9	0	18	0
Basaltic clay } Surface shaft	2	6	20	6
Basaltic clay } Surface shaft	4	0	24	6
Basaltic boulders	2	0	26	6
Basalt, rubbly ..... 13′ 8″ / Basalt, solid ..... 83′ 8″	97	4	123	10
Black clay	6	5	130	3
Brown clay, floating reef, and fine gravel	5	0	135	3
Brown sandy clay and wood	9	3	144	6
Basalt, honeycombed	51	10	196	4
Black clay	1	6	197	10
Brown sandy clay and wood	22	8	220	6
Gravelly wash, wood, and pyrites	5	7	226	1
Whitish sandy clay, fine gravel, and floating reef	5	2	231	3
Bluish clay, fine gravel, and floating reef	1	11	233	2
Whitish clay	4	0	237	2
Brown clay and wood	1	0	238	2
Sand and wood	2	6	240	8
Gravelly wash with much pyrites	8	4	249	0
Bluish clay, fine gravel, and sandstone boulders	2	6	251	6
Gravelly wash ..... 11′ 2″ / Ditto, with large sandstone boulders ..... 7′ 4″	18	6	270	0
Soft sandstone bottom	9	0	279	0
No gold in the bore.				

Compiled from the Foreman's weekly report.

No. 1 DIAMOND DRILL.

Report of Strata passed through in boring for Gold in the East Pinafore G.M. Co's shaft at Lefroy.

Bore commenced, 22nd February, 1893; finished, 18th April, 1893.

Strata.	Thickness.		Total distance Bored.		Total Depth from Surface.	
	ft.	in.	ft.	in.	ft.	in.
East Pinafore shaft	...		...		191	1
Rubbly basalt	12	4	12	4	203	5
Hard basalt	16	2	28	6	219	7
Brown clay, fine gravel, and decayed wood	8	6	37	0	228	1
Gravelly wash, floating reef and wood with pyrites, but no gold	8	0	45	0	236	1
Soft slate	8	3	53	3	244	4
Grey sandstone	7	0	60	3	251	4
Soft slate	9	0	69	3	260	4
Sandstone	23	6	92	9	283	10
Quartz vein, no gold	0	6	93	3	284	4
Dark blue slate	32	5	125	8	316	9
Quartz vein, no gold	0	6	126	2	317	3
Dark blue slate with pyrites	40	6	166	8	357	9
Hard grey sandstone with pyrites and occasional thin slate layers and quartz veins between 197 and 207 feet	81	4	248	0	439	1
Dark blue slate with pyrites	6	6	254	6	445	7
Hard grey and blue slate	19	10	274	4	465	5
Dark blue slate with quartz veins and pyrites	1	6	275	10	466	11
Grey and blue slate with pyrites and some small quartz veins	33	7	309	5	500	6
Blue slate with quartz and pyrites	0	6	309	11	501	0
Blue slate	1	6	311	5	502	6
Hard grey sandstone	5	6	316	11	508	0

Compiled from the Foreman's weekly reports.

A. MONTGOMERY, *M.A., Geological Surveyor.*

DIAMOND DRILLS.

Statement of Work done to 30th June, 1893.

Year.	*Locality.*	*Direction of Bore.*	*No. of Bores.*	*Total Distance bored.*	*Average Cost per foot, inclusive of Labour & 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.)—Gold	Ditto	1	978	0 14 9½
1891...	Spring Bay—For Coal	Ditto	4	937	0 6 10
1891...	Ravensdale—For Coal	Ditto	1	114	0 11 1½
1891–2	Back River, Prosser's Plains—For Coal	Ditto	2	854	0 6 1¾
1892–3	Lefroy (Deep Lead Syndicate)—For Gold	Ditto	4	979	0 15 9
1893...	Lefroy (East Pinafore Co.)—For Gold	Ditto	1	317	0 10 3
	Total	...	36	13,344	
	No. 2 Drill.				
1882...	Beaconsfield—For Gold	Horizontal, 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
1887...	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
1888...	Campania—For Coal	Ditto	1	600	0 7 7½
1888...	Richmond—For Coal	Ditto	1	500	0 5 1¾
1889...	Back Creek—For Gold	Ditto	4	787	0 8 5⅓
1891...	Macquarie Plains—For Coal	Ditto	2	989	0 4 5½
1891...	Jerusalem—For Coal	Ditto	1	344	0 4 9½
1892...	Langloh Park—For Coal	Ditto	4	1249	0 5 3¼
	Total	...	38	10,698	

Aggregate number of bores 74
Total distance bored 24,042

A. MONTGOMERY, *M.A.*, *Geological Surveyor.*

Launceston, 10th July, 1893.

REPORT OF THE MOUNT CAMERON WATER-RACE BOARD FOR THE YEAR ENDING JUNE 30, 1893.

20th July, 1883.

SIR,

This Board has the honor to report as follows :—

Meetings of the Board. The Board has held three meetings during the year, and the Race and Works have been inspected by the Chairman and by individual Members on various occasions during that period.

The Staff. The Staff consists of a manager and four watermen and channel-keepers.

New works. Additions have been made to the channel-keeper's cottage at Cascade, at a cost of £14 9*s.* 4*d.* A new two-roomed cottage has been erected close to No. 4 Syphon, and a portion of the old building which had become unfit for habitation was removed and added to the new building; the work, together with the extension of the telephone line, cost £92 17*s.* This new station for the channel-keeper will effect a saving of time and labour, and will also afford more security against damage to the Race by floods, &c.

No. 4 fluming, which had become unsafe, was replaced by an earth channel, at a cost of £41 15*s.*

A conserving dam has been constructed near the junction of the old Race with the new, at a cost of £490 7*s.*; this dam will afford storage room for night water, and will be the means of keeping up the supply in the event of breakage or accident, and will also enable the channel-keepers to more efficiently attend to the cleansing of the main channel without loss of revenue. It is a work which should have been constructed before the Race was handed over to the Board: it will very shortly pay for itself.

The whole Race has been thoroughly cleansed, and is now in good working order, but it must be borne in mind that the flumings upon the old portion of the Race are falling into decay; they were originally badly constructed, and renewals will from time to time have to be effected.

Regulations. On the whole these are working well, and fairly satisfactorily to the customers for water with the exceptions hereafter referred to, but the Board have found it necessary to reduce the charges, which now stand as follows:—

	Day Water, per head.		Night Water, per head.	
	s.	*d.*	*s.*	*d.*
When the English quoted market price of Tin is under £80 per ton ...	10	0	10	0
Ditto, ditto, £80 to £110 per ton	12	6	11	8
Ditto, ditto, £110 and upwards	17	6	13	4

per week of 6 days of 8 hours each; besides which water is supplied at the minimum rate of 10*s.* per head for developing new ground and for working turbines or hydraulic elevators.

Statistics. The statistics for the year are as follows:—

Average per week of claims supplied	17
Greatest number supplied in any one week.....	20
Present number supplied	14
Total number of heads of water supplied	3913
Tons of tin ore raised—approximate	184
Average number of miners employed—Europeans, 25; Chinese, 50	75

Revenue.

	£	*s.*	*d.*
Total receipts for the year.....	2541	6	9
Cost of maintenance and management	1110	9	7
Paid to Public Debts Sinking Fund for the year ending 31 Dec. 1892	1848	19	3
Total sum paid to Public Debts Sinking Fund	3631	12	3
Rate (for the year) of interest upon the cost of purchase and construction	5⅗ per cent.		

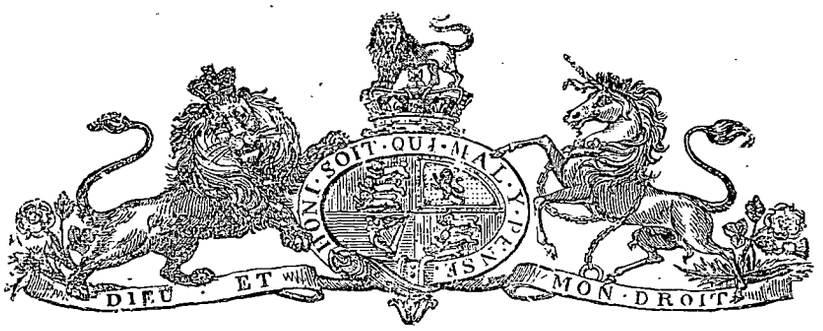
General remarks. The Board regret that during the past few months there has been a considerable falling off in the demand for water. This is attributable to a great extent to the fact that some of the ground is becoming worked out. There is, however, a very large area of country which, if mined to the best advantage and with labour-saving appliances, could be profitably worked. The miners of the district do not, however, as a rule, work their ground systematically, and are slow to avail themselves of improved methods and appliances. The water which the race could supply is not being fully used, and the Board feel themselves restricted by the conditions imposed upon them by law, which fixes the minimum price of water at 10*s.* per head, and by recent legislation prohibits them from supplying free water under any circumstances whatever.

The Board would strongly recommend that an amendment of the Law should be made in the direction of leaving them somewhat more free to dispose of water at a reduced charge, and, in cases where they might see fit, to supply spare water free for limited periods to encourage the development of new ground, and, as a result, increased sale of water, so that the supply brought in by the race may be used to its fullest extent in employing labour and in winning the mineral wealth of the district commanded by the Race.

We have the honor to be,
Sir,
Your obedient Servants,

F. BELSTEAD, *Chairman.*
C. O'REILLY,
JOHN SIMPSON,
A. MONTGOMERY,
S. HAWKES,
} *Members of the Board.*

The Honorable the Minister of Lands and Works.



REPORT ON THE GODKIN SILVER MINE, WHYTE RIVER.

Geological Surveyor's Office, Launceston, 30th December, 1892.

SIR,

I HAVE the honor to report having followed your instructions as to visiting the Godkin Mine at the Whyte River. Leaving Launceston on the 12th instant, I reached the Whyte River on the evening of the 13th, spent the next four days in examining the property, and returned on the 18th to Waratah, and on the 20th to Launceston.

The Godkin mining property includes two mineral leases, Nos. 1599-87M and 1615-87M, of 40 acres each, situated on the right bank of the Whyte River. There is a good road from Waratah to within three miles of the mine, and the latter is connected with the road by a wooden tramway; this has also been continued right up the slope of the Magnet Range to the Arthur River, six miles from Waratah.

The surface of the ground is very uneven, showing several high spurs separated by gullies. The north boundary of the north section is from 240 to 330 feet above the level of the Whyte River where it crosses the south boundary of the south section. The general slope of the ground is to the south west, towards the Whyte River.

The principal mining workings are situated in the south section, 1615-87M, towards its north-west corner, in the valley of a small stream known as Silver Creek. Here a main engine shaft has been sunk, and three adits, Nos. 1, 3, and 4, have been driven. In the north section, 1599-87M, a long adit, No. 5, has been driven, and a small one, No. 2, and No. 5 has been connected by a drive along the lode with a shaft called the north shaft. Some trenching has also been done on this section.

At the north shaft there is a very large outcrop of ferruginous gossan, consisting of oxides of iron and manganese intermixed with a good deal of clayey matter and fragments of country rock, and containing a little silver at times. This outcrop can be traced with but few breaks south-easterly to the workings in the south section, and north-westerly through the Godkin Extended, Smith's, and the Bell's Reward Sections: it is not always so massive as at the north shaft, but is generally large and distinct. The work that has been done on it by the various mining companies shows the line of gossan to lie at the contact of the two main formations of the district, sandstone, slate, and limestone lying to the west of it, and decomposed igneous rock to the east. When I formerly examined the district, in March and June, 1890, the occurrence in Bell's Reward and the Godkin No. 4 tunnels of limestone on the east side of the soft igneous rock led me to believe that there was a dyke of the latter running parallel to the main contact of the two formations; but the knowledge now gained shows this to be erroneous, and that the masses of limestone and sandstone lying east of the supposed dyke are either portions detached from the main mass or tongues projecting from it into the igneous formation. The line of gossan closely coincides with the edge of the latter, and the lode therefore is a "contact lode." The features presented by it in the underground workings, as will be seen hereafter, quite agree with this interpretation, and a proper understanding of the conditions under which the ore is found and is likely to be found can only be attained by remembering this, and discarding the belief that the lode is of the ordinary "fissure vein" type. Instead of having to deal with a mass of lode-stuff deposited in a comparatively regular and even plane, as in the case of typical fissure veins, we have here a lode formed at the irregular contact surface between a mass of once molten rock and the older sedimentary strata through which it has been thrust. Except for the main fact that the ore-bodies are likely to lie between the two rock formations, no regularity of occurrence may

be expected, the course and underlay of the lode being liable to sudden and erratic changes. Detached peices of the sedimentary rock may often be met with inclosed in the igneous matter, and round these there may be ore; and, again, tongues and dykes of the plutonic rock are to be expected penetrating into the sandstones and limestones, and ore may often lie along the boundaries of these. The main cause of formation of a contact vein between a plutonic and an aqueous rock appears to be that the heated masses shrink in cooling, leaving at the contact surface space for the circulation of water carrying metalliferous solutions. The main vein is likely to follow the main line of contact in consequence, the opportunities for deposition of ore being there greater than along the boundaries of small dykes.

When I formerly examined the White River District I was in great doubt as to the true nature of the igneous rock found in the Godkin and other mines. At the surface it is extremely decomposed, and its constituent minerals quite unrecognisable. The mine workings and the cuttings on the Main Road and the Godkin Tramway have now made the matter clear. The rock was locally termed "diorite," from its resemblance to some of the decomposed diorite dykes found in Victoria, but it is now seen that this is a misnomer. "Dolerite" would be more correct, as the rock is a basic one and belongs to the group of which gabbro and dolerite are the most thoroughly crystalline members. It is very difficult to give a thoroughly satisfactory name to the formation because it varies very much, and one name will not cover all the varieties. The main body of the igneous body lies to the west and north west of the Heazlewood field, and there is often very coarsely crystalline, becoming a gabbro, but between the Godkin line of lode and the Magnet Range, on the eastern side of the silverfield, it is generally quite fine-grained, and would rather be termed basalt. Throughout the whole district there is a great deal of serpentine in it, the result of chemical alteration of the original rock, but this, too, varies very much, some specimens being almost pure serpentine rock and others not containing much. In the eastern portion of the silverfield we appear to be on the outskirts of the plutonic outburst, the cuttings on the main road showing frequent alternations of igneous rock with slate and sandstone. The slate is frequently brick-coloured and hardened by heat, and in the vicinity of the dykes is often altered to hornstone. In this part of the field the intrusive rock appears to have issued in numerous dykes which broke through the slates; but in the western part we have the main central mass of plutonic matter, and, as is usual in such cases, the large mass is the most thoroughly crystalline and the most homogeneous in composition. Probably the dykes on the outskirts have absorbed much of the strata through which they passed into their own substance, which would account for many of the differences now observable in their texture and composition. The main fact to be noted is that the weathered, somewhat fine-grained igneous rock found in the Godkin and other mines is only a variety of the serpentine rock found in the Heazlewood mine and westward from it. The clayey character is merely the result of atmospheric influences, and will disappear soon after the mines reach the water level of the District, when the soft rock will change to a more or less serpentinous dolerite. This change is already visible very plainly in the Whyte River mine, in the lower levels driven from the Godkin shaft, and in the eastern end of the No. 5 tunnel.

The sedimentary strata on the west side of the Godkin lode consist of sandstones of generally white colour and harsh feel, quartzites, limestones, and slates. They are often fossiliferous, encrinital stem joints being very common. Two or more species of trilobites, and several small brachiopods have been collected, but not yet described and named. The fossils show the strata to be of the same age as those of the Zeehan field, where identical species are found. There is a somewhat large patch of these strata lying immediately west of the Godkin line of lode, of roughly triangular shape, running to a point towards the north, and widening going south. Along the Whyte River they extend from the Godkin mine to within half a mile of the junction with the Castray River. To the north they are seen crossing the main road at the Saddle, about half a mile east of the Heazlewood Extended Company's sections. The formation here, however, is only about a quarter of a mile wide, and runs out altogether, and is replaced by the serpentinous dolerite to the northward.

It may be here noted that in the Heazlewood and Whyte River field there is the same association of probably Silurian sedimentary strata with serpentinous rocks that prevails in the Zeehan and Dundas fields. In the case of the latter the serpentinous rocks also vary from nearly pure serpentine to gabbro and dolerite, as in the former.

The sedimentary strata are much contorted, and generally dip at high angles. The strike is about north-west and south-east, and the line of contact with the dolerite follows this line pretty closely. As might be expected, however, the intrusive rock has not altogether closely followed the bedding planes of the older strata in bursting through them, which has resulted in a feature that has caused some perplexity to those interested in the district, namely, the apparently irregular occurrence of a band of limestone. This limestone is well seen in Bell's Reward Mine, again in the north end of the Godkin Extended tunnel and round the Godkin engine shaft, but not in the Godkin No. 5 tunnel, which extends right across the line connecting the two last occurrences. Just before reaching the lode, however, in this tunnel we find occasional bands of

siliceous limestone interstratified with quartzite, and as in the Godkin Extended tunnel these transition beds lie between the quartzite and the limestone, it is pretty clear that the latter once existed in very much the present position of the lode, and that the bulk of it has been destroyed by the dolerite intrusion. The patch near the engine shaft is another portion of the same band which has escaped destruction; no doubt the limestone was continuous right along prior to the igneous outburst.

It has been necessary to go somewhat fully into these geological particulars in order to explain some of the very puzzling features met with in the workings, which have been the cause of a great deal of work being done without much good resulting therefrom. It is also necessary for the future working of the mine that they should be borne in mind. With the aid of the map accompanying this Report I shall now attempt to explain what has been found, and to indicate the direction future workings should take.

No. 1 *Tunnel.*—This was put in immediately under a mass of gossan cropping out on surface, in which there was a vein of pyromorphite two or three inches wide, giving good assay returns. Several cuttings that have been made into this mass since mining work began have proved it to be superficial and flat-lying, the gossan not extending downwards more than a few feet. From the shape of the surface of the ground it seems probable that this lodestuff has been brought into its present position by a landslip, and that therefore we should look for the parent mass higher up the hill. Unfortunately for the development of the mine, the slipped gossan, instead of coming to rest upon solid country when its superficial character would have been at once apparent, came right upon some clayey matter which might well belong to a lode, but which subsequent work has shown to be one of the broken clayey masses formed at the contact of the sedimentary and igneous rocks. There appears to be a good deal of this clay in the vicinity of this contact, formed by mechanical disruption of the older rock at the time of the dolerite intrusion, together with chemical action subsequently: under favourable circumstances true lode-matter might be formed in such situations, and the clay is much stained with oxides of iron and manganese, and in places has much the character of a true gossan. It has therefore taken a great deal of work to show its real nature, and has prevented the recognition of what appears to be the fact, that the patch of gossan on surface is not in its original position. In the No. 1 tunnel the gossany matter is found for 50 feet in from the mouth: much of it is stained black with oxide of manganese, and good assay returns were said to have been obtained from this black portion. As it has not been mined out, however, the presumption is that in bulk it was not rich enough to pay for removal. From 50 to 80 feet from the entrance there is a layer of ferruginous stuff in the top of the drive, but under it appears to be broken and stained country rock. At 80 feet there shows in the floor a piece of weathered shaly matter, probably the cap of the limestone found below this tunnel at the next level, which often contains a good deal of slaty substance in bands through it. Between 80 and 140 feet the tunnel passes through much decomposed clayey dolerite, and then to 230 feet encounters brown clay with occasional curious wavy markings; this is similar to the clay lying under the gossan at the entrance to the tunnel and to the stuff passed through in the first 200 feet of the No. 4 adit. After passing through it the drive goes through 84 feet of clayey dolerite. In the face there is a good deal of sandstone mixed with clay and traversed by ferruginous veins: there is also a little quartz. This was taken to be the side of the sandstone country coming in, but from what has been seen in the west end of the No. 4 tunnel it is more probably the eastern side of the true contact lode, which is exactly similar to this at the lower level. Another twenty feet of driving would probably have found the lode, and gone through it into the true sandstone footwall.

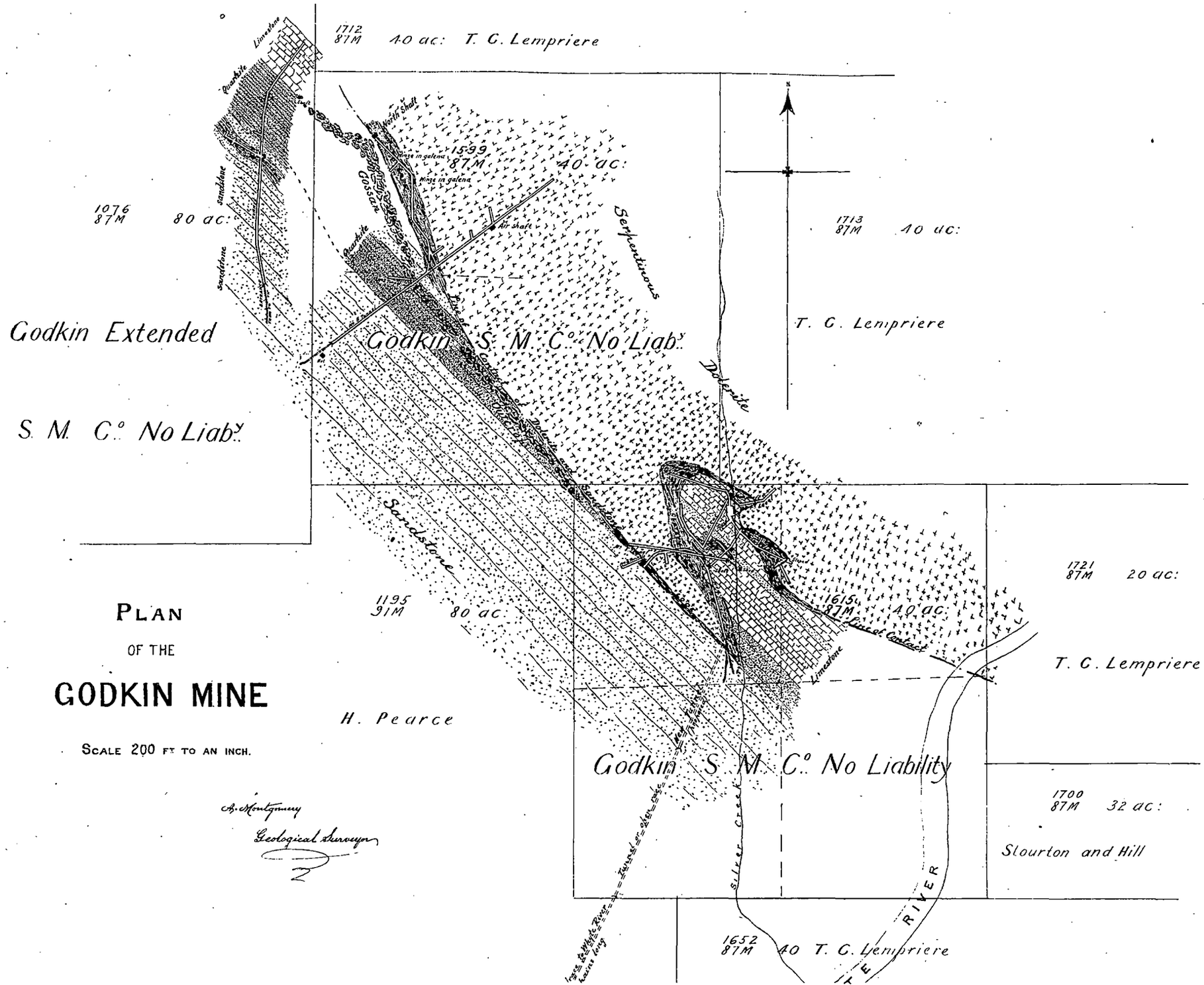
No. 3 *Tunnel.*—This is almost immediately above the end of the No. 4 tunnel. For about 12 feet in the mouth there is dolerite clay, and then the drive passes into hard sandstone. This tunnel seems to be altogether on the west side of the lode, and to have gone in just above it.

No. 4 *Tunnel.*—This is also known as the 45-feet level, as it is connected with the main engine shaft. The workings at this level consist of two main crooked drives running more or less north-westerly, connected by a cross-cut: there are also several small branch drives from these. The mouth of the tunnel is under a superficial lump of gossan, and all round it there is a good deal of ironstone. For about 180 feet from the entrance the stuff passed through is yellowish clay, much stained in places with black oxide of manganese: it is not country rock, and it is not true vein stuff, but appears to be a contact mass at the junction of the intrusive and sedimentary formations: similar masses of clay are, however, sometimes found in lodes, especially large ones, and at the time the tunnel was driven it was natural to suppose that the lode was being penetrated. After passing through this limestone was encountered in broken blocks, often with clay between them, for some 42 feet. In this limestone the crosscut to the north east to connect with the eastern part of the 45-feet level begins. Leaving it till later, and continuing on the western branch, the clay is again met with about 12 feet past the crosscut and continues for 148 feet. The weathered dolerite then appears, and is seen also in a small crosscut to the south that has been made close to where it first comes in. This continues to within 14 feet of the face. On the last day of my visit there was about four feet in width of a mixture of oxide of iron, clay, quartz, and fragments of sandstone in the face, and then for about another 10 feet back along the drive the

country seemed broken, containing angular pieces of sandstone and weathered dolerite, and was a good deal stained with oxide of iron. Since then I have heard from Mr. Godkin, the acting mining manager, that the lodestuff proved to be about 20 feet wide, and after passing through it sandstone was cut on the western side. A good deal of water was also reported to be coming from the lode. Though the stuff contains a good deal of clay and country rock I have no doubt that this is the main lode, as it is lying on the contact of the dolerite and the sandstone. While I was at the mine a small drive was put in close to the mouth of No. 4 tunnel on the contact with the sandstone, and the material passed through was very similar to that found in the face, so that it would seem that this tunnel began just on the edge of the lode and went gradually away from it: the mouth of the adit seems, however, to be just at the point of a tongue of dolerite coming in from the northward, and the lode is small and would probably soon die out if followed into the sandstone country to the south east. No trace of it appears to have been found in this direction, and it seems most likely that in order to find lodestuff again we must go a little further east to the contact of the sandstone and dolerite once more.

Returning now to the crosscut connecting the two main drives of the 45-feet level, we find it to be all through limestone, broken at first, but more solid towards the north-east end for the whole distance, except for a band of sandstone in the middle close to the air-shaft. Along the western edge of this sandstone a short drive has been put in to the north-west along a seam of clay, which appears to break somewhat obliquely across the strata, and is probably a branch from the clayey contact mass lying between the dolerite and the limestone. The sandstone is only a small band some 8 or 10 feet thick, in the limestone. The air-shaft is one which was sunk early in the history of the mine: near the surface there was in it a vein of rich galena, which was lost lower down. The crosscut was driven to prospect for this vein, and was successful in finding galena and native silver about 70 feet north-east of the shaft. The eastern drive at this level was made for the purpose of following this ore, but has not been very successful. The best ore was found between the crosscut and the main shaft, and a large quantity was stoped out, from which some 30 tons of picked ore was shipped to the smelting works. This returned about £17 a ton gross value, the bulk assay giving about 150 ozs. of silver and 27 per cent. of lead. Mr. Godkin could not give me the exact figures, but these are pretty nearly correct. An examination of the heap of seconds showed them to consist of limestone with veins running through it of galena with a good deal of blende. Some very fine specimens of native silver were obtained during the progress of stoping. The galena when dressed clean assays very well, but the assay value of the whole heap of seconds I should judge to be very low, the percentage of galena in it being evidently very small. So far as I could learn no proper sample of the bulk has been taken, so the exact value is not known. This ore would be valuable in future for fluxing purposes on account of the large quantity of lime contained in it, and the silver in it would then help to pay expenses of smelting richer ore, but I am much mistaken if it could be profitably dealt with in any other way, even by concentration. The vein seen in the stopes from which the stuff at grass was taken does not appear to me to be a true lode at all; it is rather a part of the limestone that has been fractured and been impregnated with galena and silver in the cracks and joints; it has no regular walls, and the lodestuff does not differ sensibly from the enclosing country limestone except in being traversed by the strings and small veins of ore. I do not think that any reliance could be placed on its continuance either horizontally or vertically. The drives to north-west and south-east on its course, and following it as far as could be judged at the time, have not proved the rich ore to extend any considerable distance, and I do not think that this discovery will ever prove of much importance. It has even been detrimental to the mine, for it has diverted attention from the main lode. Its best point is that it proves that the country is favourable for the deposition of silver and galena, and therefore increases the probability that good ore will be obtained when the main lode is opened up.

The crosscut has been driven from 20 to 30 feet past the drive on the supposed course of the lode. In the face serpentinous dolerite makes its appearance, indicating the edge of the main mass of this rock seen on surface extending eastward for a long distance. Between the main drive and this face has been all called the "The Native Silver Lode," but I could see no reason for regarding it as lode-matter at all, though there may be a few minute veins of ore through the limestone. The main drive, south-east from the crosscut, goes through limestone for about 75 feet and then strikes a formation of brown and grey clay, stained with oxides of iron and manganese, and containing some chloride of silver in parts. The clay shows wavy lines and markings similar to that in the mouth of No. 4 tunnel. Where the drive strikes the side of this a crosscut has been driven to the north-east through it a distance of about 30 feet. In the face we again meet with the weathered dolerite. From the mouth of this little crosscut the drive is continued on a more easterly course than at first and passes through the formation which is known as the "Chloride Lode" into weathered dolerite once more. Near the end another small crosscut has been driven south-west almost along the edge of the dolerite, but is not yet through the lode-matter, if it may be called such. Connection has here been made with the surface by means of what is called an underlay shaft, but which seems to me to be inclined in a direction opposite to the underlay of the lode. This shaft is through weathered stained dolerite, and I could not distinguish any lode on which it had been sunk: it is very straight and even, and appears to have been started as an inclined rise, and continued on at the same angle of slope without any reference to the lode.


1712
87M 40 ac: T. C. Lempriere
Limestone
Quartzite
Sandstone
North Shaft
Mine in galena
1599
87M 40 ac:
Mine in galena
Gossan
Air shaft
Serpentinous
1076
87M 80 ac:
Quartzite
Sandstone
1713
87M 10 uc:
Godkin Extended
Godkin S. M. Co. No Liab.
T. C. Lempriere
Dolerite
S. M. Co. No Liab.
Sandstone
1721
87M 20 ac:
1195
91M 80 ac
1615
87M 40 ac:
Limestone
T. C. Lempriere
PLAN
OF THE
GODKIN MINE
SCALE 200 FT TO AN INCH.
H. Pearce
Godkin S. M. Co. No Liability
1700
87M 32 ac:
Slourton and Hill
A. Montgomery
Geological Surveyor
1652
87M 40 T. C. Lempriere
RIVER

Between the two crosscuts the lode-matter is more ferruginous, and contains more manganese oxide and also some quartz, and thus has more the character of true lodestuff. As this is evidently another contact between the limestone and dolerite formations, it seems probable that here again a contact lode has formed, and it is probable that if followed to the south-east the lode-stuff would be found to continue along the junction.

The drive to the north-west from the engine shaft was partly blocked up in the end at the time of my visit, and I could not see all the north-west end of it. For about 140 feet from the shaft it passed through limestone, a good deal shattered, and with a lot of soft clayey matter (pug) between the blocks. From 140 to 200 feet was all black "pug," containing fragments and lumps of limestone. From 200 feet to 233 feet from the shaft, which was as far in as I could get, there was a great deal of gossan; where first met with this was lying rather flat, resting on whitish clay, and this again on the black "pug." The gossan is largely composed of oxides of iron and manganese, but also contains a good deal of clayey matter and some quartz; it is, on the whole, similar to the gossany lode-matter found in the main lode on the North section. I was unable to ascertain if the dolerite was met with after passing through the gossan, but, judging from the shattered condition of the limestone and the position of the dolerite on surface, it is extremely likely to be close at hand.

90-*ft. Level.*—This was not examined by me, having been shut up by the new centering which was being put in the shaft. It passed through limestone, and then struck hard green serpentinous dolerite. Some lode-matter, 4 or 5 feet wide, taken to be the Native Silver lode, was cut at 130 feet from the shaft, but my informant could not tell me if it was at or near the contact of the limestone and dolerite or not.

110-*ft. Level.*—A crosscut has been driven to the south-west a distance of 189 feet from the centre of the engine shaft. For 116 feet it passes through hard solid limestone, then goes through fossiliferous sandstone for about 55 feet, and the remaining 18 feet was through soft sandy "pug." The end of the drive was filled up and could not be seen, but was said to have struck hard country again, either sandstone or limestone. A drive from the crosscut was put in to the north-west a distance of about 100 feet, following the soft "pug" formation; I could not get far into this, as the soft stuff had run very much into the drive and dammed the water back in it. A strong stream of water keeps flowing from this drive.

It seems probable that the soft clayey formation met with in the 110-ft. level is identical with that passed through in the crosscut at the 45-ft., just before reaching the old main shaft, and that both are connected with the clayey contact mass seen in the first 180 feet of the No. 4 adit, and again past its junction with the crosscut; the gossan found in the north-west end of the eastern drive at the 45-feet level may also be connected with these.

The work that has been done, therefore, reveals that there is a tongue of sedimentary rock, mostly limestone, projecting out into the main mass of serpentinous dolerite, and that all round this, on its contact with the dolerite, there is matter of a more or less lode character; in parts it forms a true gossan, but generally it is very largely composed of clay, and only stained with oxides of iron and manganese. Though on the whole of a rather unfavourable appearance, still there is a certain amount of likelihood that ore will be found in parts of it, and to the south-east along the main contact of the two formations there seems every reason to expect that there will be a body of lodestuff similar to that found in the north section in the corresponding position. It may here be remarked that in the Godkin Amalgamated Company's sections on the south side of the Whyte River the tunnels that have been driven show the existence of wide ferruginous-stained masses of more or less lode nature at the contact of the dolerite and sandstone formations.

North Section, No. 5 Tunnel.—This is driven to the north-east across the line of the lode. For the first two hundred feet it passes through sandstone, the strata striking N. 40° W. and dipping as a rule to the north-east at pretty high angles. Between 152 and 162 feet from the entrance there is a band of broken iron-stained country where a good deal of water was struck when driving the adit. This has been taken to be the place where the Godkin Extended lode passes through the drive, but I hardly think it has anything to do with it: it is the axis of a small synclinal fold in the strata, for after passing through it we see them dipping to the south-west for some distance. At 145 feet there is another broken band of country much stained with oxides of iron and manganese, and which has evidently served as a channel for the passage of water through the rock. At 207 feet a distinct fault is met with; strike N. 40° W., dip 85° to N.E., showing slickensided surfaces. Immediately past this the strata stand vertical; so it may prove to be a fault of some magnitude, though I did not notice any sign of it in the adjacent Godkin Extended tunnel. Just past the fault the drive went through first three feet of sandstone, then struck beds of quarzite and flinty sandstone, dipping vertically. At 330 feet the beds begin to dip again a little to the N.E. and there is what may prove to be another fault, probably a small one. An occasional bed of hard siliceous limestone or calcareous quartzite is hereabouts met with, corresponding to the beds lying between the quartzite and the limestone in the Godkin Extended tunnel. At 338 feet there is a bed of clayey slate, and then sandstone

comes in again, similar to that passed through in the first part of the tunnel. At 348 feet this begins to be much broken and iron-stained, and at 355 feet it is so much impregnated with oxides of iron and manganese as closely to resemble lode-matter. At 396 feet the lode is reached and passed through at 424 feet: it consists of iron and manganese oxides, some clay, and a good deal of fragmentary wall rock. The lode appears here to be underlaying to the N.E. about 1 in 1. After going through the lode the tunnel has been continued for about 350 feet, in decomposed dolerite, which becomes harder and less altered as we proceed. A small iron-stained vein carrying a little silver was cut through, and followed a short distance to the north by a small drive, but was too small to be of any consequence.

From the tunnel a drive has been made along the lode to the north shaft: it is rather crooked, having been diverted from time to time from one course to another as the walls of the lode seemed to be at hand. In the first part of this drive, though there is much nice-looking gossan, there is also a great deal of clay and country rock, but towards the north-eastern end the appearance is much more favourable, the gossan being spongy and nearly all made up of iron and manganese oxides. Two winzes have been sunk, the first 34 feet deep, the second nearly 40 feet. In the first one a little galena and cerussite were obtained, and in the second ore came in at a depth of about 10 feet, continued to be got for about 8 feet, and then dipped to the north-east out of the winze, but was cut again by a small crosscut from the bottom of the winze. Just beside this winze a crosscut has been put in to the south-west, but not far enough to reach the footwall of the lode. Some very nice cellular gossan is seen in the mouth of this, probably corresponding to the ore vein cut in the winze. The north shaft is down 45 feet below the level, and would have been sunk deeper only that the water became too heavy for the horse-whim to deal with; it was raising from 1000 to 1200 gallons an hour, but could not cope with the flow. The chamber at the tunnel level is in very nice-looking gossan, and the shaft appears to be at the east edge of this; it is also at the east side of the huge outcrop of gossan on the surface, and this would indicate that the lode has very little underlay; however, 30 feet above the level a seam of galena was passed through underlaying to the north-east, and again sandstone has been found for ten feet in the bottom of the shaft, underlaying N.E. about 1 in 4, so that there seems to be really a certain amount of underlay to the north-east. As before remarked, from the nature of a contact lode it is likely that there will be sudden and considerable variations in the underlay. As the shaft below the level and the winzes had water in them at the time of my visit, I could not examine them to see the ore *in situ*. I, however, looked closely at the pile of it that was stacked at the mouth of the tunnel. It consists mostly of carbonate of iron, with veins and spots of galena and blende, very similar to the lode seen close to the creek at the mouth of Bell's Reward tunnel. A bulk assay is said to have yielded 12 per cent. of lead and 11½ ounces of silver per ton; and Mr. Godkin says that the average of his assays of picked pieces of the galena is 48 to 50 per cent. lead and about 37 ounces of silver to the ton. The stuff is too poor to be worth smelting as it stands, but would be worth concentrating; about 20 tons of it have been raised from the shaft and winzes. There is also a pile of from 15 to 20 tons of gossany stuff carrying galena and cerussite which has been saved, but which I should not consider to be of much value.

The workings from this adit are under the largest and best-looking outcrop of gossan on the property, and in the tunnel, too, the lodestuff is of a very promising character. The appearance of carbonate of iron and galena in the winzes indicates that the level is not much above the bottom of the oxidised capping of the lode, and gives hope that at a short distance down the gossan will disappear and be replaced by unaltered lode-matter carrying valuable minerals. It is clearly necessary to sink deeper, and the Company have now to consider the best way of opening up the lode at a greater depth; the most obvious way would be to sink the north shaft deeper and open the lode from it; this involves putting a pumping engine on the shaft and enlarging and re-timbering it before sinking could be resumed. It has been proposed to remove the Worthington pump from the main engine shaft on the south section to the north shaft, but I cannot see that this would be a really effective solution of the difficulty, for the experience now gained as to the quantity of water in the country renders it highly probable that the present plant will not be able to cope with it. If the Company were in a position to put an 18 or 20-inch lift on the north shaft or on a new shaft more to the south east of it, so as to be more in the centre of the body of ore to be worked, I should recommend them to do so, and eventually, if the mine comes up to the hopes entertained by its owners, it is likely that such a shaft will have to be sunk. I do not think it would be worth while moving the present engine, however, but would rather see the new shaft at once equipped with one able to deal with any water likely to be met with.

An alternative proposal has been made, which seems to me in the present state of the Company to be the most advisable to adopt, namely, to drive in to the lode in the south section from the Whyte River and then to drive along the lode to below the north shaft. Surveys have been made by the officers of the mine which show that an adit could be driven to cut the lode immediately under the mouth of No. 4 tunnel at a depth of 111 feet below the brace of the engine shaft, or almost at the present 110-feet level. The south-west corner of the southern section is very flat-lying ground, and an open tail-race is proposed to be brought in from the side of the Whyte River for a distance of 12 chains, at the end of which it will be 10 or 12 feet deep. For about 500 feet further

the depth will gradually increase to about 20 feet, and it will depend on the nature of the country whether an open cutting can be taken in or a tunnel driven. Finally from 360 to 400 feet of driving through sandstone country should reach the lode. From this point to the north shaft is a distance of about 2000 feet. The entire cost of the work would probably amount to about £2500 when completed; the benefit of it would, however, be perceived long before completion, for it is probable that soon after cutting the lode the latter would drain so as to enable the north shaft to be sunk to the level of the new tunnel and work carried on from the north end also, while a considerable amount of stoping of ore might also be anticipated to be done. The present engine shaft perceptibly drains the north section, so that it is reasonable to expect that the new adit would do so also. Besides this it is so low down that we may pretty confidently expect that even in the southern section it will strike the lode below the zone of oxidation, and therefore in driving along it there will be every probability of cutting through any shoots of ore contained in it. The entire length of the lode will be prospected from it at the lowest level at which natural drainage can be secured, and the pumping engine on the present main shaft will be dispensed with, effecting a saving of about £24 a week, or will be set free to enable the shaft to be sunk deeper and allow of further prospecting being carried on below the water level on the "chloride lode" and other parts of the eastern contact lode. Besides these there is another powerful argument for its construction: not only would it serve the present purpose of prospecting the mine and postponing the erection of an expensive pumping engine, but it would also be permanently useful as a drainage level, as it would never be necessary to pump the water any higher than to it. As it will be about 115 feet below the No. 5. tunnel this will mean that every gallon of water raised in future, even when the main new shaft is down, will have to be lifted 115 feet less than if it did not exist—a continual economy in pumping expenses that would soon repay its cost.

In calculating the expense of this work at £2500 I have taken the cost of the other work done on the mine as a basis and have allowed a margin for contingencies; but if it should prove that the lode is quite unoxidised along the tunnel level and is largely composed, as is likely, of hard carbonate of iron, the cost of driving will be greater, and the total expense would probably somewhat exceed £3000. Mr. Godkin has estimated that it would cost £1000 to remove the Worthington pump to the north shaft and to enlarge this and sink it to the tunnel level, and I do not think it could be done for less. The engine is, however, required in its present place for deeper prospecting of the eastern lode, and it would therefore be a pity to move it. Taking everything into consideration, I think that the long drainage tunnel would be the best work the Company could undertake under present circumstances. Though of permanent value for drainage purposes, it will not be of any use for haulage of ore unless a new machinery site can be got further down the Whyte River—a question on which I have no knowledge. The present engine shaft is not too high to supply the dressing-works with ore as it is, for it is important to have the material raised once for all so high that in going through the dressing-sheds it can fall downwards by gravitation from machine to machine without being handled or elevated. The main shaft is well situated for delivering the ore to the machinery site, and this supplies another reason for not removing the engines from it to the north shaft, as the former is the better situated for winding. To get the ore from the north shaft to the dressing-sheds an aërial tramway would probably be required, or else a long ground tramway too crooked to be worked automatically, so it would be better to truck it underground along the new tunnel to the present winding-shaft, raise it there to surface, and let it run from there to the dressing-sheds by a self-acting tramway. To do this the present 110-feet level would have to be extended to join the new tunnel along the line of the lode. If it is decided to make the drainage tunnel, work should be carried on from the 110-feet level simultaneously with the cutting of the tail-race, so that the crosscut might have reached the lode and a good deal of driving been done on it before the drainage tunnel reached it. Owing to the want of fall in the ground through which the tail-race passes it will not be possible to tip the stuff from the tunnel except at the Whyte River, unless an incline is constructed at the entrance. With such a long way to carry the stuff before tipping it the expense of driving will be much increased. It will therefore be best to raise as much as possible of the spoil from the tunnel through the main winding shaft and save trucking it such a long distance.

I would therefore recommend that the construction of the new tunnel be begun simultaneously from the 110-ft. level of the engine shaft and from the Whyte River. It is possible that when the 110-ft. crosscut strikes the lode the water will be drained at once in the north section, and that sinking the north shaft with the present appliances can then be resumed, and ground opened up for stoping.

If the drainage tunnel is made I do not think that any steps should be taken towards sinking a new main shaft until the former work is completed, except making arrangements whereby there would be no delay in getting a good pumping plant, should such be required for deeper sinking. The tunnel will prospect the mine pretty thoroughly, and will allow a fair estimate to be made of the water likely to be met with lower down. Should the prospects of the mine then warrant deeper sinking a site for a main shaft to command the whole length of the lode will depend very much on the position of the ore-shoots found, and therefore cannot be chosen at present.

Another drainage tunnel has been proposed, from the side of the Whyte River above the machinery site. This, however, would be 21 feet higher than the one recommended, and would be as long or even longer than it, certainly much longer if it is found that the open approach to the latter can be taken right through the flat ground and up to the foot of the sandstone spur. The only advantage the second tunnel would have would be that it might be driven along the eastern contact of the dolerite and sandstone formation, and would therefore be likely to be in lodestuff. Seeing that the gossans found in the No. 4 tunnel, or 45-ft. level, prove that the zone of oxidation of the lode descends below it, and that it is imperative to get below this zone, I think that the scheme recommended should be preferred, as being more certain to reach the unaltered lode-matter.

Prospects of the Mine.—In spite of the large amount of work that has been done and the great expense which has been incurred, the future of the mine is still entirely a matter of speculation, depending altogether on the results of further prospecting work. No ore of payable value is yet in sight. Notwithstanding this the prospects must be regarded as fairly good. The gossan in the No. 5 tunnel is of a favourable appearance, and is now giving place to unoxidised ore carrying galena of good assay value, and there is reason to hope that valuable deposits will be found at no great depth below the present level. In the southern section native silver has been found accompanying the veins of galena, and a little silver exists in all the gossany matter ; the lode appears to be strong and permanent over a long distance. There is every inducement to go to the expense of further opening and testing the mine, and very reasonable hope of its turning out remunerative.

Much adverse criticism has been lavished on the way this mine has been worked, but I do not think that this has been fairly deserved. It is only now that a great deal of work has been done that the nature of the lode occurrence is evident, and so far as I can see there has always seemed to be good reason for all the work that has been undertaken at the time it was done. That so much of it has proved futile is unfortunate, but I do not think that any stronger term can be fairly applied. The discovery of the native silver naturally diverted all attention to the eastern lode, and postponed the attack upon the main lode. The great outcrop of gossan in the north section, however, ought not to have been neglected so long, and it is unfortunate that it was not opened up from the first instead of the southern section.

In my opinion a mistake was made in extending the tramway from the Whyte River to the Arthur River. From the mine to the Whyte River it was required, but from the latter the road would serve all present purposes. Should the mine become of importance the tramway to the Arthur would be very useful, but it has been erected needlessly soon, and money that would have been better spent in underground work is locked up in it.

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

A. MONTGOMERY, *M.A.*, *Geological Surveyor.*

The Secretary of Mines, Hobart.

WILLIAM GRAHAME, JUN.,
ACTING GOVERNMENT PRINTER, TASMANIA.

REPORT ON THUREAU'S DEEP LEAD, NEAR GEORGE'S BAY.

Mines Office, Launceston, 6th January, 1893.

SIR,

I have the honour to forward to you a description of the Deep Lead near George's Bay, first described by Mr. G. Thureau, F.G.S., late Government Mining Geologist, and hence known by his name. In August, 1888, reports were written by Mr. Thureau dealing pretty fully with the portions of the lead held by The Salisbury Prospecting Association, Messrs. Haley and Rattray, and the Kent Prospecting Association, and incidentally with it in general, but as these were made under the then prevailing system by which the Government Mining Geologist was allowed to furnish reports to private parties they were not officially published. Private reports have also been made to people interested by Messrs. A. R. Browne, M.E., and F. Danvers Power, F.G.S., but so far as I am aware no official report has ever been made for public information. As the lead has attracted a great deal of attention and is quite likely to prove an important source of tin ore, a description of it may now be useful.

Since Mr. Thureau made his reports above mentioned the properties therein described have been more or less completely absorbed by the St. Helen's Tin Mining Company, which now holds practically all the upper part of the lead for two miles above the point where it crosses the Golden Fleece Rivulet. Lower down the lead, near the junction of the Fern-tree Creek with the Golden Fleece, the workings known as the Ruby King Mine (sections held in names of J. W. Syme and F. J. Pike) are also on the deep alluvial ground, but, with the exception of two or three other claims, these and the St. Helen's Company's workings comprise the whole of the mining work yet done. There is still a great deal of vacant Crown land along the lead, and should the works now in progress prove it to be valuable, no doubt this will be taken up on mineral leases.

The country rock from George's Bay to the Blue Tier is all granite, with the exception of a piece of country to the south of the head of Medea's Cove, where slates and sandstones of probably Silurian age occur. These form the southern edge of the deep alluvial ground where it is crossed by Constable's Creek, and extend southward towards the Scamander River, being part of the extensive Silurian formation in which the Mathinna, Mangana, and Mount Victoria Goldfields are situated. Except for this occurrence of sedimentary strata the lead is entirely bounded by granite, and as this generally crops out on surface in numerous protruding masses, it is a simple matter to follow the boundaries of the alluvial ground. This shows on the surface numerous waterworn pebbles of quartz, occasional rounded boulders of hard granite, and sometimes boulders of basalt, often cemented together by brown oxide of iron. Much of the surface gravel is fine, but patches of pebble drift are not uncommon, and the thoroughly waterworn character of the stuff is unmistakable. On the solid granite country there is often much fine surface gravel derived from the atmospheric disintegration of the rock, but this is always more or less angular and not waterworn. By noting these differences and the outcrops of the solid bed-rock I was able to clearly trace the lead from the head of Medea's Cove to near the junction of the George's River and Power's Rivulet, a distance of $6\frac{3}{4}$ miles. The alluvial ground on which the town of St. Helen's stands appears to belong to it, and it probably runs right out under George's Bay. The course of the lead is shown on the map accompanying this report. Two branch, or rather tributary leads run into the main one, one running northward from the Ruby Dam and joining the main lead in section 286–87M, the other coming southward across the present George's River north of 1765–87M; the former is probably fairly deep, the latter has been proved by prospecting-holes to be shallow. The junctions with these branch leads are the only breaks in the continuity of the boundary line of the main deposit, and as both of them rise into the hills it is impossible that the outlet of the old river could have been through either, and they must be, as above said, tributary leads.

This deep lead is simply an old bed of the George's River, similar to the Brothers' Home lead at Derby and numerous other buried rivers elsewhere. In my reports on the Beaconsfield and Gladstone districts I have pointed out that in Early Tertiary times the northern part of Tasmania must have been higher above sea level than now, as river channels were cut out which are now far below tidemarks. The stream which cut out the Ophir Deep Lead at Beaconsfield, now 270 feet below the sea level, must once have run downwards into the sea; about the same time the Deep

Leads at Lefroy and Black Creek, now below sea level, were also running streams; and further eastward, in the Ringarooma Valley we find evidence to the same effect in the fact that the bottom of the old lead in the North Brothers' Home mine is at least 90 feet below that of the existing river. During this period the drainage from the Blue Tier Range doubtless ran down the Deep Lead now under consideration and carved a channel out of the granite rock. An important point to note is that the streams of the Early Tertiary Period seem all to have run considerably below those of the present day, the whole country having subsided since then, and consequently that it must be expected that the outlet of Thureau's Deep Lead is probably a hundred or more feet below the level of George's Bay.

The evidence of the gravel terraces round Mount Cameron and on the slopes of the Cabbage Tree Hill at Beaconsfield, and of the deposits of the Launceston Tertiary Basin, proves that between Early Tertiary and Middle Tertiary times a long continued subsidence of the whole of the northern part of Tasmania took place, during which the rivers gradually filled up the valleys they had previously eroded, and the sea encroached further and further inland. It was in this period that the stanniferous gravel of the old Ringarooma and George's River (Thureau's Deep Lead) valleys were deposited. The streams kept bringing down a little tin from the mountains along with the ordinary gravels, but owing to the fact that the river beds were in process of filling up, the sediments were not much agitated after being laid down, and consequently the ore could not become concentrated into heavy alluvial deposits. The case is different when a stream is cutting out its channel, for then the gravels are being from time to time scoured away and subjected repeatedly to a natural ground-sluicing process, which results in their contained heavy ores finding their way on to the bedrock in the bottom of the gutter. The lowest parts of a lead contain the concentrated ore resulting from the washing of the stuff which has been excavated in the whole of the river basin, less the quantity that has been mechanically or in solution swept into the sea: hence their richness as compared with the later gravels filling the upper parts, which are derived from a less quantity of rock and have been less frequently sluiced by the river. Attention is drawn to these facts, because Thureau's lead has been thought little of on account of the small quantity of tin in the upper drifts. The top layers of alluvial matter in the Brothers' Home lead are similarly poor, and yet it has been proved that there are rich deposits in the lower part of the gutter, and in the same way we are likely to get rich ore in the bottom of the former lead. The general occurrence of tin ore through all the top layers proves that the rivers kept bringing down supplies of it continuously, and gives good ground for thinking that in earlier times when the conditions were favourable for the concentration of the material, rich gravels must have resulted.

The movement of subsidence came to an end about the time of the great eruption of Tertiary basalts which we find overlying the drifts at the Brothers' Home, Scottsdale, and Lefroy. The land then again began to rise slowly and the sea to recede. The streams then began to cut into the accumulated sediments of the preceding period of subsidence, washing them away more or less, and forming new channels which had not necessarily any relation to the older ones. As the elevation went on these new channels have been cut deeper and deeper, so that we now find the Ringarooma and George's River running in rock-bound granite channels roughly parallel to the old beds in which they ran in Early Tertiary times.

The surface of the old lead now is far from level, having been carved into rounded hills and occasional deep gullies by the action of the surface waters running over it. It is noticeable that the centre of the alluvial ground is generally higher than the edges, and that the watercourses often run just at the contact of the gravels with the granite bed-rock: this is no doubt due to the porosity of the alluvial drifts allowing the rain which falls upon them to soak down into their substance without running off and scouring the surface. At the edges, however, the water running from the solid granite country has scoured away the soft drift matter and established water-channels, which have worn deeper and deeper as time went on. The highest part of the lead is in sections 1123-87M and 1124-87M, where the surface is about 265 feet above the sea; in section 1283-87M it is about 250 feet. Where the Golden Fleece Rivulet crosses the lead the alluvial matter has been greatly worn away and the surface level is about 100 feet above high-water mark, but rises again considerably between this point and the Fern-tree Creek, which again cuts deeply into the accumulations of gravel. From here to the head of Medea's Cove the lead sediments have been greatly worn away and the ground slopes gently down to the beach, but an indication of the former height to which they rose is afforded by a spur or hill lying east of Constable's Creek between A. Becker's 50-acre and 103-acre purchased blocks of land, which rises to a height of 170 feet above the sea, and is composed of waterworn gravel cemented by brown oxide of iron. This cemented stuff being hard has resisted erosion, and remains to show that the whole valley was once filled with alluvial detritus to probably at least 200 feet above the present sea level.

I have not myself seen any marine shells in this district in positions which would confirm the above explanation of the formation of the deep lead through subsidence and re-elevation of the land, but I was informed by Mr. Potter, formerly Manager of the St. Helen's mine, that some had been found in the workings near the Ruby Dam, up the Golden Fleece Rivulet: this would indicate a former subsidence of the whole countryside to a depth from 250 to 300 feet below its present level,— quite in accordance with the view I have taken of the lead.

As far as I could see or learn, no trace of the lead is found to the west of the junction of Power's Rivulet with the George's River, and there is nothing to show down which of these streams

the main body of stanniferous drift came into it. Probably both existed in the days when the lead was being formed, with their main valleys much in the same position as now, and contributed tin ore to the drifts. In the Early Tertiary times, however, the Blue Tier Range must have been higher than it is now, as denuding agents have been at work wearing it down unceasingly ever since then, and the modern river valleys are probably now much below the level at which the streams ran that carved out the channel of the lead; consequently it is probable that all the ancient river bed above the junction of the Power and the George has been completely eroded away, and traces of it higher up the range are therefore unlikely to be found. It may be here noted that though the subsidence of the lower grounds below sea level would result in filling up the lower parts of the old river channels, and the subsequent re-elevation would cause the rivers to cut new beds, the higher parts of the valleys that did not become submerged would remain unaffected, and the water would flow through them in one ever-deepening channel all the time. So long as the flow of a river is so fast that it is constantly scouring out its bed it is plain that no large deposits of gravel can form in it.

St. Helen's Company.

The mineral sections lately held by this Company are numbered 1863-87M, 1607-87M, 1605-87M, 1473-87M, 1283-87M, 1282-87M, 1539-87M, 1123-87M, 251-87M, 1124-87M, 1482-87M, and 1543-91M, comprising in all 300 acres. In the south part of section 1863-87M a shaft was sunk close alongside the Golden Fleece Rivulet to a depth of 57 feet, but did not strike the granite bottom. The flow of water became too strong to be overcome without machinery, and the shaft had to be abandoned. Occasional boulders of basalt were found in this shaft which must have come a long distance, as this rock does not occur anywhere in the neighbourhood. To the east of this shaft there is an outcrop of granite, and the Golden Fleece Rivulet runs over the bedrock, but further east again on sections 1750-87M and 1437-87M we come on the old alluvial ground, here much cemented by ferruginous matter and showing occasional stones of basalt similar to those got in the shaft. It seems very likely that the main gutter lies in these sections, and that the shaft is to the west of it, which would lead to the belief that the bottom of the lead is probably much below the depth reached in sinking.

In section 1473-87M two shafts have been sunk to depths of 40 and 60 feet respectively, through light gravel, course sand, and clayey drifts, containing a little tin ore throughout. These could not be sunk deeper by manual labour on account of water, and did not reach the bedrock. They are situated in some of the highest ground in this part of the lead, and in order to get below them an adit was being driven at the time of my visit from a point about 30 feet above the Golden Fleece Rivulet. A good deal of trouble was experienced in driving this, owing to the soft nature of the ground passed through, and the amount of water in it. It will have to go about 1420 feet in order to be under the highest part of the lead in section 1473, and will then be 110 feet below the surface. This adit seems to me to be a very useless piece of work; it is 30 feet above the Golden Fleece Rivulet, and therefore about 85 feet above the bottom of the deep shaft there, which itself did not reach the bedrock. We may therefore say confidently that the adit starts some 85 feet at least above the gutter, and it will therefore have to be driven a very long way before it reaches the lower layers of drift. It will certainly drain the surface layers, but these are so far above the gutter that they are not likely to be worth working, and if not the adit is quite useless. It seems to me to have been begun in the belief that the lead is comparatively shallow, and that by driving up it the bottom would soon be met with, but in my opinion the evidence is against this view, and the lead is probably deeper than it has been imagined.

In section 1274 there is a shaft 55 feet deep, which reached the bedrock, but is probably a long way from the gutter. In the north-west angle of section 1539 there is another, 40 feet deep. In section 1123 a shaft 57 feet deep was sunk near the roadside but did not reach bedrock. There are also three old shafts in sections 1124, 1180, and 1273, about 18, 20, and 70 feet deep respectively, the two latter of which appear to have bottomed on the granite. In all these shafts the drift is very light gravel, carrying a little tin ore. The tests that have been made from them have been contradictory, but the truth appears to be that the ground passed through does not contain tin ore in payable quantities except perhaps when treated on a large scale by the hydraulic process of sluicing. In section 251 a large excavation from 12 to 20 feet deep and about 15 chains long has been sluiced out along the edge of the deep ground, the débris being washed into the George's River, but this work did not pay, the ground being too poor. In order to get fall it was necessary to work along the edge of the granite and against the dip of the gravel drifts, and this sluicing cannot be considered a fair trial of the lead, though indicating probably pretty nearly the value of the superficial gravels..

Near the Golden Fleece Rivulet the ground is commanded by what is known as the Clio Water-race, and a good deal of surface work has been done by tributers. It has consisted principally in stripping off the surface vegetation from a layer of cemented drift which often lies about a foot beneath the surface and follows the contour of the latter. The explanation of this superficial layer being payable no doubt is that it contains the ore concentrated from a considerable mass of drift which has gradually been worn away by the action of surface waters, the light sand and gravel having been removed, while the heaver tin ore remained. In some of the small gullies, too, nice patches of tin have been worked, similarly resulting from natural sluicing of the poorer drifts. A good deal of prospecting has been done over the alluvial ground, and many places are said to be known where tributers could make a living if they were able to get water for sluicing and outlet for the tailings, both of which necessaries are rather hard to obtain.

When the hydraulic sluicing work was in progress in section 251 the tin ore obtained was far from clean, being contaminated with titanic iron, rutile, zircons, pleonaste, and other heavy valueless minerals. A mistake appears to have been made in not trying to "stream" the ore cleaner, as a great deal of the impurities could have been removed by doing so. The low assay value of the tin ore obtained has given a bad name to the lead, which is undeserved, as the later results show. The following figures are from the returns received from the Tasmanian Tin Smelting Company, Launceston, for parcels of ore sent by the tributers:—

	bags.	cwt.	qrs.	lbs.		
26th August, 1892.	4	3	3	4	assay 71·4 per cent.	metallic tin.
„	9	7	3	8	„ 63·2	„
„	9	8	2	25	„ 62·1	„
9th September, 1892.	7	6	2	7	„ 58·4	„
„	4	3	1	4	„ 70·2	„
„	5	4	3	6	„ 70·8	„
„	1 (seconds)	0	3	19	„ 43·1	„
13th October, 1892.	4	3	3	13	„ 71·5	„
„	3	2	1	11	„ 72·2	„
„	3	2	3	7	„ 70·6	„
„	1 (seconds)	0	3	17	„ 44·7	„
„	2	1	3	25	„ 71·6	„
„	1	0	2	16	„ 71·0	„
„	1 (seconds)	0	3	16	„ 51·6	„

These returns show that it is quite possible to clean the tin ore from this ground sufficiently to yield over 70 per cent. of metallic tin, which is a highly satisfactory percentage. The ore from the Ruby King workings lower down the lead is also of good quality, and I have no doubt that with proper care in streaming all the tin ore obtained from the whole length of the lead could be brought to a fairly high assay value.

Bartley's Workings.

Near the head of the lead, on old sections 2864-87M and 2865-87M, Mr. D. Bartley has been working some gravels in a small watercourse which runs down into the George's River. Though the ground was shallow where he began work, it appears to be getting deeper going towards the lead. The tin ore is pretty coarse and well waterworn, and is not unlikely to be derived from the main lead. The bottom of the latter is here probably shallow, and the lower gravels would therefore be liable to be cut through by the surface watercourses, and it seems very likely that these are the source of the tin now being found. A series of shallow prospecting shafts along the west boundary of section 2864 would be very likely to find the top of the deep lead gutter, and would get it in a place where it could be pretty easily worked by a deep tail-race or adit from the valley of the George's River. Any such approach to it, however, should be deep enough to get well below the part of the gutter to be worked, as the fall of this is, of course, down the lead and not into the modern valleys.

Ruby King Mine:—*Sections* 958-87M, 292-87M, 1125-87M, 1088M, *and* 1464M.

A large amount of superficial work has been done on this ground, but nowhere has the bedrock been reached. The drifts are mostly light gravels and sand, with clayey beds between them. In several places I noticed flinty cemented quartz gravel, forming a very hard conglomerate, similar to that found in parts of the old Mussel Roe Lead near Gladstone. In some places a layer of this conglomerate is said to have been taken to be the bedrock, but it is not so, being only a layer of gravel that has been strongly cemented together by siliceous infiltrations. Owing to denudation of the upper drifts of the lead the strata worked by the Ruby King miners are probably lower relatively in it than those in the St. Helen's Company's ground, which will probably account for their greater productiveness; but still they must be far above the bottom of the gutter. A great deal of tin ore has been taken from these sections, which have been worked for many years.

Future Working.

It will be seen from the foregoing that a little tin ore is found all along the course of the lead, and that practically nothing has yet been done to ascertain the depth of this and the quality of the gravels in the gutter, where the best "wash" is always reasonably, and according to universal experience, expected. The future of the lead depends on these lower gravels, and as there is good reason for expecting them to be payable, there is every inducement to make a vigorous effort to exploit them. The best method of doing so is now to be considered. Believing as I do, from consideration of the geological history of North-Eastern Tasmania, that the gutter will run deep below sea level at its outlet, I do not think that any good can result from adits driven from the George's River or from the side of the Golden Fleece Rivulet into the gravels, as they are pretty certain to strike them far too high. An adit driven up the lead from the Golden Fleece in section 1437 would in time strike the bottom of the gutter, but would probably have so far to go that it would be of very little use. The prospecting will therefore have to be done by means of shafts. Experience has now shown that these cannot be sunk by manual labour alone on account of the large amount

MINERAL SECTIONS.

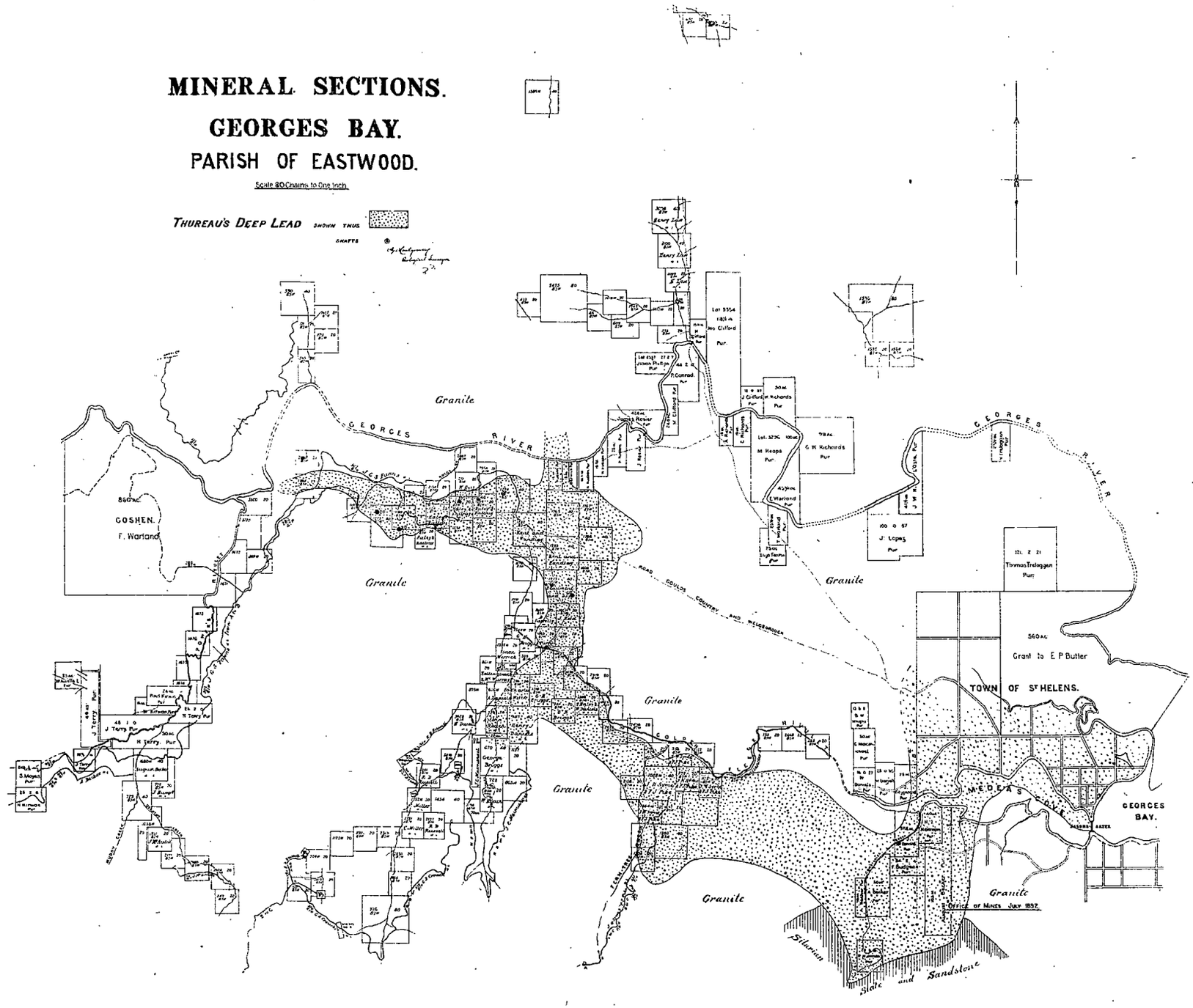
GEORGES BAY.

PARISH OF EASTWOOD.

Scale 80 Chains to One Inch.

THUREAU'S DEEP LEAD SHOWN THUS

SHAFTS



Office of Mines July 1892

of water in the ground, and engines will therefore be required. It will be an expensive matter, however, to prospect in this way without some guide as to the depth of the gutter and its position, and I should therefore recommend that boring with a diamond drill or water-auger be resorted to before any shafts are sunk. A few holes run down with these machines will test the value of the ground to a certain extent and will locate the gutter, and when this has been found it will be possible to pick out a site for a main shaft in a position favourable for working. The main shaft should be sunk in the granite to one side of the lead so as to be safe, and a drive from it to be put in under the gutter. The lead can then be drained properly by an engine on the shaft, and working carried on right up the deepest part of the lead in a miner-like fashion. The preliminary finding of the gutter by bores has come to be regarded as of the greatest importance in working deep alluvial ground, and the expense of the work is more than made up for by the certainty with which the permanent shafts and drives can be laid out.

As will be seen from the plan of the lead, its narrowest part is just north of where the Golden Fleece Rivulet crosses it, and this would therefore be the best place to put down a line of bores from east to west. It might be more convenient, however, to put the bores along the bank of the Rivulet, as water for the engine would there be at hand. At least three bores should be made, and it would be better to have six or more, so as to locate the deepest ground pretty exactly. The cores brought up by the drills would afford a good test of the value in tin of the drift passed through, but too much reliance should not be placed on these, and the main function of the drill should be to find the gutter. This being found, the proper and satisfactory exploration of the stanniferous gravels can only be done by mining methods.

Water Supply.

In every alluvial district the question of a supply of water is of the utmost importance. At present the St. Helen's Company have the Clio Race, which carries 7 heads of water, and could be made at small cost to carry 15, but this race is not high enough to command all the upper parts of the lead, being only about 100 feet above the Golden Fleece Rivulet. Another race, about 14½ miles long, has been surveyed from the George's River, to bring in 80 heads of water, at a cost of £8000, but this, too, is at a low level, and only 24 feet higher than the Clio Race. It is said that a race which would command all the lead, giving a pressure of 250 feet at the Golden Fleece crossing, could be got from the Scamander River, but that only about 20 heads of water could be safely reckoned on from this source for nine months in the year. It is thus a matter of considerable difficulty to get a copious high-level water supply, and it would probably be necessary to go from 20 or 30 miles up the George's River before a satisfactory one could be obtained. With the Blue Tier range close at hand, however, there should be no insuperable difficulty in the way of getting whatever water is required, and at a sufficiently high elevation, and the supply would resolve itself into a question of cost, which at present the absence of data does not permit discussion of. Should the upper gravels of the lead prove to be payable by hydraulic sluicing, the quantity to be washed is so immense that it would pay to construct an expensive race. Extended and very careful quantitative trials of the quality of the drift by sinking shafts all over it and washing the material therefrom are however required before it would be possible to judge correctly as to whether the upper layers are payable, and till these are made no steps should be taken towards making a big race. There is need for a very considerable expenditure in prospecting work over the whole of the lead before any expensive permanent works are begun, and the owners will have to exercise considerable patience in developing their properties.

My examination of Thureau's Deep Lead has led me to the conclusion that there is a very great probability of the existence of rich stanniferous gravels in the lower parts of it; that it is possible, but somewhat doubtful, that the superficial portions may be profitably worked by hydraulic sluicing; that the principal method of working will have to be that of underground mining, and that prospecting by boring is a necessary preliminary to the regular mining work. The deposit is very extensive, and if payable will afford employment to a large number of men, and it is highly desirable that its importance should be recognised and prospecting by boring begun upon it without delay.

I have the honour to be,

Sir,

Your obedient Servant,

A. MONTGOMERY, *M.A.*, *Geological Surveyor.*

The Secretary of Mines, Hobart.

WILLIAM GRAHAME, JUN.,
ACTING GOVERNMENT PRINTER, TASMANIA.

REPORT ON THE TIN MINES AT THE BLUE TIER, COUNTY OF DORSET.

Geological Surveyor's Office, Launceston, 19th January, 1893.

SIR,

I HAVE the honour to report to you on the state of the tin-mining industry in the Blue Tier district as seen during my recent visit in October last. There has not been very much progress since I previously visited the field in October, 1889, and in some respects there is not a great deal to add to my report of 5th November, 1889. On this occasion, however, I visited several properties which have been opened up since my former visit, and I have now to describe these, besides noting the progress made on those previously seen.

The granite of which the Blue Tier Range is composed is quite similar to that found in all the other tin districts of North-eastern Tasmania, the Mount Cameron, Ben Lomond, Freycinet Peninsula, and St. Paul's River granites being indistinguishable from it. It is a somewhat coarse-grained grey, or occasionally pink-coloured, porphyritic granite, the porphyritic crystals of felspar being often from half an inch to over an inch in length. Small quartz veins carrying tinstone are pretty common through it, and there is reason to believe that much of the alluvial tin which has been so plentifully found in the district is derived from these, and not from large lodes as is usually assumed.

Through the main country granite run a number of dykes of another sort of granite which often is richly impregnated with tin-ore. As pointed out in my former report this varies so much in composition that it is hard to find a satisfactory name for it: it is as a rule much finer grained than the main granite, and there are no porphyritic crystals of felspar. In some places it is a fairly typical quartz-porphyry, but in others it becomes greisen and haplite. It is generally much decomposed near surface by the action of atmospheric influences, the felspar being converted into kaolin, and the mica into talc and clayey matter. On the whole I still think that quartz-porphyry is the most appropriate name to be given to this rock, though certainly parts of it vary very far from the typical composition. The dykes of quartz-porphyry are distributed irregularly through the district, but there appear to be two main masses of it, one north of Poimena township, of which Mt. Macmichael must be about the centre, the other in the Anchor and West Anchor Companies' properties and westward from these. A detailed survey would be required in order to lay down the position of these dykes accurately on a map; and in the existing state of much of the ground, still covered with dense forest growth, this would be a tedious and expensive work, but their general position and probable relation to each other are shown in the sketch diagram attached to this report.

In regarding these bodies of stanniferous granite as dykes, I regret to find that I am not in accord with the high authority of Professor G. H. F. Ulrich, who views them as stockworks in his report on the Cream Creek mine. The Cream Creek stanniferous rock is the same as is found in the Anchor, Liberator, New Moon, Puzzle, and other mines on the Blue Tier, and if the former is called a stockwork the latter should also be so named. Professor Ulrich's remarks are well worth quoting: he says—"First, as regards the character of the tin-bearing deposit in a mining geology point of view, I must at once say that I do not agree with the views that I have heard advanced in this respect. The deposit is in my opinion neither a lode, intrusive dyke, nor superficial tin-bearing cap of granite, but belongs to the class of deposits called 'stockworks,' of which examples exist and have been worked for ages in Saxony, Bohemia, and Cornwall, in which latter country they are usually called tin floors. They may be regarded as mineralised zones or bodies of the country rock, *i.e.*, granite, which in longitudinal extent and depth have no defined boundaries, whilst laterally such boundaries do exist in some cases, in others they are likewise absent. The granite of these bodies is nearly always different in character from the prevailing country rock, *i.e.*, more dense or fine-grained, more felspathic or quartzose, or again more micaceous, with mica of a

different colour from that of the country rock; and as regards the tin ore, it occurs in it in various ways, such as impregnated throughout the rock from very poor to very rich in places, and from the finest grains, hardly visible to the naked eye, to particles above a hazel-nut in size; in fine veins and seams traversing the rock in all directions; in larger patches, often showing fine crystals in drusy cavities, veins, or little lodes of quartz, felstone, and greisen (quartz and mica), always, and often richly, tin-bearing are rarely (if ever) absent, traversing the tin granite. Now, as already intimated, all these special features gradually disappear in longitudinal extent and depth, and there is a gradual transformation into the common barren granite, whilst in lateral extent there may be either a sudden change or also a gradual transition. As an evident consequence of this change the stockwork becomes, of course, ultimately too poor for working. This description refers to stockworks in general, but from what I have noticed the Cream Creek deposit, as regards mineral character, conforms to it in all essential particulars."

The Blue Tier stanniferous granites agree very closely with the above description; but it seems to me that their mode of occurrence, as shown in the sketch diagram, is that of intrusive dykes. Nowhere in the district have I seen any gradual transition from the quartz-porphyry into the surrounding granite, the line of demarcation between them being always distinct. The altered granite, too, in the neighbourhood of the tin-bearing veins in the main country rock is not in the least like the material of the dykes or stockworks. In one of the cuttings of the Anchor mine the junction of the two sorts of granite is exposed, and here we see quartz veins in the main granite running from the quartz-porphyry, and the former rock appears to have been shattered by the latter; the appearances certainly pointing to the conclusion that the stanniferous rock has been intruded through the porphyritic granite. In some of the workings of the New Moon mine, where the junction of the two rocks is exposed, it seems pretty clear that they are of different ages, and the shape of the deposit in this place, running as it does in a long narrow belt through the main granite, is that characteristic of a dyke. Another reason for regarding these masses as dykes is that, in parts, they are composed of hard dense quartz-porphyry of typical character, containing little or no tin ore, and presenting none of the alteration of the constituent minerals which is so general a feature in the more stanniferous portions. This sort of quartz-porphyry is well seen in the deep cutting at "The Falls," at the outlet from the tail-race from the New Moon battery. My reading of the district therefore is, that there have been intrusive dykes of quartz-porphyry forced through the older country granite, and that these have subsequently undergone a great deal of chemical alteration, which has resulted in the separation of tin ore in fine crystals throughout their mass. The difference between Professor Ulrich's view and my own really is that, while he considers the stanniferous masses to be a portion of the main granite, which has been modified by chemical alteration, I think that they are later dykes through it which have undergone a similar chemical change. There is this important difference between these conceptions: that if the former is correct, the depth of the tin-bearing deposits is comparatively limited in all probability, while, in the latter case, the ore is likely to occur in the dykes to a great depth. This question of the downward extension of the stanniferous rock in depth is of very great importance to the district, and boring with diamond drills should be resorted to to settle it. I shall have more to say on this head later on.

In all the stanniferous dykes on the Blue Tier the tin ore appears to be segregated into certain patches, often of considerable extent, which gradually become poorer towards their outskirts, and finally pass into almost barren quartz-porphyry. These patches of richer rock might, perhaps, be termed stockworks, and the mode of occurrence of the tin ore might then be said to be as stockworks in dykes of quartz-porphyry. I prefer, however, to use the less restricted term "impregnation," which signifies that the ore is scattered irregularly through the mass of rock containing it.

During this second examination of the Blue Tier district I found the quartz-porphyry to be much more widely distributed than I had noticed it on my previous visit, and it does not appear to be so generally tin-bearing as I then imagined, large areas of it appearing to be very barren. Where it is hard and dense, and consists of granules of quartz set in a felsitic matrix, it seems to be always poor, but when the mica and felspar are distinguishable and the rock is softer, more tin ore is found in it. The micaceous varieties appear to be rather more favourable for tin than the others, though I have seen rich specimens of haplite (quartz and felspar) containing no mica. Both the mica and the felspar, in the stanniferous portions generally, appear to have undergone much chemical alteration, even in the deeper parts where they have not been altered by atmospheric action, and the possibility suggests itself that the tin was originally in the rock, in combination with other bases, as a silicate, and that it has been set free as oxide much in the same way as magnetite in serpentinous rocks, which is eliminated from a state of previous combination during the chemical change from olivine to serpentine. This, however, is only a suggestion.

I shall now proceed to describe the various properties visited on this occasion. As most of these have more or less alluvial tin upon them, in addition to the more permanent deposits in the shape of lodes and stanniferous dykes, it will be easier to describe each by itself without attempting to group together all those on which there are alluvial workings, all those which possess true lodes, and those which are on stanniferous dykes. Several of the properties have all three modes of occurrence of the tin ore.

Lottah, Wellington, and Giant Mines.—No work having been done on these leases since my former visit, I did not examine them again on this occasion. It is a great pity to see such a promising mine as the Lottah lying idle, especially as it has been opened up all ready to begin stoping, and so prove quickly if the mine is payable. Judging from the ore taken from the drives I think it ought to be. For a full account of this and the other two mines above named I must refer to my former report.

New Moon Mine.—This property was formerly called the Full Moon mine, but has been renamed. It is owned by the New Moon Tin Mining Company, No Liability, which also now holds the ground spoken of in my former report as Haley's Lease (sections 907 and 908). These have since been made over to the M'Gough Tin Mining Company, No Liability, which later on was amalgamated with the New Moon Company. The latter now holds sections 1263M, 184-87M, 966M, 967M, 1683M, 907, and 908, in all 322 acres. In the old Full Moon part of the ground not very much work has been done since my former report, and the description therein given of the lodes and alluvial workings does not now require any addition. At the time of my previous visit a battery was just getting ready to start crushing the stanniferous quartz-porphyry, and this was described in my report. After working for about six months the owners found they could not make a profit on account of the smallness of the mill and the expense of raising the stone to it, and abandoned operations. I have not been able to get complete figures of the quantity of stone crushed and tin ore saved, but, in answer to my inquiries, Mr. Stackhouse, manager of the Full Moon Company, was good enough to give me the following particulars:—"I find that from the 1st February, 1890, to 19th July, 1890, we crushed 2088 tons of tinstone, which yielded 26 tons of black tin ore, the average assay of which was 62 per cent.; the value of it would be about £1500. We got on the average about 35 bags tin ore for a fortnight from, say 165 tons of tinstone; this would be valued at, say £87, and our expenses for the fortnight would come to about the same amount, so that I find there was no profit." The yield for the period stated is equivalent to nearly eight-tenths of one per cent. of metallic tin, and the value of each ton of rock milled is 14*s.* 4*d.* Some stone was rejected and not put through the battery, but not very much, and from what I could see of the workings there should be no great difficulty in getting plenty more stone of the same quality as that stamped, and this, if crushed in a large battery, ought to yield a profit. Work was suspended, it should be observed, because it was not profitable with the appliances possessed by the owners, not on account of any lack of crushing stuff. The stanniferous porphyry has now been proved by cuttings made into it to extend over a block of ground quite four chains long by 2½ chains wide, and tin ore is freely visible over this area, not evenly, but still more or less all over. Many of the patches of ore are very good, and I should think that the stone milled by the Full Moon Company might be regarded as a fair sample of the whole mass. It was not taken from one part only but from several excavations, and should therefore be fairly representative. The quartz-porphyry is exposed in the lower parts of a flat valley lying below the battery, but appears to extend into the hills on each side, and when further prospected it may prove to be easier to get the ore from open quarries in these. The raising of the stone from the workings to the battery was a constant expense to the Full Moon Company, and had a good deal to do with its failure. All the country immediately round the deposit of tin, however, is either higher than it, or slopes so gently away from it, that it would be difficult to get a site for a battery anywhere within reasonable distance. The stone has either to be hoisted to a battery site above the workings, as has been done, or else carried about 70 chains to below "The Falls" on the Wyniford River. A good battery site is obtainable at this latter spot, and has the advantage that it would be considerably below the large conservation dams, which, as pointed out in my previous report, could be, at small cost, constructed on the Sun and Wheal Tasman Flats, and close to the township. The dam at the township would be about 70 feet above the Wyniford River at the battery site, but there would not be very much pressure obtainable from the Wheal Tasman dam. I doubt very much if water-power sufficient to drive a large battery of, say 60 heads of stamps could be obtained, and unless this was the case there would be no advantage in having the mill so far away from the mine. It should not be forgotten in dealing with this question that a battery capable of crushing 1000 tons a week would in less than two years use up all the rock now exposed above the level of the tail-race, and that below this level both stone and water would have to be lifted. Under these circumstances, the only alternative to a plant driven by steam-power lies in the adoption of a scheme for bringing in power from a distance by means of electricity, which is quite feasible, or else in making a long and deep adit from the Lottah ground, on the other side of the Blue Tier range, of which I shall have more to say hereafter.

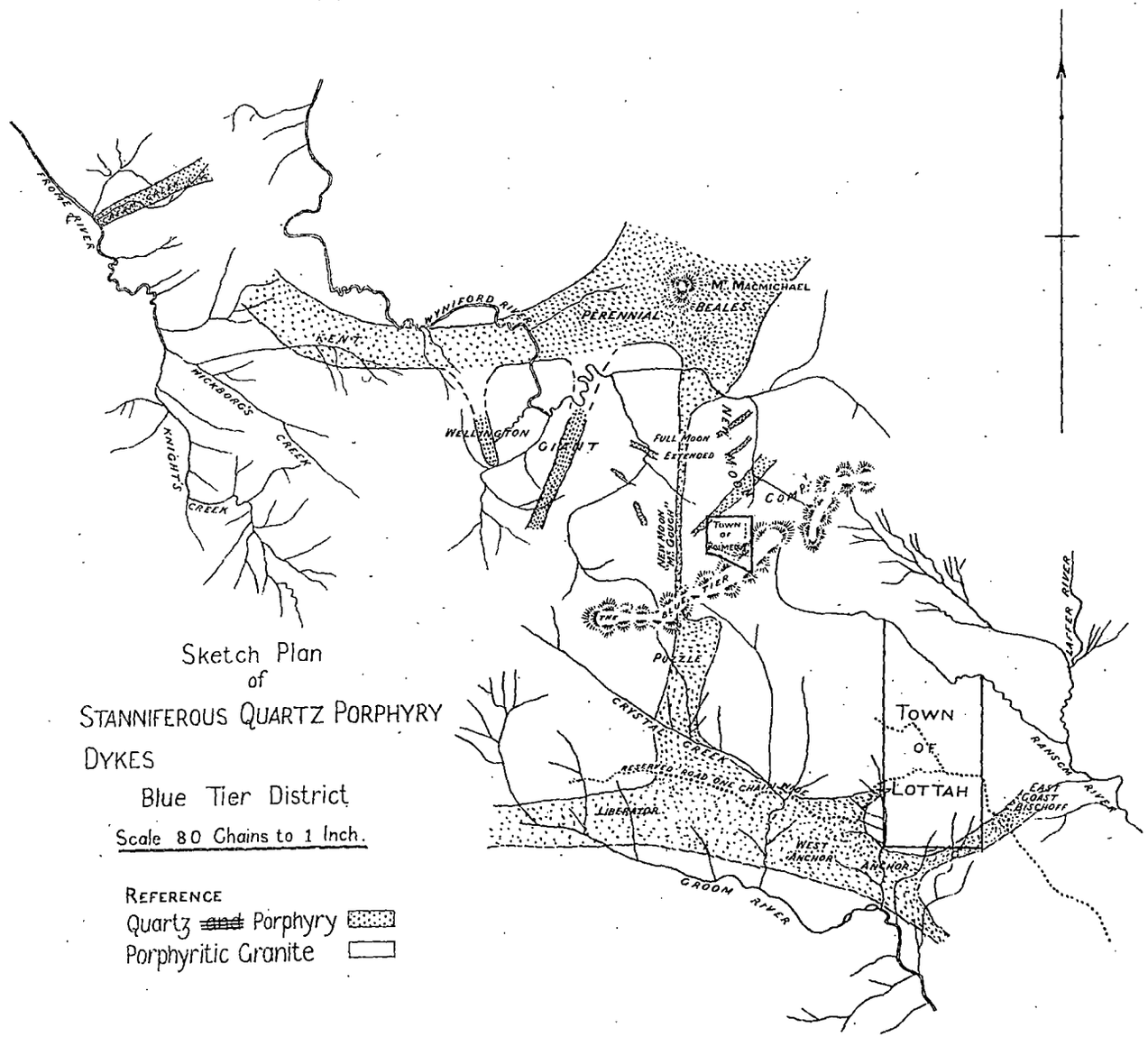
The New Moon Company on acquiring this property began to erect a 30-stamp battery, but owing to the failure of the Bank of Van Diemen's Land this was never finished. The property is, I believe, a good one, and with a large crushing-plant, not less than 50 stamps, capable of paying dividends; but, like all the other Blue Tier stanniferous dykes, the one now under consideration has not been proved to any depth, and before erecting a large mill this ought to be done, so that there should be no doubt as to there being supplies for it for many years of work. I know of no way in which this testing could be more cheaply and thoroughly done than by means of a diamond drill. With this machine it would be a simple matter to sink series of holes all over the tin deposit to any depth that might be thought necessary. If a reasonable number of holes were bored, and the cores carefully crushed and assayed as work went on, it would be possible to estimate with

substantial accuracy the value of the rock to the depth of the borings, and it would be a question then for engineering skill to decide if it would be possible to mine and mill the material at a profit. The preliminary expense of testing the ground by boring would be considerable, but I am convinced that it is the proper way to begin working these large low-grade deposits. The only way in which they can by any possibility be made to pay is by working them on an extensive scale, and before putting up the expensive machinery required for this, it is surely a business necessity to make certain that there will be enough ore to keep it in work. Boring would be preferable to shaft-sinking as a means of testing the deposit, as by its means numerous deep bores could be made all over a block of ground for the same cost as one shaft; and it is clear that the greater the number of places from which samples of the rock are taken the greater is the certainty that their average yield will truly represent the value of the entire mass.

In the portion of the New Moon property formerly belonging to the M'Gough T. M. Company work has been more vigorously carried on. A battery has been built near the north-west corner of Section 907, on a small stream which runs down to join the larger creek passing through the Blue Tier T. M. Company's ground. The plant consists of 15 heads of stampers and the 5 ft. Huntingdon mill that was formerly in the Full Moon battery; 2 stone-breakers, one for the Huntingdon mill, the other for the stamp battery, and 11 Frue Vanners, one of which is kept for finally dressing the headings from the others. A 40 h.p. engine drives the crushing-plant, and there is a separate small engine for the Vanners. The crushed stuff flows from the stamps and Huntingdon mill through launders to the Frue Vanners without any classification, which, in my opinion, is a mistake, as it is impossible to treat sands and slimes satisfactorily on the same concentrator simultaneously. The Frue Vanner does wonders in its attempt to do so, but makes better work when dealing with classified stuff; and, as the spitzlutten classifiers are cheap, simple, and automatic in their working, there is no reason why they should not be used, and so allow the tables to be worked to the best advantage,—some treating sands alone, and others set at a flatter slope devoted to the slimes. I observed two spitzlutten at the battery, but one had not been used, and the other was simply separating out any heavy sand remaining in the surplus water from the battery which had passed the feeding shoots of the vanners.

Mr. Henry Simpson, manager of the company, has been good enough to give me the following information as to working results and costs :—"I have taken a period from May 7th to November 11th as affording perhaps the best example. During that time 5037 tons of stone or tin dirt were crushed and concentrated. The cost of mining and delivery to battery was 2*s.* 3*d.* per ton; crushing and concentrating 4*s.* 3*d.* per ton; all other costs, including freight and management, 4*d.* per ton. This 5037 tons of stuff yielded 32 tons 13 cwts. 1 qr. 23 lbs. of tin, for which we received £1643 net. The highest assay was 73 per cent. and the lowest 65·8 per cent.; the average of 13 assays equals 69 per cent. approximately. These operations resulted in the ultimate loss of £77 15*s.* 9*d.* You will please understand that this is an approximate statement, but must be *very nearly* correct."

During the six months covered by Mr. Simpson's statement the Huntingdon mill was only at work for perhaps one month, and owing to want of boiler capacity was not working well during the most of that time, so the figures represent the performance of the 15 heads of stamps practically. The crushing capacity of the mill appears to average about 2 tons per head of stamps in 24 hours. The stone yielded ·6486 per cent. of black tin, and had a value per ton of 6*s.* 6¼*d.* All expenses amounted to 6*s.* 10*d.* per ton of rock treated, leaving a loss of 3¾*d.* per ton. I look upon this result as highly encouraging, seeing that it is the performance of only a small mill. The costs are less than half of those at the Full Moon battery quoted above, and would have left a good margin if the stone had been equally rich. With a battery four times as large as the present one, and better facilities for mining the ore and sending it to the mill, I think that stone containing only one half per cent. of black tin will yet be made to pay all expenses and a little profit. Want of capital has prevented the Company from increasing their milling power and saving expenses both in the mine and in the battery. For instance, at the time of my visit great trouble was being experienced in keeping steam up in the boilers on account of the miserably wet green wood that had to be used as fuel. The myrtle wood in a green state contains a great deal of moisture, and what was being used had only been felled a few days. Owing to the state of the company's finances they were not able to keep a stock of dry wood on hand, and had to use it as it came in. Dried myrtle wood is a very fair fuel, and if a good stock of it were kept on hand there would be no trouble in getting enough steam. There are other makeshifts in connection with the working very much on a par with the above, and only requiring a little capital to be put right, with consequent economy in working. In the mine the want of money is felt as severely as in the mill, and mining costs could be considerably reduced if it were better opened up. A tramway runs from the battery hoppers to the mouth of the adit mentioned in my 1889 report. This tunnel has been driven south along the dyke, and the stone above it is being sent down into it through hoppers. Several faces have been opened out, the deepest being 36 feet from the tunnel to surface: practically all the stone has gone through the battery. The stuff varies very much in value, but the good and poor stone are so intermixed that sorting is not possible to any extent. A face that is very poor one day often shows good stone after a few blasts have been fired in it, and *vice versâ*. If more faces were at work, however, it would be easier to keep the work of the mill uniform. The tunnel ought to be pushed



Sketch Plan
of
STANNIFEROUS QUARTZ PORPHYRY
DYKES
Blue Tier District

Scale 80 Chains to 1 Inch.

REFERENCE
Quartz ~~and~~ Porphyry
Porphyritic Granite

ahead of the working faces, so as to open up new ground and provide fresh places from which good stone could be got to make up deficiencies in the older ones. Several patches of good stone are known on surface south of the present workings; and the rich vein formerly worked by tributers as deep as they could go for water, with very good results, is also ahead of them. Instead of extending the present tunnel, however, it would probably be better to start a new one about 25 feet lower. To get this it would be necessary to cut a tail-race up the creek beside the battery, and drive some little distance through barren granite to the dyke, in order to get drainage for the workings. This lower tunnel would be below the battery hoppers, but not so far but that the stuff could be brought up to them on a gentle grade by the tramway. This uphill traction is undesirable, but I think the other advantages would compensate for it. From the lower tunnel it would be possible to work the rich ground round the old shaft near the north boundary, where the best ore known on the property has been obtained, and, in driving south, the height of backs above the tunnel would be from 20 to 50 feet, permitting of a much larger output of material than the present adit.

In the workings it has been found that the dyke encloses occasional "horses" of the main granite, or else sends branches off into it, as the latter has now been found in more than one place with the quartz-porphyry on each side of it. The line of demarcation between the two is always quite distinct, there being no visible gradation from the one to the other as far as my observation went.

As natural drainage cannot be got for this mine without a very long adit, it will eventually require to be worked from a shaft, in which case a new battery site will probably be chosen near the shaft,—the mine water raised by the pumps being used for the dressing plant. While the working results so far show that the average value of the stone is very low, I do not think that it is by any means hopeless to work it profitably; but, to do so, it will be necessary to deal with it in large quantities, and with the aid of every labour-saving contrivance. Only by a large expenditure to begin with can it be made to pay. On the other hand, the large quantity of stuff exposed makes it almost a certainty that if a margin of profit can be realised the mine will be steadily reproductive for a long period, and thus give better results to the investor than more brilliant yet more ephemeral mines.

Full Moon Extended—80-acre Section No. 1632M, and 40-acre Section No. 271-91M.—Nothing had been done on this property since I previously reported upon it, though an attempt was being made to pump out the shaft. This was not successful, owing to the boiler being too small to keep up the required head of steam for the Blake pump. There is some very fair tinstuff in this ground, and the owners were anxious to get into the shaft in order to take out 50 tons for a trial crushing. A few tons of very nice-looking stone had been scraped together from the surface trenches to help to make up the crushings, but no new work of any consequence had been done. The workings are on the same dyke as those of the M'Gough T. M. Company last mentioned, and show tin ore pretty freely in many places. A considerable quantity of ore could be got by driving the old tunnel from the Wyniford River south along the dyke; and this, though not very deep below surface, would test the superficial portions of the tin-ground pretty thoroughly; but I am inclined to think that it would be better to sink a shaft for drainage and hoisting, and work from it rather than from the adit. The dressing sheds would probably be best situated on the Wyniford River. A great deal more prospecting will have to be done before it can be estimated if this property is likely to be payable; and this will require considerable expense. There is every reason, however, for spending the money needed to test the ground, as the development so far as it has gone has given fair promise of success.

When I formerly visited the district I did not see any sign of the quartz-porphyry crossing the Wyniford River, and was told that it did not crop out in it; but if I had gone a little higher up the stream I should have seen it. It comes in a little above the adit, and extends right up to the "Falls," a distance of 12 or 15 chains; but in all this portion it seems to be very dense and barren. On the north side of the river there is a very large development of the quartz-porphyry, in the Sections next to be described.

Sections 2292-87M, and 405-91M.—These lie at the base of the small peak known as Mount Macmichael,—the south-west corner peg of Section 405-91M being right on the peak. A good deal of stripping of the surface soil has been done in Section 2292-87M by Mr. Beales, with fairly satisfactory returns of ore. The tin ore in this surface stuff is not waterworn, and is in small black grains exactly the same as those found in the underlying quartz porphyry. The loose ore on surface is evidently derived simply from the weathering of the bed-rock *in situ*. This has been stripped by sluicing for a space of perhaps an acre and a half without exposing any of the main country granite. Parts of the quartz-porphyry are poor, but a little tin ore seems always to be present; and there is a considerable area, probably over quarter of an acre in extent, which shows tin plentifully, and ought to be payable. The whole extent of the rich ground is not yet known, as the stripping has not gone far enough to bare it all. The tinstuff is exactly similar to that in the New Moon Company's mine. In Section 405-91M very little work has yet been done, but

some nice tin prospects have been obtained in alluvial ground from one to three feet deep. In this there is a great deal of white angular quartz in large lumps, from which it is probable that there is a lode of some sort in the vicinity. These two sections, generally known as Beales', seem likely to be valuable, the prospects of tin being equal to those in the greater part of the New Moon and M'Gough workings; and, if the latter can be dealt with at a profit, it is probable the former will also pay.

Perennial—Section 1610-91M, formerly 791-91M.—Near the eastern boundary of this section a patch of rich tin-bearing quartz-porphyry about 12 yards square has been laid bare by sluicing off the surface soil. Some 59 cwt. of tin ore was obtained from this small area. The tin-stuff in the bed-rock is soft and easily crushed, but would no doubt get harder in depth. The stuff is quite similar to that in the other stanniferous dykes; and if further prospecting should prove that there is a workable extent of it, this mine will have much the same prospect of success as the others in the district on the same class of stuff. Besides the section named, the Perennial Company also own Sections 834-91M and 792-91M. There appears to be a very large dyke of quartz-porphyry running south west from Mount Macmichael through these sections towards the Kent Company's ground; and there is much likelihood that when the surface is cleared other patches of payable tin-stuff will be found in it. The presence of loose tin ore in unwaterworn crystals in the surface soil would be the readiest guide to the prospector in discovering these.

Mount Macmichael—Section 91-91M.—It was in sluicing some surface stuff towards the west boundary of this section that the tin ore which was worked on the Perennial Company's adjoining section, 791-91M, was discovered. The quartz-porphyry formation extends through the Mount Macmichael Company's section into Beales', but very little has been done to test it except the above little bit of sluicing. A small tunnel has been begun near where the Perennial Company's discovery was made, but, after cutting an approach about a chain in length and driving 25 feet, work was abandoned. A little tin is to be seen in the approach and tunnel, but not payable. Lying as it does between the Perennial and Beales' discoveries, this seems a likely section and should be well prospected.

Kent—Sections 518-91M, 519-91M, 520-91M, 516-91M, 517-91M, 42-87W, 1145M, 670-91M, 667-91M, 668-91M, 669-91M.—There is here an occurrence of tin ore quite similar to the foregoing ones. Several acres of ground have been stripped and sluiced, with fairly good yield of tin ore, and in the quartz-porphyry bed-rock several patches have been found pretty richly impregnated with it. Three or four very shallow holes have been cut into some of these, and some very good tin stuff taken out. There seems a strong likelihood, from the extent of surface soil that has proved stanniferous, that there will be a correspondingly large area of tin-bearing rock below, but a lot of work will have to be done to prove this. The property ought to be prospected thoroughly, for if the stone should prove payable the working facilities obtainable are better than in the other properties that have yet been mentioned, there being a very steep fall from the west side of the holding to the Frome River.

Cream Creek.—The sections formerly held by the Cream Creek Tin Mining Company, No Liability, have all been given up again by them, except 758-87M, on which the battery was situated. Part of the old mine has again been recently applied for by a party willing to give it another trial. The tin-bearing rock is the same as in the preceding cases—a quartz-porphyry of variable composition impregnated with tin ore. It is possibly connected with the large dyke which seems to run all the way from Mount Macmichael to the Kent holding, but I cannot say that this is so for certain. The course of the workings in the Cream Creek mine is between N.E. and S.W., and E.N.E. and W.S.W., and if this is the course of the dyke it would run very much at right angles to the other one. The workings are situated on the slope of the range lying between the Wyniford and Frome Rivers, and extend nearly down to the latter, the battery being situated near the S.W. corner of Section 758-87M. The reduction plant consisted of 15 heads of stampers, and the dressing machinery of three pairs spitzlutten, 4 pairs jiggers, 1 pair dressing-jiggers, 3 18-ft. Kayser-buddles, 2 15-ft. single slime-tables, and 1 15-ft. double slime-table, all driven by a turbine and a 3-ft. Pelton wheel, with a water-pressure of 94 feet. The crushing capacity of the plant was about 240 tons a week; its cost when completed about £6000. The machinery was well constructed and of a good type, being the same as is used so successfully at Mount Bischoff. It has since been sold to the Brookstead Tin Mining Company, and has, I understand, been removed by them. Mr. Thomas Oldham, who was mining manager of the company during its operations, informs me that 4375 tons of stone were crushed for a return of 21 tons of tin ore, worth, on the mine, £50 a ton, or £1050. There were also obtained five tons of tin ore from alluvial workings. The stone yielded ·48 per cent. of black tin, and had a value of 4*s.* 9½*d.* per ton, which was not payable. I have been unable to obtain the cost of mining and milling in this instance. The stone crushed, however, was only a small fraction of the quantity broken out, probably ten tons being rejected for every one that went through the battery, and the mining costs per ton crushed would, therefore, be very high. The milling should have been done very cheaply, as the whole plant was worked by water-power, and only a very few hands were required. In all the company spent about £12,500, of which probably one-half was expended in mining work. Five principal faces have been opened along the dyke on the slope of the hill, and connected with the battery by means of a tramway. This, how-

ever, was not, as might have been expected, a self-acting grade, but an ordinary horse-tramway, and as the different faces are at different heights a series of hoppers were required, necessitating four or five handlings of the rock from the highest faces before it got into the battery. The stuff from the highest face was carried a short distance in trucks and shot into a hopper, which lowered it to the level of the tramway from the next lower face; that coming from both these faces was then trucked along almost on the level for a few chains further and shot into a hopper, to be discharged at the next tramway line below, and so on. This was a very uneconomical way of working. The slope of the hill is very favourable for the construction of a self-acting grade, and it would have been an easy matter to arrange this, so that the rock from each face should go direct to the battery without handling on the way.

A very large quantity of stone has been mined and rejected, though most of it contains a little tin ore. I cannot help thinking that it would have been better to have put a great deal of this through the battery, so long as it would pay the bare cost of crushing and concentrating. The net financial result would be the same, but the output of the mine would be greatly larger, and it would have been possible to estimate the value of the rock in bulk and come to some conclusion as to whether it could be made to pay with a larger and cheaper battery. The best-looking ore is at the highest face, where there is some very nice tin in a softish talcose matrix, containing in addition a good deal of copper pyrites in parts. This face seems very likely to be rich enough to pay for working, and is therefore worth further trial.

Very fine specimens of rich tin stuff have been obtained from various parts of the workings, but they were found very irregularly distributed, and a single blast was often sufficient to tear out all the payable rock in a face; nevertheless, there is hope that portions will still be found rich enough and large enough to be profitably worked; and it appears to me a fair mining speculation to spend some money in prospecting for these. A systematic test ought to be made of all the rock exposed to ascertain if it could be worked successfully without selecting the ore. The working facilities being very good, a very small percentage of tin might be made to pay, and I cannot regard the trial made by the late company as conclusive that the ground is worthless.

St. George's—Section 1578-91M (formerly 375).—This ground has been held for many years without any work being done on it, but lately a party of men have traced a run of nice heavy alluvial tin up from the boundary of the New Moon Company's sections into it, which they have been sluicing with payable results. This alluvial stuff is in a flat depression in the ground sloping down to the Full Moon Creek, and is mostly pretty shallow, from one to three feet deep. The tin ore is much coarser than that found on the surface of the quartz-porphyry dykes, and resembles that got in the Full Moon Creek and on the Lottah ground, which was probably derived from lodes and veins. The country rock in this section appears to be all the main granite, not the stanniferous quartz-porphyry. The alluvial tin having the appearance of having come from a lode, search was made for this, and at about the line on the hillsides, where the alluvial tin ore ceases to be found in the surface soil, one was found. It has been trenched across, and shows six feet in width of hard quartzose lode matter, striking N. 40° W. A little coarse tin ore has been found in some of the quartz. No sinking had been done when I saw it, but a few trenches had been put in across the line of it N.W. and S.E. from where it was struck. In these nothing was cut but small leaders. I rather suspect that the apparent 6-ft. lode of quartz is only a flat vein, and that on sinking it would be cut through very quickly; however, a little work would soon resolve the matter.

Puzzle—Sections 1173-91M, 1174-91M, 198-91M, 345-91M, 1515M, 343-91M, and 344-91M, comprising 140 acres. This ground is taken up on a quartz-porphyry dyke which extends from the top of the Blue Tier range down to the Crystal Creek: it is connected with the dyke in the New Moon Company's Sections 907 and 908, and also with the large mass of quartz-porphyry extending westward from the Anchor mine. A small branch of the Crystal Creek runs southward through the holding, and a good deal of ground sluicing has been done along the upper parts of this, the quartz-porphyry being bared for an area of about 3 chains long by one chain wide. The average depth of the surface soil stripped would be about two feet, though lower down it is 6 or 8 feet deep in parts. About 12 tons of tin ore have been raised from these workings. Most of the quartz-porphyry so far stripped is very barren, but there is a little tin frequently obtainable by crushing and washing it, and in one place a large boulder was found with very good tin ore in it. In sluicing, some remarkably rich pieces of stone have been picked up, which must have come from the slope higher up. About two or three chains south of the north boundary of Section 1515M, and at a height of 700 feet above the Crystal Creek, the tin-bearing rock begins to be found *in situ*. A number of prospecting trenches have been sunk in a line running east and west for a distance of about 5 chains. In all of these fair tin ore has been got, especially in those towards the west end of the line, where some of the rock must contain 8 or 10 per cent. of ore. The rich stone contains much green talc. In the eastern trenches there is a good deal of silicious gossan, some bornite, and a little wolfram, and it looks rather likely that there is a lode running east and west through the quartz-porphyry. The prospects of tin all along this line of trenches are so good that the work of opening the ground further ought most certainly to be gone on with with all possible despatch. About a chain higher up the hill another east-and-west lode is met with,

consisting of micaceous quartz containing much copper pyrites and a little tin ore. These lodes may prove to be true lodes of considerable size and length, or they may be simply short bodies of quartz-porphyry much altered by infiltration of silica: they will have to be better laid open before their true nature will be evident. Going still further north a few more holes are found in which tin-bearing porphyry has been exposed: one of these is about the centre of Section 198-91M, and shows a very white typical quartz-porphyry containing probably quite three per cent. of tin ore. Good tin is again seen in a hole close to the S.W. corner of Section 1173-91M, in quartz-porphyry, and also in another hole about 4 chains further north. Near the extreme north of the holding and right on the top of the range there are two more holes showing tin ore pretty freely in the rock. As mentioned in my former report, tin was found still further north again, in a shaft about 60 feet deep, in the old Ethel Company's ground and in several trenches; and it would appear likely that the dyke is stanniferous from here right through to the New Moon workings (M'Gough's section). So far as the Puzzle holding is concerned we may say that from the extreme north boundary of the property to two or three chains south of the north boundary of Section 1515M, a distance of 26 chains, every hole that has been sunk into the quartz-porphyry has proved it to be tin-bearing, and probably rich enough to pay for working. The ridge of the Blue Tier range at the northernmost boundary is 160 feet above Poimena township and 1100 feet above the Crystal Creek, and the ground slopes very steeply down to the latter. The upper part of the ground could be worked from either side of the range, but it would be best to work from the Crystal Creek side. Numerous open working faces could be cut into the tin-bearing rock, and the stuff from them sent down to a dressing-shed at the Crystal Creek by a self-acting tramway, at a very low cost for transport. A good battery site is obtainable at the Crystal Creek, and plenty of water for dressing purposes: I am not sure that there is water-power enough to drive a very large battery in the Crystal Creek; but, as the battery site would be over 1000 feet below the top of the range, it ought to be possible to bring in other streams as well, and so obtain the water supply required. Some 20 to 30 chains up the Crystal Creek, from its junction with the small creek running through the Puzzle workings, there are some falls in the stream; and above these falls there is a very good site for a dam which would impound a large quantity of water. From this dam to the battery site there are about 130 feet of fall. The Crystal Creek is a permanent stream and always contains a good deal of water, and in flood-time a very large volume. I do not think that there should be any extraordinary difficulty in getting sufficient water-power to work a large battery, if care were taken to conserve the rainfall as much as possible by constructing numerous small dams along the courses of the various small streams wherever the ground was favorable for doing so.

This property is very well situated for cheap working, and appears to me likely to be a very valuable one. It is very probable that when more of the quartz-porphyry formation has been laid bare by sluicing away the surface soil that payable stone will be found lower down the hill nearer the Crystal Creek than that now known. But even if this were not so, I think that a highly payable mine could be opened up, unless the present appearances are very deceptive. More trenching should be done on surface, in a systematic manner, so as to determine the area of good ground and the average value of the stone all over it; and as the hill is very steep, and testing by means of a tunnel consequently easy and inexpensive, an adit should be driven to try the quality of the dyke-stuff at a depth. A tunnel driven at the north boundary of Section 1515M would be about 400 feet below the top of the range. Should it demonstrate the existence of tin-bearing rock for a distance corresponding to the surface distribution there would be work for a century to mine and mill it at the rate of 1000 tons a week. This gives some idea of the magnitude of these stanniferous formations at the Blue Tier, and of the immense importance to the Colony of ascertaining as soon as possible how to work them profitably. As pointed out in speaking of the New Moon mine, the first step is to prove how deep the tin-stuff extends, and to make sure that the quantities and values anticipated on the strength of the surface appearances are really present. If they will average over one-half per cent. of black tin, I feel certain that they can be made to pay.

Anchor.—The workings of this Company are in the vicinity of the north-west angle of Section 893, being partly in this section, partly in 1211A, and partly in 274. In addition to these sections the owners hold several others, amounting to about 300 acres in all, but I am not sure of the exact numbers of the sections. This mine was described in my former report, and I have now to add principally particulars of work done since. The battery has been very much improved by throwing out the old cumbrous dressing appliances and substituting Frue Vanners. There are 40 heads of stamps in the mill, but only 30 are in use,—the remaining 10 being very much out of order. A stone-breaker has been placed between the tipping-frame and the feeding-floor of the battery, and crushes the coarse lumps of rock before they go under the stampers. 15 heads of stampers are fed with stuff from the stone-breaker, and the other 15 are supplied with fine stuff from the mine trucks direct. No mechanical feeders are used,—boys doing the work. The stone-breaker is awkwardly placed, and two men have often to be kept shovelling away the crushed material to keep it clear: this wants alteration. The battery crushes on an average about 170 tons a week, or barely one ton per head in 24 hours: this is a very poor result considering the ease with which the rock is crushed; a good battery ought to put through three tons per head per day. The boxes are too wide, and consequently there is very poor discharge.

The whole battery wants extensive repairs. The stuff from the battery goes into three of the old separating tubs, which have been altered so as to work on the spitzlutten principle, though not nearly so effective as good spitzlutten. The sands are concentrated on four Frue Vanners and the slimes on two, and there is another one used for finally dressing the headings. The battery is driven by a large overshot water-wheel, 64 ft. in diameter and with 4 ft. breast: the vanners by a 4 ft. Pelton wheel under a pressure of 50 feet of water.

Since the present proprietors have had the mine and the Frue vanners have been put in, 12,307 tons of stone have been crushed for a yield of 134 tons of tin ore, realising a return of £6322. The rock therefore contained 1·09 per cent. of black tin, and was worth 10*s.* 3¼*d.* per ton. The average quantity crushed has been about 170 tons a week, or a total value of £87 6*s.* The average expenses per week for all wages on the mine and mill are from £50 to £52, to which have to be added the cost of supplies, interest on cost of plant and sundry other expenses, an exact statement of which I have not been able to obtain. There is a profit of, probably, about £30 a week on the operations, and the cost of treatment per ton of rock is about 6*s.* 9*d.* This could be materially reduced by improving the mill and the methods of transporting the rock to it; the latter are very bad, the stuff having to be handled about six times. There are nine principal working faces and several smaller ones at different levels on the slope of the hillside, and the rock is shot from hopper to hopper, from the higher ones to the lower, in the same way as above described at Cream Creek. The hillside is steep, and all the faces could be easily connected with the battery by a self-acting grade. With improved methods of mining and milling I still think that the rock ought to be dealt with on this mine for not more than 4*s.* a ton.

The tin-bearing quartz-porphyry has now been exposed in this property over an area of about 8½ acres, and the full extent of the stanniferous ground has not yet been laid bare. The highest face is 185 feet above the battery hoppers, and the slope of the ground most favourable for open quarrying. The different working faces are so distributed over the tin-bearing area that we can safely regard their produce as the average of the whole of the surface stuff. The superficial rock is softer, more clayey, and more easily crushed than the less decomposed rock lower down, and work has consequently been mainly confined to the easily mined stuff; but, so far as I could see, there was no perceptibly greater richness of the surface portions. Very little rock has been rejected, and we may fairly, I think, take the results of the crushings as showing what the whole rock mass would average. The old company got 154 tons of black tin from 18,427 tons of rock, and the present owners 134 tons from 12,307, the total produce to date being therefore 288 tons of black tin from 30,734 tons of stone, an average of ·937 per cent.

As more work has been done on this mine than on any of the others at the Blue Tier, and as it has the advantages of a splendid situation for working, and of possessing water-power for driving the mill, it offers the best opportunity of any for the investment of the large capital required to work these stanniferous dykes to the best advantage. If the surface stuff is fairly representative of the general value of the dyke matter for a hundred or more feet in depth, there should be no doubt as to its being a highly payable concern and one of great magnitude. In order to prove the deposit thoroughly I should recommend the free use of a diamond drill; but a good test could also be made by driving into the hill from the lowest face and making cross-cuts from the tunnel. It appears to me that there is every reason to believe that the rock at a depth will be as good as that on surface; but this ought to be proved without any possibility of mistake. Having proved it, a battery of 200 stamps might be put up with confidence.

On the south side of the Groom River and between the latter and the battery there is a considerable area of alluvial ground that is very likely to be payable. It has not been worked on account of want of outlet for tailings, and because some of it is deeper than the bed of the Groom River, but the use of a hydraulic elevator would surmount both these difficulties. The ground is well worth a trial, and would probably reward the company well for working it.

West Anchor.—Very little has been done on this company's ground, which lies immediately west of the Anchor workings. A few trenches have been cut which show that the quartz-porphyry exists in large quantity, but so far it has been poor, though very nice tin-ore was found in a patch in one of the trenches. A great deal more work has to be done before it can be known whether there is anything payable in the ground.

In Section 383-91M belonging to this company a number of small parallel veins of quartz, very close together, are seen in the banks of the Groom River, composing a band about 12 feet wide in the main country granite. There are about 20 of these small veins in the 12 feet. The veins themselves are very small, ⅛ or ¼ of an inch in thickness only, but the granite on each side of them is often hardened and altered by infiltration of silica. A little tin-ore, a good deal of copper pyrites, and a little wolfram are to be seen in the veins, but nothing payable. The course of the veins is about S. 65° W. The occurrence is very similar to another seen in the Great Eastern property, to be described below.

East Coast Bischoff—Sections 69-91M, 252-91M, and 253-91M.—A branch of the Anchor dyke of quartz-porphyry runs north-easterly into Section 69-91M, and in this a quartz lode has

been discovered traversing it. A shaft 25 feet deep has been sunk on this, in the bottom of which the lode is composed of two feet in thickness of quartz, much iron-stained, and containing occasional largish flakes of mica. Strike, S. 35° W.; underlay, 1 in. 8 to N.W. On the foot-wall of the quartz vein there is about two feet in thickness of soft talcose clay containing a good deal of tin-ore. There appear to be several quartz veins in the country round the shaft, and some work might be done with advantage to develop these. About 15 feet from the surface the lode widens out to 6 feet of hard flinty quartz. I saw no tin-ore in this, but on surface there were a number of pieces of very rich ore in stone evidently from this part. It appeared to me very possible that the bulk of the lode lay to the westward of the bottom of the shaft, and that the lower part of the latter has been sunk on a branch of the main vein. So little work has been done that no decided opinion can yet be formed as to this. Some very rich specimens have been exhibited as coming from this shaft, but very little tin could be seen in it anywhere at the time of my visit. Thirty-three feet below the mouth of the shaft a small adit has been driven S. 15° W., a distance of 31 yards, almost under the bottom of the shaft, and a few feet past it, and a small cross-cut, 11 feet long, has been put in to the westward from the end of the adit. The country passed through in both shaft and adit is soft weathered quartz-porphyry, in parts a good deal stained with oxide of iron. I saw no tin in it, but a little is said to have been got here and there in driving. In the end of the drive there are some veins of quartz visible, but I saw no tin-ore in them, and they seem to me to be rather irregular strings than well-defined lode-masses. The quartz-porphyry being *par excellence* the tin-bearing rock of the Blue Tier district, it is reasonable to suppose that lodes traversing it will be rich, and there is no doubt that there have been some rich pockets in this one, but so far as yet exposed it is far from payable. A great deal of harm has been done to the claim and to the district by wildly extravagant statements about the East Coast Bischoff lode, and it is to be hoped that those concerned in the mine will prevent a repetition of these, and do some more work underground to prove if there is anything payable there. About a chain south-west of the principal shaft there is a hole about 10 feet deep in nice-looking soft quartz-porphyry, but I could see no tin in it. Very little work has been done on this property, but it shows that the ground is worth prospecting.

Volturno.—Sections 309-91M and 310-91M. A good deal of alluvial tin has been won from this property, which is on the main country granite. Two or three chains to the south west of the centre of Section 310-91M a large excavation has been sluiced out of the soft granite, and a small covered tail-race has been constructed. Several small soft veins traverse the granite and yield tin. One in particular is mostly soft talcose kaolin and mica and rubbly quartz, about 6 inches thick, lying pretty flat, its dip being about 15° to the westward. This is very rich in tin in parts. About two tons of tin ore in all were obtained from this place, but the vein got smaller as work progressed. A small shaft has been sunk in the bottom of the excavation, and in the hard granite brought up from it I noticed a small quartz vein with copper pyrites. The shaft was full of water, so could not be examined.

Crystal.—On Sections 202 and 203 a great deal of alluvial work has been done, and much tin been obtained, but not much is now being done. At the Crystal Creek there is still a good deal of flat ground to be worked, and an attempt is being made to do so with a small hydraulic elevator of a primitive design. There is not the least doubt that the low-lying ground could be easily worked by hydraulic elevators, and as high pressure water is easily obtainable there is no reason why it should not be tried.

Some six or seven chains from the eastern boundary of Section 203, towards the north-eastern angle, a lode has been discovered running north and south and underlaying a little to the west. The soft outcrop has been worked by sluicing to a depth of often 12 or 15 feet, as deep, in fact, as it was possible to go with safety, for a length of 5 or 6 chains. The lode is said to have been up to 4 feet wide, and very rich: it must have been good to pay for the removal of so much barren granite along with it. Numbers of rich specimens are to be seen in the forkings from the sluicing. The bottom of the workings is now all full of rubbish and dirt from the sides, and the lode cannot be seen. In the north end it is visible, but has become hard and split up into veins. This lode, from what I have seen and can learn, is worth a mining trial: it can be easily driven on by a tunnel, as it strikes right up a steep hillside. The top of the workings on it are about 420 feet above the Crystal Creek.

Great Eastern—1051-91M and 2004-87M.—Passing through the north-east corner of Section 2004-87M, about three chains from the corner-peg, there is a group of small parallel quartz veins, striking N. 25° to 30° W., carrying a good deal of tin ore. The country rock is the main porphyritic granite. The formation, which might almost be called a stockwork, is from a chain to 30 yards in width where it has been laid bare, and has been traced to the south east for about 15 chains. The veins are from one-eighth to one-fourth of an inch in width, rarely half an inch, and a very few up to 1½ and 2 inches. The granite on each side of the quartz veins is often impregnated with silica and altered considerably. On the surface the little veins, owing to their greater resistance to the weathering action of the atmosphere, stand out in small ridges up to half an inch high from the general surface of the granite. They are often very rich, but contain a good deal of wolfram as well as tin ore. Some years ago a shaft was sunk 25 feet on the east side of the formation, and a drive

was put in to the west across it. This is now inaccessible; the veins are said to have been got as on surface. The rock is very hard, and I doubt very much if it could be made to pay. There are, without dispute, a large number of small rich veins, and the stanniferous ground is a good width, so that the rock could readily be broken out in quantity; still I am afraid so much barren rock would have to be treated that the rich veins would not pay for the whole. It is an interesting occurrence of tin ore. In order to ascertain the bulk value of the rock several trenches might be cut across the group of veins, and the stuff from these crushed and dressed. A test of 50 or 100 tons would afford data for an estimate of mining and milling costs, as well as of the value of the rock. Such work as has yet been done is in the south-east part of Section 1051-91M. On the line of the formation to the south-east, close alongside the main road, Messrs. Bak Hap obtained 19¼ cwts. of tin ore from a patch of shallow alluvial ground about 100 feet long by 30 feet wide. A great many pieces of stone showing a small quartz vein flanked by dark altered granite were picked up in working, showing that the tin was probably derived from the group of veins.

Cambria—1510M, 482-91M, and 577-87M.—These sections are situated on the edge of the Little Plains, and present several features of great interest. They are situated on a number of steep spurs and gullies towards the head of the Waratah Creek. The lower-lying ground is all porphyritic granite, but the highest parts are overlaid by basalt of probably Tertiary age. Traces of a marine formation of age intermediate between these rocks are pretty common also, especially towards the western part of the property, loose boulders of the fossiliferous sandstones and mudstones of the Lower Coal Measures (Permo-Carboniferous) being very abundant, also boulders of hard conglomerate. We must therefore expect to find in this vicinity the tin-bearing granite in places covered up by the younger sandstones and basalts. In the workings furthest to the north in Section 1510M close to the edge of the basalt the alluvial stuff shows a tendency to dip under the latter, and as no doubt the outpouring of basalt completely altered the course of the streams then in existence, there is a considerable probability that deep leads may be found beneath it.

This locality has been a notable producer of tin in the past, and a fair amount is still being obtained. The present owners (Messrs. Cooper and party) have raised 30 tons, their predecessors got 400 tons, and a large quantity was also obtained by Chinese tributers. A great deal of the tin ore is not much waterworn, and probably has not been carried far from the parent lodes.

There are two or more sets of lodes running through the property, one set running north and south, and another about north west and south east, while some other veins have been laid bare which seem to run a course between those of the two main sets. It appears to be characteristic of the lodes that they consist not of one vein but of several parallel ones lying close together and sometimes running into one another. The outcrops have been laid bare by sluicing the surface, and consist of talcose clayey matter mixed with rubbly micaceous quartz, and often contain very good tin. From the prospects I saw washed I should judge that the lodes must be payable to work or very nearly so, but of course a much more extended trial should be made before any value is attached to this opinion. The lodes are certainly good enough to be worth giving a working trial by sinking pits on them at intervals, and taking out 50 tons or so for a bulk test.

Some years ago a beginning was made at working the lodes. A tunnel was driven 300 feet eastward from a gully close to the lodes, and cut both the north-and-south and the north-west and south-east lines. The former was driven on to the north for about 30 feet, and the latter for about 30 feet from each side of the adit. An intermediate lode was also cut and driven on a few feet. The tunnel is now very dilapidated and dirty, and a good view of the lodes is not obtainable, but still a good deal of tin ore can be seen. In the stone at the mouth of the tunnel tin is freely visible, yet the best part has been taken away. Chinese tributers sluiced a good deal of the stuff, and got some 26 cwts. of tin by this rough treatment. The tin ore is generally in large coarse crystals, and the best ore seems to be found in a talcose quartz. In all the Blue Tier lodes talc seems to be a very good matrix for tin.

The north and south line of lode has been traced about 30 chains. In Section 577-87M it is seen in the old South Cambria shaft, said to be 120 feet deep. Fair prospects may be washed from the loose stuff lying about the shaft, and tin is also visible in the lode to the north of it, where it is cut through by two small creeks.

On the north-west and south-east lodes in Section 1510M an old prospecting tunnel was driven. This is now inaccessible, but a lot of very good ore from it is lying about the surface. There would be no difficulty in getting together several tons of very good ore from the various workings that have been made. I do not know what was the reason why working the lodes was abandoned. The amount of work done was certainly not sufficient to give them a proper trial, and as far as can now be seen the quality of the ore obtained was very fair indeed. The lodes are of fair width, from one to six or eight feet, and traced tin-bearing over considerable distances, and the shape of the ground is highly favourable for working by means of tunnels. A good supply of water for milling is obtainable, and I rather think that water-power for driving machinery could be secured by making conservation dams. Altogether the property appears to be a very promising one, and well worth a thorough mining trial.

Liberator, 2521-87M, 346-91M, 237-91M, 3140-87M.—These Sections are on the quartz-porphyry formation which is pretty continuous from the Anchor mine to here. About three chains south of the north-east corner of Section 2521-87M is the highest point of a small rounded hill from which the ground slopes gently to the northward, and rapidly southward to the Groom River. On the northward slope a good deal of surface sluicing has been done with payable results, the tin ore being the fine black crystalline sort characteristic of the quartz-porphyry formations. The rock bared by sluicing contains a little tin, but not enough to pay as far as I could see, but round the top of a small hill for about an acre in extent it appears to be much richer. Right on the top of the hill a shaft eight feet deep has been sunk which contains tin ore pretty freely from top to bottom: two samples taken from it by Mr. Danvers Power, F.G.S., are said to have yielded 1·52 per cent. and 1·05 per cent. of metallic tin respectively: a sample taken by myself and washed on the spot gave a result of about the same value. Several other small holes have been made near the main one, and in all of these fair tin is to be got. The stuff is not rich, but should run about the same as the M'Gough portion of the New Moon Mine, probably from ½ to 1½ per cent. of black tin, over an area of at least an acre. . As the alluvial stripping progresses and the surface of the rock is laid bare, it will be seen how much stanniferous rock there is, and a better idea of its value will be obtainable. If the other dykes on the Blue Tier should prove payable this one also should be well worth working, and it would therefore be advisable for the owners to open it up sufficiently to prove its extent in area and depth. The latter could be most easily tested by diamond drills, but might also be effected by means of adits from the steep slope to the Groom River, which is 350 feet below the crown of the hill. An adit 1250 feet in length would be required to reach from the side of the river to a point below the shaft, but shallower adits could be put in higher up the hill with less length of driving. As all the face of the slope is quartz-porphyry they would be proving likely ground as they went along. A good battery site can be got down at the Groom River, and the stuff could very easily be sent down to it by a self-acting incline. There is always a good deal of water in the river, and I do not think there would be much trouble in getting water-power for a battery even of 50 or 60 heads. The working facilities being good, I therefore regard this as a very likely mine.

Waverley Lode, Weldborough.—Though not in the Blue Tier District proper, this lode was visited by me immediately after leaving the latter, and was found to be similar in many respects to the Cambria veins. The granite country of the Blue Tier is continuous right down to Weldborough, and, geologically speaking, both places are in the same formation. The behaviour of the Waverley lode may therefore be a guide to what to expect of those at the Blue Tier. The Waverley mine is close to the township of Weldborough, and has been working alluvial ground for many years, about 1500 tons of tin ore having been obtained from it. In sluicing, several veins of quartz traversing the bed-rock have been laid bare, and some of these contain tin; but the best lode-stuff yet found is on the hill side above the alluvial workings. The outcrop is about 230 feet above the main street of the township, and consists of a bunch of micaceous quartz veins, associated with kaolin and talc, and carrying rich tin, and often a good deal of tourmaline. In all there appear to be some 10 or 12 feet in width of tin-bearing veins, with granite separating them, the veins themselves being 2 to 12 inches in width. The outcrop has been worked by sluicing to a depth of 15 or 20 feet for a distance of perhaps a chain. The veins run from N. 7° W. to N. 15° W., and appear to come together towards the south end. Here a short surface drive has been put in, following a vein of quartz and tourmaline 6 inches wide, carrying good tin. All the veins underlay westerly into the hill. The outcrop seems to have been largely composed of very soft lode matter, from which the tin was easily got by sluicing. The mean course of the bunch of veins is about N. 5° W. In order to cut the lode at a greater depth a tunnel has been driven about 82 feet below the outcrop a distance of 302 feet. This tunnel is not driven to come in right under the surface workings, but under a point some 200 feet south of them. The line of lode was laid out as S. 14° E., but if the mean bearing of the branching veins is taken, I think S. 5° or 7° E. would have been nearer the mark: the vein cut in the tunnel below is as seen below S. 7° E., and is probably parallel to the main belt of lodes. Owing to this bearing being taken the lode was expected to be cut at about 302 feet, but it seems to me to be more likely to be about 40 feet further in. The tunnel passed through soft decomposed granite for about 285 feet, and then struck the hard unaltered rock. At 290 feet a small quartz lode, averaging 8 inches in thickness, was struck, carrying very rich tin, and a very little native copper. Strike N. 7° W., underlay about 1 in 2 to the westward. The lode was driven on 4 feet to the south and 8 feet to the north, and became very small and poor in each end. The remaining 12 feet of the tunnel were made through very hard granite. I do not think the vein met with at 290 feet can be the main set of lodes or veins seen on surface, and think the adit should be continued further into the hill 40 or 50 feet at any rate.

General Remarks.—The great problem for solution at the Blue Tier is how to profitably treat the large masses of low-grade quartz-porphyry rock existing in the Anchor, West Anchor, Liberator, Puzzle, New Moon, Full Moon Extended, Beales', Perennial, Kent, Cream Creek, and doubtless other mines. If these deposits continue to any depth of the same richness as on surface the wealth contained in them is enormous; and if means can be found of successfully winning the tin from them, the Blue Tier will be one of the greatest tin-producing districts of the world. Two things are therefore urgently required to be proved about them,—first, that they are permanent to some depth, and, second, that they can be mined and milled for less than the value of the contained tin. Their

behaviour in depth can be readily ascertained by diamond-drill boring or by shafts and adits; and in view of the immense importance of the question I would strongly urge the owners of the properties to lose no time in testing their ground. With regard to the possibility of mining and reducing the ore profitably, the average value of the rock is not yet well enough demonstrated to allow of at present saying whether it can or cannot be done; but supposing that it will average ½ per cent. of black tin of 70 per cent metallic assay, I think that profits should be possible. With tin at £90 a ton, black tin of 70 per cent. metal is worth 6¾*d.* per lb., and ½ per cent. represents a value of 6*s.* 3½*d.* per ton of rock. With small mills and very far from the best methods of handling the stuff, the Anchor Company have been able to reduce expenses to 6*s.* 9*d.* a ton, and the New Moon Company, in their M'Gough battery, to 6*s.* 10*d.* These results make me regard it as quite possible, with large mills and all labour-saving appliances, to reduce the costs below the value of ½ per cent. rock very considerably. It is not easy to find an exactly parallel case to this one from which we might be able to learn what has been successfully done already under similar circumstances: the Red Face at Mount Bischoff cannot be cited, as the great bulk of the stuff is very soft and can be greatly reduced by sluicing before being sent to the battery: neither can we compare with the stockwork of Altenberg, in the Saxon Erzgebirge, which is similar in many respects to the Blue Tier tin deposits, and yields from ½ to ⅓ per cent. of tin ore, for European and Colonial costs of labour and appliances are very different. The most instructive example for comparison which I have been able to find is that of the copper mines in the Lake Superior district of North America. In these the ore is chiefly native copper and oxide of copper, and the treatment it receives is, first, crushing by rock-breakers and stamps; second, concentration by jiggers, buddles, slime-tables, Frue vanners, &c.; third, smelting and refining. This is exactly what has to be done to our tin-rock; and the smelting and refining of copper is rather more difficult than that of tin. The copper-bearing "amygdaloid" and "conglomerate" rock has, moreover, to be mined, in most cases from great depths, up to no less than 3000 feet, and is as hard to mine and crush as our quartz-porphyry, or even harder; so that mining costs, where the stuff can be got by open quarrying, as in the Anchor, Liberator, and Puzzle mines, ought to be much lower here than there. Another point in our favour which should permit of costs being lower than in the Lake Superior mines is that good water for dressing, and perhaps for power, can be obtained by gravitation, whereas the Michigan mines have to pump up water for their dressing works. Costs of fuel, labour, and supplies are, as far as I have been able to ascertain, as high at Lake Superior as here. There seems, therefore, every reason to believe that if our Blue Tier dykes were worked in the same extensive manner as the Michigan copper mines that they could pay at even a less value per ton of rock. The following table gives some particulars of the work done by seven dividend-paying copper mines, taken from their published annual reports: the costs per ton of rock including all expenses of mining, milling, smelting, insurance, brokerage, storage, and office management, showing in fact the entire cost of treatment :—

Mine.	Year.	Tons of rock (2000 lbs.) milled.	Refined Copper per ton produced.	Cost of treatment per ton.	
				s.	*d.*
Atlantic	1889	278,700	13·27 lbs. or 0·66 per cent.	6	4½
Ditto	1890	278,300	13·00 „ 0·65 „	6	11½
Ditto	1891	297,000	12·30 „ 0·615 „	6	5¼
Franklin	1890	144,393	39·04 „ 1·95 „	12	7½
Ditto	1891	135,758	31·56 „ 1·58 „	11	5½
Allouez	1890	97,020	14·51 „ 0·73 „	8	10¼
Kearsarge	1890	60,619	26·87 „ 1·34 „	9	5
Ditto	1891	81,424	21·21 „ 1·06 „	10	2¼
Osceola	1889	175,605	25·82 „ 1·29 „	9	2½
Ditto	1890	188,561	28·08 „ 1·44 „	9	11½
Ditto	1891	234,361	27·92 „ 1·40 „	8	10½
Quincy	1891	263,678	40·00 „ 2·00 „	15	3
Tamarack	1891	282,987	49·74 „ 2·49 „	10	8½

In the Allouez Mill in 1890 the cost of crushing and concentrating the rock came to 1*s.* 9½*d.* per ton, and in the Atlantic mill to 1*s.* 2*d.* a ton. As showing the miners' wages, I note that in 1891 the 182 miners employed underground in the Quincy mine averaged earnings of $53·40 a month, or 8*s.* 6½*d.* a day. As showing the depths from which the rock is raised, the following particulars are of interest :—

The Tamarack No. 1 shaft is nearly 3000 feet deep and has 14 levels.
„ No. 2 „ 3070 „ „ 15 „
„ No. 3 shaft is 1300 feet deep, and has to be sunk to 4250 feet to reach the lode.
„ No. 4 „ 1100 „ „ „ 4480 „ „ „
The Tamarack Jr. No. 1 shaft cut the Calumet conglomerate, 10 ft. wide, at 2476 feet.
„ No. 2 shaft is down 2500 feet, and is calculated to strike the lode at 3000 feet.
The Kearsarge is raising rock from its 10th to 13th levels.
The Allouez No. 1 shaft is 1300 feet deep.
„ No. 2 „ 1800 „
„ No. 3 „ 1300 „

The Allouez mine has opened its 18th level.

The Red Jacket shaft of the Calumet and Hecla Mine is down 2425 feet, and is to be sunk to 3300 feet. Some of the workings of the Atlantic mine are at 2200.

The Centennial Mine expects to sink 3500 before it will cut any copper rock.

These depths are noted in order to show that these mines, with their remarkably cheap rates of treatment of the rock, are not favourably situated for working, but have the great disadvantage of having to wind rock and pump water from an immense depth. Superficial quarrying, such as can be done at the Blue Tier, should be very much cheaper than such deep mining, and will no doubt yet be done for less than two shillings a ton.

These Michigan copper mines owe their success to the very large scale on which they are worked, and the immensely powerful machinery used, such as hoisting engines of 1200 H.P., pumping engines of 1200 H.P., and engines of 750 H.P. in the stamp mill. The crushing of the rocks is effected by means of what are known as Ball stamps, striking a blow of 40 foot-tons or more, and capable of crushing from 150 to 300 tons in 24 hours per head. The Calumet and Hecla stamps average each about 230 tons in 24 hours. They are steam stamps, worked from an overhead cylinder, to the piston of which the stamp stem is attached, and each head has a mortar to itself. Owing to the enormous power of the blow, the foundations have to be extremely strong and solid. I am not aware of these stamps having ever been tried for crushing tin-bearing rock, but can see no possible reason why they should not act as well as on the copper rock, and attention is directed to them as a possible means of treating our Blue Tier stuff. It would be worth while to send a shipment of 500 tons to Lake Superior to be tried.

In comparing the costs of treatment at Lake Superior with our own it should be remembered that the former are calculated on the short ton of 2000 lbs., and, consequently, that we should add one-eighth to them. But even doing so, if the Atlantic Copper Company can raise stuff from a depth of 2000 feet and treat it for a total cost of 7*s.* 5*d.* a ton, using steam as motive power, I fail to see why we should not be able to quarry half per cent. tin-rock in Tasmania, and mill it by water-power, at a handsome profit.

Crushing Appliances.—There has been a good deal of controversy among those interested in the Blue Tier district as to the best form of crushing-plant to be erected, some advocating stamps, some rolls, while other crushing appliances also have their adherents. The subject is too wide for discussion here, but a few remarks may be made upon it. The stamp-battery and the Huntingdon mill have both been tried on the tin-bearing rock more or less successfully. The Huntingdon mill has proved itself a good machine for soft stuff, but not very successful with hard quartz; most of the surface rock could, however, be very well treated by it. It is cheaper than a stamp-battery of equal crushing capacity, but is expensive in wear and tear, and a good deal of time is lost in effecting repairs. For a lot of the soft clayey surface rock, however, it seems to me to be preferable to a stamp battery, while the latter is better for the harder and tougher portions. Of the stamp-batteries that have been at work in the district, that at Cream Creek appears to have had the greatest crushing capacity, putting through 2⅔ tons per head in 24 hours, as against two tons at the M'Gough mill, and less than one ton at the Anchor. None of these, however, are really first rate results, as, on the soft rock dealt with, each stamp-head should be equal to a performance of three tons in 24 hours, or even more. In order to secure this result the mortar or stamp-box ought to be specially made with low discharge, large screen surface, and very little space between the stamp-head and the sides of the box, the object being to get the crushed stuff out of the way as fast as possible. A stamp-box made for treating auriferous quartz has more to do than one for tin ore, as a considerable part of the amalgamation is generally done inside it, and the shapes for the two purposes should be somewhat different. In our batteries a box made for gold quartz has been often used for tin ore crushing, and *vice versâ*. In the same way there is not enough attention paid to the weight of the stamps, number of drops per minute and length of drop, all of which have a great deal to do with obtaining the maximum crushing work from a battery. Different sorts of stone require different treatment in these respects, and the best result can only be attained after numerous experiments. Another subject for careful and systematic experiments is the size of the holes in the gratings. In order to put through a large quantity of rock the screens should be as coarse as is compatible with saving the tin ore. These experiments are rarely gone about in a thorough and knowledge-seeking manner, the battery being set going in accordance with the judgment of the person in charge, and allowed to run on without attempting to find means of improving its performance. This is on a par with the prevalent custom of making no regular tests of the tailings, leaving the batteries to ascertain what is being lost. The stamp-battery has the great advantages of simplicity, durability, and small cost and great ease of repairs, and still holds its own against all competitors as an all-round useful crusher, dealing equally well with hard and soft stone, clay, or anything else. When proper precautions are taken to obtain its maximum performance it is probably the most suitable pulveriser for fine crushing of tin ores yet in the field. It should always be assisted by a stone-breaker, and fed automatically by a self-feeder.

For coarser crushing, rolls are generally better than stamps, and where progressive reduction of

the stuff is desirable they are generally employed. For fine crushing high speed rolls are very successful with clean hard quartz, having very large capacity compared with a battery of the same cost; but where the material is clayey they are very liable to get choked and work badly. Much of the Blue Tier stuff is very clayey, and I do not think that fine crushing by rolls would work well. Coarser crushing could no doubt be successfully accomplished. A series of experiments with rolls might be made with great interest and advantage on the Blue Tier rock, for there is a probability that a great part of the tin in the surface rock could be set free by comparatively coarse crushing,—it being sufficient to disintegrate the particles composing the rock, without crushing them to powder. For example, a piece of soft surface tinstuff (quartz-porphyry), from the Liberator mine was crushed by squeezing, not pounding, it in a mortar, and then washed off: it gave nearly all the tin ore it contained by this treatment. Half of the tailings was then washed off again without further grinding, and the other half was ground finely in a mortar and also panned off. The tin ore obtained was in each case about the same in amount, showing that the last grinding had practically no effect in freeing more tin. The experiment was instructive in another way: the tin ore, though very fine, was not slime, and was pretty easily saved in washing. If a rough crushing will liberate the ore there is no necessity for grinding it finely, and making a large quantity of slime tin. It seems possible that the soft stuff might be sufficiently disintegrated by passing it through rolls set pretty widely apart, to enable the bulk of the tin to be saved from it, and if the coarse uncrushed pieces were separated out by a trommel they might be crushed again more thoroughly. The harder rock found a little way below the surface could not, however, be dealt with in this way, and would have to be crushed in the ordinary fashion.

Rowley's mill, recently patented, is likely to be tried at the Blue Tier. From a trial of it in Launceston, at which I was present, it appeared to me likely to do very good work on the quartz-porphyry, especially the more clayey portions; and as it is cheap and a rapid pulveriser it seems likely to be very useful. It has not, however, been working long enough to afford figures as to wear and tear and cost of repairs and working.

Very few, if any, of the numerous "disintegrators," "pulverisers," "pulverators," and ball-mills in the market are likely to be of use at the Blue Tier for tin-ore crushing, all having the fatal objection that they make too much slime. For the soft clayey rock, the "Dodge pulveriser," an iron churn of a sort, might be useful.

In my opinion, the choice of crushing machinery lies between Ball stamps, ordinary stamps, and mills of the Huntingdon type, with perhaps Rowley's mill, and under some circumstances, rolls. Of course stone-breakers should precede any of these crushers. I do not think progressive crushing will be of much use on account of the general fineness of the tin ore.

As regards dressing machinery I do not intend now to make more than a few remarks. For coarse tin ore jiggers are the most efficient sort of concentrators, and put through large quantities of stuff rapidly. For the sands the choice lies between buddles and revolving belt machines, like the Frue, Triumph, and Lührig vanners: I should be inclined to favour the self-discharging belt machines. For the fine slimes the convex slime tables appear to me to do the best work. In order to have this classification into coarse and finer sands and slimes it will be necessary to use spitzlutten, with or without the addition of pyramidal settling-boxes (Spitz-kasten).

Power.—In my 1889 Report I drew attention to the necessity of conserving the plentiful rainfall of the Blue Tier in order to get water-power. I have now only to re-iterate what was then said. The water-power need not necessarily be obtained close to a battery site, for with the perfection of transmission of energy by electrical means which has been now arrived at it is possible to utilise water-power several miles away. The falls on the George's River, and the numerous large streams which flow from the Blue Tier, may thus all be pressed into the service of the mines on the top of the range, and when this aspect of water-power is considered there can be no question as to the immense quantity of it available. If we are successful in treating the stanniferous dykes, a very extensive scheme of water conservation and utilization may be looked forward to.

Deep Adits.—The mines on the top of the Blue Tier are hampered by want of water-power to drive their machinery, and are threatened with having to hoist all their rock to their batteries. The project of making long and deep tunnels from the Puzzle and Lottah mines under the New Moon and M'Gough dykes is therefore worth consideration. An adit one mile in length from the Puzzle ground would reach the north boundary of Section 907 of the New Moon Company's ground at a depth between 350 and 450 feet below the surface, and would be along ground stanniferous on surface all the way. The rock could be sent down by shoots to the tunnel level, and taken out to a battery in the valley of the Crystal Creek. At the same time the big conservation dams on the Wyniford slope of the range could be sources of high-pressure water for the other side. Another tunnel about the same length and equally deep could be taken in from the Lottah property, but would not have the same advantage of following the quartz-porphyry rock all the way. As drainage, mining, and supply of water-power would all be benefited by either of these deep adits they are worth keeping in mind.

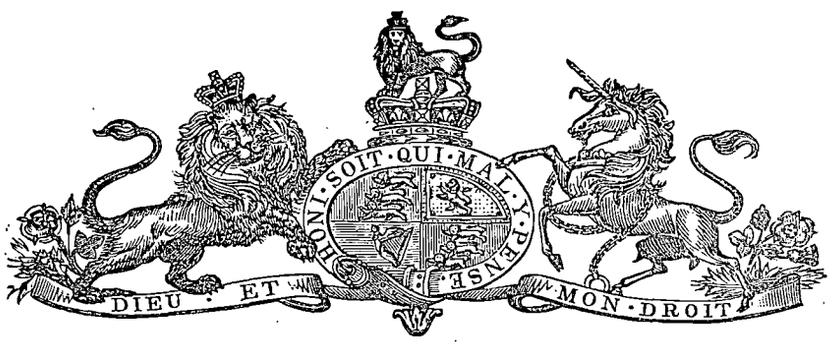
Conclusion.—In concluding this Report I have to express my conviction that the stanniferous dykes at the Blue Tier are of the very greatest importance to the colony. They are of low value in tin, it is true, but of such immense size that a very small margin of profit can be made to mean an enormous sum in dividends, and, what is even more important, a steady and permanent industry employing a large number of men. To work them profitably will tax our engineering skill to the utmost, but will, I believe, be successfully done. At the risk of repeated re-iteration, however, I must point out that this opinion is founded on the supposition that the tinstuff remains to some depth of the same value as on surface, which is not yet a proved fact. Even if it only lasts for 100 feet in depth, however, there would still be an immense body of crushing stuff. What has now to be done is clear: we must prove by boring and mining that the tin does or does not go down, for everthing depends on this, then raise capital for working on a very large scale. If the tin does not last to a depth it will be a question whether the superficial rock will be sufficient in quantity to be worth treating in an extensive plant; but if it does go down, and averages anything over one half per cent. of black tin, then we may confidently look forward to the Blue Tier district becoming quite as famous as Mount Bischoff. I see no reason to fear that the tin will not last, and am therefore very sanguine as to the prospects of this field.

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

A. MONTGOMERY, *M.A., Geological Surveyor.*

The Secretary of Mines, Hobart.

WILLIAM GRAHAME, JUN.,
ACTING GOVERNMENT PRINTER, TASMANIA.



REPORT ON THE MOUNT LYELL MINE, COUNTY OF MONTAGU.

Geological Surveyor's Office, Launceston, 6th April, 1893.

SIR,

I HAVE the honour to forward to you a Report on the Mount Lyell Gold Mining Company's mine at Mount Lyell, which I examined on the 26th and 27th of February last.

The property is situated on a ridge connecting Mount Owen with Mount Lyell, about 1000 feet above sea level, and distant by road about 30 miles from the port of Strahan. The road is a fairly good but narrow cart-road for 23 miles, as far as Lynchford, and from here onwards is a sledge-track very steep in places. The mine is situated on the eastern slope of the range, being at the head of one of the branches of the Linda Creek, an affluent of the King River. The lowest adit and the battery are about 180 feet below the saddle over which the road from Strahan comes in, and the top of the outcrop is about 230 feet above the adit. A route for a railway is now being surveyed from Strahan to the mine, and I understand that it is intended, if found practicable, to bring it over the saddle to the mine itself. It would be possible to reach the deposit by a tunnel from the Queen River Valley on the western side of the range, and this would prove the mine to a much greater depth than can be attained by any adit from the eastern slope. No surveys had been made up to the time of my visit to determine the distance that would have to be driven, but it is expected to be very considerable, and this tunnel is therefore not contemplated for the present unless unexpected trouble should be met with in getting the railway line over the saddle. This saddle is about 1160 feet above sea level by aneroid measurement.

The mine was discovered in 1886, gold having been traced up to it from the Linda Valley. On section 14-86 an immense outcrop of hematite was found, and proved to contain gold: this got the name of "The Iron Blow." Up till 1890 it was worked with varying success as a gold mine, the stuff from the outcrop being crushed and amalgamated in an ordinary stamp battery. The workings soon disclosed the existence of a large mass of pyrites standing in close connection with the hematite, and as development proceeded it has become evident that this pyrites really constitutes the main body of the deposit. Analysis having shown it to contain copper, gold, and silver, it was recognised at last that the treatment most suitable for the ore would be the process of smelting for copper, by which all the contained valuable metals would be recovered.

The outcrop consists of hard, dark, dense hematite mainly, which has a somewhat shaly or fibrous structure. With this there is, however, much yellow and brown friable and pulverulent oxide of iron *(Limonite)*, which is much mixed with pulverulent baryte (sulphate of barium). The dense hematite also contains occasional veins of baryte, and sometimes lumps of some size. The limonite carries more gold than the hematite and is often very rich both in gold and silver. It frequently is found between blocks of the hematite, the main mass of which appears to be more or less shattered, but is in greater quantity towards the north-east side of the outcrop, where it forms a body lying between the hematite and the pyrites. The latter has been exposed on this side by several trenches, and appears as a solid mass of iron sulphide, but blue stains of sulphate and green ones of carbonate of copper every here and there testify that this metal also is present. The pyrites is generally covered, as might be expected, with a thin superficial capping of brown iron ore,

resulting from its oxidation. The width of the outcrop is from 280 to 290 feet. The stuff crushed in the battery for gold all came from the soft portion of the deposit lying between the pyrites and the main hematite mass. When I formerly visited the mine in 1890 ("Report on the state of the Mining Industry on the West Coast," April 25th, 1890), 1530 tons of material had been crushed for a return of 1480 ounces of bullion, about half of which was gold and half silver. Since then there have been some few small crushings of which I have not obtained particulars, but nothing of much consequence. The gold being very light and scaly, and the gangue of oxide of iron and baryte very heavy, there was great loss in amalgamation on the battery-plates, and I was not surprised to learn from Mr. Schlapp, the present manager, that his assays of the tailings saved in the tailings-dams ran up to more than an ounce of gold to the ton. By the battery treatment all the silver, amounting to as much as 30 ounces to the ton, was allowed to escape into the tailings as well. In getting out the stuff for crushing in the battery an open quarry has been worked into the outcrop; this is now nearly 50 feet in diameter in the floor, and the highest part of the face is about 30 feet high. An adit known as No. 1 adit has been driven westward across the ore body from the foot of this face. After going for 64 feet through gossany material solid pyrites was struck, and continued to be found to the end of the drive, 72 feet in. This adit does not penetrate to the western wall of the ore-body, which, indeed, has not yet been reached in any of the adits. Some 26 feet lower down another adit, known as No. 2, has also been driven westward; but I did not go into this, it being now used as an explosives magazine. No. 3 adit is 60 feet below No. 2, and is driven across the course of the ore, that is, south-west. The first part of it is in country rock, mostly hard sandstone, and the eastern wall of the ore-body was reached at 128 feet in. It has been driven a total distance of 420 feet, or 292 feet into the pyrites. For all this distance the ore is a solid mass, absolutely free, as far as can be seen from a fairly close examination of it, from gangue, other than occasional streaks of baryte, and from country rock. The pyrites, however, appears to lie in ribs or layers parallel to the wall of the deposit and also parallel to the stratification of the enclosing country rock. Towards the end of the drive the ore became poorer in copper than in the first part, and the last 100 feet would not be mined to begin with, though when all works were in thorough going order it might pay to take this portion out also. At present the engineer in charge, Dr. E. D. Peters, jun., only counts upon treating the first 200 feet passed through. On the eastern wall there is some hematite, which would go to show that the pyrites body has been partly decomposed at its contact with the country rock by solutions passing through the latter and down the wall. From the adit or cross-cut a drive has been put in to the south east along the eastern wall of the ore for a distance of about 450 feet (on the date of my visit), and from this two cross-cuts, one 50 and the other 13 feet in length, have been put into the ore-mass without going through it. In these cross-cuts the ore has the same character as in the main one, namely, dense solid pyrites free from gangue, lying in layers parallel to the wall. Close to the wall some galena, blende, purple copper ore and copper pyrites are occasionally visible distributed through the mass of iron pyrites; but even when no copper pyrites are distinguishable by the eye there is always copper in the ore. At this level some very good copper pyrites was being taken out at the time of my visit for a smelting test at Argenton.

No. 4 adit is 97 feet below No. 3, and goes in from beside the old battery. For 343 feet sandstone country rock was passed through before the wall of the ore-body was reached. The strike of the strata is from N.W. to N.N.W., agreeing with that of the ore deposit, and conforming to the usual course of the older sedimentary strata all over the West Coast. For the first 20 feet the ore contains some hematite and a good deal of baryte, also a little galena, but not much copper. This portion would be mainly rejected in working the mine. Just on the wall, however, there is in it a vein of quartz carrying tetrahedrite (Fahl ore), assaying from 300 to 600 ounces of silver to the ton, and rich ore of secondary deposition appears to exist more or less all along the wall, for at a cross-cut 92 feet further south a winze has been begun in a belt of somewhat oxidised hematitic ore six to eight feet wide, lying between the pyrites and the country wall-rock, which belt for about four feet in width is very rich in silver. Where this changes into pyrites the tetrahedrite is again seen, this time not in quartz, but in a band from half to one inch wide disseminated through the pyrites. Bornite (purple copper ore), carrying as much as five or six per cent. of silver, has also been found. This is rather a mineralogical curiosity, as bornite does not generally contain more than traces of silver. The chemical action resulting from the passage of water along the wall appears to have caused a partial oxidation of portions of the ore, and solution and redeposition in fresh compounds of some of the silver and copper. This enrichment of parts of a lode at the expense of others is a well-known feature of many copper mines. The drive along the foot-wall (as the eastern wall has got to be called, though the underlay is almost nothing) has been extended 165 feet to the south east, and a cross-cut has been put in at the winze for 35 feet, all except the first few feet above-mentioned in dense solid pyrites. The main adit was in 411 feet at the time of my visit, and work was still proceeding; from 363 to 411 feet was solid pyrites the whole way.

Another adit could be made from the Linda Valley to cut the ore-body some 200 feet below No. 4, but would probably have to go through country rock for about 1000 feet before striking it. As above mentioned, still lower tunnels could be driven from the Queen River valley, so that the facilities for obtaining natural drainage of the mine to a depth which will not be reached in twenty years of work are very good.

Mr. O. G. Schlapp, who has been mining manager for over two years past, was good enough to show me his assay-book, containing records of hundreds of bulk assays made by him during the progress of the work. He has worked out the average values as follows :—

The limonite and pulverulent baryte gossan contains from 20 to 25 ounces of silver and from 20 to 25 pennyweights of gold to the ton.

The solid pyrites in No. 1 tunnel yields from four to five per cent. of copper, about two ounces of silver, and three pennyweights of gold to the ton.

The pyrites in No. 3 tunnel (rejecting the last 90 feet, which contains less than one per cent. of copper) contains nearly four per cent of copper, and from one to two ounces of silver and two to three pennyweights of gold to the ton.

The pyrites in No. 4 tunnel (rejecting the first 20 feet as too much mixed with baryte), yields about the same values in copper, gold, and silver as in No. 3.

The general average of all of the pyrites is calculated to be about $4\frac{1}{2}$ per cent. of copper, two ounces of silver per ton, and three pennyweights of gold per ton, or a gross value of about £2 19*s*. a ton for these three metals.

Though a good deal of work has been done, it is not yet possible to form any very accurate estimate of the amount of pyrites in sight, the levels driven having penetrated to such an insignificant distance as compared with the entire mass of the deposit. The end of the No. 3 adit is a little further west than the apparent edge of the ore on surface, so that there seems to be no sign of the latter getting thinner going down; rather the reverse, for in the winze from No. 4 adit the wall is underlaying a little to the east. The ore-body would therefore appear likely to be wider underground than it is on surface, where it is close on 300 feet across. Let us take the width as 200 feet, seeing that the ore is of the average value for that distance in No. 3 adit: it has been driven on to the south for 450 feet, and to the north it has been exposed on surface for over 350 feet, making a total known length of, say, 800 feet. Let us call the average height of the surface above the level of No. 4 adit 180 feet; we may say that the ore is pretty fairly exposed for a block 800 feet long, 200 feet wide, and 180 feet high. This would contain a little over one million cubic yards, or, say, $3\frac{3}{4}$ millions of tons. Below No. 4 level it is reasonable to expect quite as much ore as above it, so that above the level of the Linda Valley there should be quite $7\frac{1}{2}$ millions of tons. These are large figures, but the estimate is quite a conservative one. Taking only one-third of the quantity as payable, there would still be enough ore to supply 1000 tons a day for seven years. The very uniform quality of the pyrites wherever it has been cut into entitles us to be confident that there will be no great variation from the now known values when the mass is further exploited, and the quantity exposed is so large that there need be no hesitation in at once proceeding with the erection of smelting works. Should it be thought desirable or necessary to have still further proof as to the quantity and quality of the ore, a series of bores with a diamond drill would yield it in a very short time equally well as extensive underground mining.

The method of mining to be adopted will depend to some extent on where the railway comes in. If it can be brought over the saddle and down to the level of No. 4 adit the mass will probably be worked from the south side as an immense open quarry, but if the outlet has to be by means of a tunnel from the Queen River valley the system adopted will no doubt be a combination of underground and open-cast working, the surface and the lower levels being worked simultaneously. The width of the ore is so great that open quarrying is sure to be one of the principal methods of winning it for a depth of at least 200 feet from the surface; below this level difficulty would probably be experienced in preventing heavy slips of the country wall-rock. There are excellent facilities for open-cast workings, as faces can be opened at a great many different points along the slope of the hill, and there is plenty of room for getting rid of waste rock. The steepness of the hillsides on each side of the ridge is also very favourable for easy transport of ore, either by self-acting grades or by overhead wire-rope tramways. When the railway is completed from Strahan, and the disadvantage of inaccessibility now experienced is thus removed, it would be difficult to imagine a mine better situated for economical working.

It is proposed to have smelting works in the Queen River valley, within a mile and a half in a direct line from the mine. Good water-power for driving blowing-engines and for mechanical handling of material can be got from the Queen River, and as there are numerous other considerable streams in the district this could be supplemented if required by electrical power transmitted from generating stations within a few miles of the works; the Queen River, however, is probably able to supply all the power required. As for fuel, coke and coal can be got from the seaboard in not more than 25 miles of railway carriage, and the whole of the Queen River valley is covered with thick forest, which will give ample supplies of wood for the roast-heaps for many years. The ore being very rich in sulphur, averaging over 45 per cent. of it, does not require much fuel in roasting, only enough to start the combustion. Should the process of pyritic smelting, that is, smelting pyritous ores direct without roasting by means of the heat caused by the combustion of the contained sulphur, become a commercial success—and there seems to be a very great likelihood of this being so—the Mount Lyell ore ought to be very easily smelted by it, almost without fuel at all, for it is so pure and so rich in sulphur as to be an ideal ore for this process.

When I visited the mine a roast-heap of some 65 tons was being burned, the object being to ascertain beyond doubt by a practical test that the ore would roast well without decrepitating or falling to powder when heated. This trial was quite successful, the roast going on very satisfactorily. At the same time 100 tons of ore were being taken down to the smelting works at Argenton to be reduced to matte and sent to England for further treatment. This ore was mostly picked copper pyrites of good quality from No. 3 tunnel, much richer in copper than the general average of the ore, the object being simply to produce a few tons of 65 per cent. matte to show interested parties the quality of the product, and allow the best method of refining to be determined. This being the case, it would be absurd not to pick out the richest ore conveniently obtainable, especially as it had to be carried out from the mines on pack horses, over a poor track. This explanation has to be made in order to prevent misapprehension as to the nature of the test: there is no intention of treating an average sample of the ore, but only of making the required parcel of matte in the shortest and cheapest manner. At the same time a few tons of the very rich oxidised ore from the winze in No. 4 tunnel is proposed to be separately run down into a specially rich matte to pay the expenses of the test.

The owners of the Mount Lyell mine are to be complimented on their enterprise and wisdom in obtaining the services of so well known and high an authority on copper smelting as Dr. E. D. Peters, jun. It is evident that the mine must be worked on a very large scale, as its average value is not very high, and it is only a man of high standing in the copper world and great experience in copper mining and smelting who is competent to pronounce with authority on the prospects of the mine, and design and lay out the reduction works. It is very satisfactory to know that Dr. Peters expresses himself as convinced of the payable nature of the mine. He proposes to build works capable of treating 500 tons a day at first, to be later on increased to 1000 tons daily capacity if required. There is no doubt as to the ability of the mine to supply the quantity of ore with ease, and the average quality has been sufficiently proved by numerous tests. The ore is about double as rich as that of the celebrated Rio Tinto mine in Spain, which contains only from 2½ to 3 per cent. of copper, about 1 ounce of silver to the ton, and only traces of gold. As will be shown below there are many features in common in the Rio Tinto and Mount Lyell deposits, and there is every reason to believe that the latter will yet rival the fame of the great Spanish mine. In calculating the profit on the treatment of the Mount Lyell ore, Dr. Peters, in a report to the shareholders, takes no account of the rich silver ore that has been found, or of the valuable auriferous gossan on surface, basing his figures only on the average value of the main pyrites body. The rich ores are, however, an important factor in the profits of the Company, and there is a great probability of their considerably raising the general average yield of the mine of gold and silver. The policy of disregarding them in making an estimate of the results to be expected in working is highly commendable as a conservative and cautious one—the poor average ore alone is relied on, and any rich stuff will be a gift to the owners superadded to their regular profits. The richness of the gossan, and of the decomposed and altered ore on the eastern wall, indicates that there has been extensive chemical action on the outskirts of the ore body, and it is very likely that the quantity of richer material will prove to be very considerable.

One valuable constituent of the ore will not be realised upon for some time to come, namely, the sulphur, unless it is found profitable to ship raw ore to Europe as ballast. The pyrites contains over 45 per cent. of sulphur, and is worth a little over a pound a ton in England for this constituent, so it seems possible that an export trade might be done in the raw ore. The Spanish and Portuguese pyrites sent to England is first of all burned by the sulphuric acid manufacturers, then treated by wet processes for copper, silver, and gold, extremely small quantities of the noble metals being profitably extracted, and finally the residual oxide of iron has a ready sale. The utilisation of the sulphur for making sulphuric acid in the Australian Colonies is, I am afraid, still in the future, the demand being small, principally for the manufacture of superphosphates. It is a great pity to waste the sulphur of a first-class sulphur-yielding pyrites like that of Mt. Lyell, and no doubt the management will devote attention to the possibilities of dealing with it profitably when once they have got their works fairly started.

The Mount Lyell ore deposit is very similar in its mode of geological occurrence to many other well-known masses of pyrites, the most famous perhaps of which are the Rio Tinto mine, in Spain, and the Rammelsberg, in the Hartz Mountains, Germany, both of which have been worked for many centuries. There has been a good deal of difference of opinion as to the mode of origin of these deposits, some authorities regarding them as true lodes, others as bedded or stratified layers contemporaneous with the enclosing country: the latter opinion being now generally considered the more correct one. The Rammelsberg ore deposit consists mainly of iron pyrites, but contains also galena, copper pyrites, fahlore, blende, and heavy spar, while quartz is quite rare: the ore-bed is stratified conformably with the enclosing slates, and shares their foldings and contortions. It is noteworthy that at Mount Lyell the same minerals occur, though galena is not of such importance there as at the Rammelsberg, and that the principal earthy mineral is baryte, quartz being almost absent. The pyrites too is, as far as can yet be judged, in layers parallel to the layers of the country rock. The Rio Tinto deposits of cupriferous pyrites consists, according to J. A. Phillips (Ore Deposits, page 371), "of a series of more or less continuous lenticular masses running parallel with

the bedding of the enclosing slate, sometimes extending to a great length, occasionally having a width extending fifty fathoms, and composed of an intimate admixture of iron pyrites with a little copper pyrites, through which strings of the latter mineral sometimes ramify." Quartz is present in very small quantity, and the drusy cavities so characteristic of lode deposits are exceedingly rare. The average value of the pyrites is about 2½ per cent. of copper. The celebrated Tharsis copper mine, near the Rio Tinto, is quite similar to the latter.

Cases are known in which iron pyrites containing a little copper is forming at the present day in lagoons in swampy ground, the rate of growth being in some instances quite perceptible in a few years. The formation of the mineral is explained thus:—Iron and copper pyrites exist in small quantities in the country rocks and become oxidised to soluble sulphates which are dissolved out by surface waters and washed into the lagoons; in these the sulphates are deoxidised by the powerful reducing action of decomposing vegetation and the insoluble sulphides reprecipitated. The sulphur often present in decomposing vegetable, and more particularly in animal matter, is also liable to combine with the iron always present in swamp water as carbonate. The common occurrence of iron pyrites in coal seams is an instance of the formation of this mineral through the agency of organic matter. Under favourable circumstances, therefore, heavy deposits of pyrites could be formed in swampy localities where the waters were charged with soluble sulphates. The common occurrence of numerous lenticular masses of pyrites in the neighbourhood of the main deposits of this ore favours this explanation of their formation, the deposition of mineral having gone on simultaneously in numerous detached lagoons. In course of time these have become covered over with layers of silt, which have hardened into rock; and in progress of ages the strata have been crumpled and contorted till we now find them standing on edge instead of in their original horizontal position. At Mount Reid, in what appears to be the same belt of country in which the Mount Lyell mine is situated, a somewhat similar pyrites deposit has been found, and in this case the ore seems very plainly interlaminated with the country rock. There are reported to be several deposits of pyrites in and near the line of country connecting Mount Lyell with Mount Reid, which would go far to bear out the theory of their sedimentary origin.

It is important to arrive at a conclusion as to the origin of any ore deposit, so as to have some guide in reasoning out its probable behaviour in strike and depth. If the above explanation is correct, we may expect to find the ore-masses of more or less lenticular shape, purest in the middle, and becoming more and more mixed with bands of country rock towards the edges of the lenses. They may not go to any great depth before narrowing and gradually thinning out, but it is just as likely that the present surface of the ground may be far above the centre of the lenses, and that they will increase in size going down. It depends altogether on the size of the original basins of deposition how far the ore will extend in strike and in depth; in the case of a huge ore-mass like the Mount Lyell one, it is reasonable to expect a great extent, comparable to the Rio Tinto and Rammelsberg mines, which have been worked to great depths. It is probable that numerous other lenses will be found along the line of strike of the main mass, and it is quite likely that some of these after pinching nearly out will be found to swell out again into fresh bodies of ore. Though the lenticular shape is rather characteristic of pyrites masses, therefore, there is no reason to consider them less reliable sources of ore than true lodes; the contrary is indeed the case, an ore-bed being much more likely to carry ore throughout its extent than a lode in which it is usual for large blank spaces free from or poor in ore to exist.

The mining work in the Mt. Lyell mine having proved the existence of a mass of pyrites nearly 300 feet in thickness without any enclosed bands of country rock, it appears to me, on geological grounds, that it is likely to prove a very large and extensive deposit, the purity of the ore being, to a great extent, a guarantee that is was deposited far from the shores of the original basin, just as coal seams are generally most free from bands towards the centres of the basins. Another important deduction to be made from the theory of sedimentary origin is that the value of the ore in metals is likely to be very uniform throughout each layer, the mineral having been precipitated from uniform solutions. The experience of long-worked pyrites bodies confirms this reasoning, the metallic contents having been found to vary but little from the general average. In saying this I must except, however, those portions of the ore-bodies which have been subjected to a secondary chemical change, as in these the values are liable to vary very greatly, some constituents having been removed and others enriched by additional matter brought in in solution. During the ages that have elapsed since the ore was first laid down, a good deal of secondary chemical action is only to be anticipated. For example, the pyrites under the outcrop at Mt. Lyell is generally richer in copper than at the lower levels, an almost inevitable consequence of the leaching of the copper from the gossan above; and the rich ore on the eastern wall has already been ascribed to secondary action.

A peculiarity of the Mt. Lyell deposit which is difficult of explanation, and which has led to some extraordinary theories as to its origin, is that part of the outcrop is hematite and part is limonite; the latter is easily accounted for by the oxidation of the pyrites, but it is not so easy to explain the presence of the hematite. So far as I know, pyrites never alters directly to hematite,

but always to the hydrated oxide of iron (limonite), and bodies of hematite are generally considered to be limonite from which the combined water has in course of time been expelled. The mass of hematite is found running down into the ground alongside of unaltered pyrites, and much deeper than the gossan or limonite. Two explanations seem possible—first, that bog-iron ore was deposited below or above the pyrites in the original lagoon, and that the hematite is a bed contemporaneous with the pyrites; this, however, does not seem to me to meet the circumstances of the case; and second, that at some long past period the ore-body has been subjected to atmospheric oxidation and partly converted into limonite, and then buried again under newer strata which have since been removed; while so buried the limonite would gradually change to hematite. There is evidence that the coal measures (permo-carboniferous) formation has extended all over the older rocks of the West Coast, though now almost entirely removed again by denudation, and it seems possible that the ore was partially oxidised prior to their deposition.

While going over the mine I took a number of samples for analysis and assay, which have been examined by the Government Analyst in Hobart. The following description explains what each is:—

No. 1.—This sample was taken by picking up small fragments all over the heap of rich ore from the winze in No. 4 tunnel; it was therefore not a fair bulk sample, as parts of the interior of the heap might differ materially from the outside portions; still it should approximately represent the value of the whole. It yielded on assay 462 ozs. 3 dwts. 12 grs. of silver and 13 dwts. of gold to the ton.

No. 2.—This was taken from a heap of gossan in the open quarry in the outcrop by taking small fragments from all over its surface. In this, as in all the other samplings, the whole of the stuff taken was crushed in a mortar and put through a sieve of about eight holes to the lineal inch before taking the sample for the Analyst. As in the former case, the interior of the heap may not have been of the same value as the outside from which the tests were taken. The assay gave 7 oz. 8 dwts. 1 gr. of gold and 32 oz. 9 dwts. of silver to the ton. The gold in this is much above Mr. Schlapp's average assays, and it is probable that a piece of unusually rich ore must have got into the sample; but I may say that after picking out part of the pulverised stuff to send to Mr. Ward, I washed the remainder in a pan and only got two very minute specks of gold, showing that there was no appreciable quantity of coarse gold to make the tests erroneous.

Nos. 3, 4, and 5.—These were samples of pyrites, and were analaysed as well as assayed for gold and silver. No. 3 was taken by picking up small fragments from all over a heap of pyrites from No. 1 tunnel. No. 4 was taken in No. 3 tunnel by knocking off chips from the walls of the drive every yard or so for the first 200 feet; and No. 5 was similarly taken from the walls of No. 4 tunnel, from 363 feet into the face, at 411 feet, thus rejecting the first 20 feet of lode-matter known to contain much baryte and also streaks of rich secondary ores. The following analyses were obtained:—

	No. 3.	No. 4.	No. 5.
	Per cent.	Per cent.	Per cent.
Copper	9·6	5·3	4·6
Lead	trace.	trace.	trace.
Iron	40·3	40·0	39·0
Barium Sulphate	0·8	2·5	3·0
Sulphur	45·0	45·0	46.0
Silica	2·8	4·6	5·8
	oz. dwt. grs.	oz. dwt. grs.	oz. dwt. grs.
Silver per ton	2 18 19	4 14 17	3 2 1
Gold „	0 1 15	0 2 14	0 2 1

The richness of No. 3 sample in copper, as compared with Nos. 4 and 5, is no doubt due to the copper leached out of the overlying gossan; the average of the two latter parcels, viz., 5 per cent., is nearer the truth as to the value of the main mass. The silica is much higher than Dr. Peters has generally found it, which may be due to dust on the surface heap and walls of the drives from which the samples were taken. He informs me that he has rarely found over two per cent. of silica in the pyrites, a fact which will necessitate the using of siliceous matters as a flux in smelting. Siliceous silver and copper ores would therefore be very useful to the Mount Lyell company as flux, and no doubt they will be large buyers of such ores when at work. The average of the three assays for gold and silver is two pennyweights two grains (2 dwts. 2 grs.) of gold and three ounces eleven pennyweights and twenty grains (3 oz. 11 dwt. 20 grs.) of silver to the ton. which is a trifle higher in silver and lower in gold than Mr. Schlapp's average above given. Taking the average copper at 5 per cent., the gross value per ton, viz., £3 4*s.* 6*d.*, is 5*s.* 6*d.* higher than the manager's estimate, which is very satisfactory as a check on the latter, showing it to be a conservative one. The samples of the pyrites taken by myself and assayed by the Government Analyst therefore confirm the accuracy of the mine assays taken during the progress of driving the tunnels.

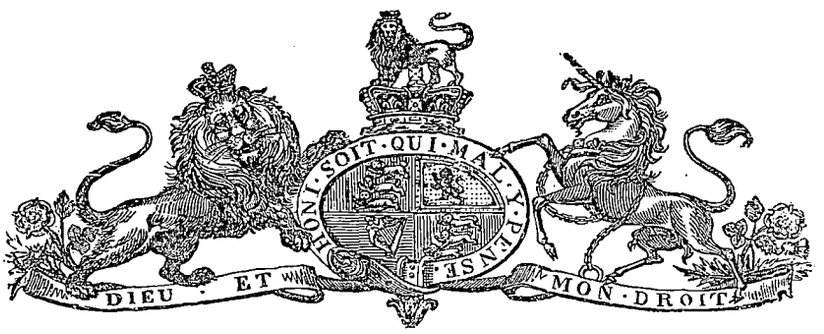
Taking the great size of the ore-body, its value, its proximity to a shipping port, and the excellent mining and smelting facilities into consideration, I have no doubt as to Mount Lyell being a paying mine when opened up on a large scale, such as is proposed by Dr. Peters; it would be simple folly to attempt working on a small scale. When equipped with the most modern smelting plant and connected by rail with the port of Strahan, the mine should be in a position to put copper into the European market cheaper than most of its largest competitors, which means that even should the price of copper fall this mine would be able to survive longer than less favourably situated rivals. It is pretty well known that very few indeed of the great copper-producing mines of the world could continue working if the price of the metal were to fall below £40 a ton, so there is a good assurance that there can be no great fall in value without a large shrinkage in production, unless very large and rich new mines are found or very great improvements in smelting methods discovered. There is, therefore, cause to congratulate the Colony on the possession of what is likely to prove one of the great mines of the world.

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

A. MONTGOMERY, *M.A.*, *Geological Surveyor.*

The Secretary of Mines, Hobart.

WILLIAM GRAHAME, JUN.,
ACTING GOVERNMENT PRINTER, TASMANIA.



REPORT ON THE SANDFLY COAL MINE.

Geological Surveyor's Office, Launceston, 12th April, 1893.

SIR,

I HAVE the honor to report to you on the Sandfly Coal Mine, visited by me on the 28th of March last.

Coal has been known to exist in the Sandfly District for many years past, and several attempts have been made from time to time to form companies to work it; but hitherto none of the various owners have been able to lay out the capital required for opening the mine, and connecting it with deep water at North West Bay. The work done is confined to mere prospecting, the outcrops of a number of seams having been cut into by short drives to the dip of the coal. As regards mining, the property is therefore practically in a state of nature; it is covered with dense forest, and the only roads through it are the old road to Woodstock, and the bush tracks that have been cut between the various outcrops. It is necessary to explain this, as from the length of time during which the mine has been talked about, it would be natural to suppose that a good deal of permanent mining work had been done. Any coal taken out up to the present has been packed out of the bush on men's backs, so it is evident that the output cannot have been large.

The Sandfly Coal Mining Company's property consists of 977 acres of ground, situated on the south slope of the watershed between the Huon and North West Bay Rivers, close to the saddle on the road from Hobart to Woodstock, about 16 miles by road from Hobart. The sections are numbered 1706–91M (293 acres), 242–91M (74 acres), 911 (210 acres), 1279M (100 acres), 1278M (200 acres), and 1699–91M (100 acres). A high ridge runs nearly east and west through the two northern sections, and it is on the south slopes of this that the outcrops of coal have been discovered, generally in the beds of watercourses draining into the Sandfly Rivulet, a tributary of the Huon River. The junction of the road from Woodstock, which passes through the eastern section with that from North West Bay to Hobart, takes place close to the eastern side of the property. This saddle is about 1400 feet above sea-level according to my aneroid.

The right of constructing a railway from the mine to deep water at North West Bay has been conceded to the Company by Parliament, and two surveys of possible routes have, I am given to understand, been made, one 9 miles, the other 11½ miles in length. The latter has been lately partly re-surveyed, and the engineer is said to be confident of being able to shorten it by about a mile. As the railway route comes up the valley of the North West Bay River, it has to cross the saddle above mentioned before coming on to the mine, and this fact has an important bearing on the method of winning the coal that will have to be adopted. It will not be possible to bring the railway so far down the slope on the west side of the saddle as to enable much work to be done on the seams from adits, a mode of opening the ground which its slope would otherwise favour. Any main adit put in to work all the seams, and at the same time drain the workings, would be too low down to be reached by the railway. This is not of so much consequence as it would be if the seams dipped the opposite way, for they all dip to the north-west, or into the hill, and therefore the adits would have to be driven a long distance before cutting them. Owing to this, shaft-working would probably be preferable under any circumstances, even if the railway could be brought in low down the hillside. The same consideration shows us that not much advantage is to be gained from the steep slope of the hill being favourable for the employment of self-acting inclined tramways, for these would only be useful in lowering coal to the railway, not in raising it.

The country in this vicinity is composed of strata belonging to the Coal Measures, intersected, broken, and possibly overlaid in parts by diabase greenstone of probably Mesozoic age. On the road from Hobart fine sections of the marine beds of the Permo-carboniferous system are frequently exposed, and near Port Cygnet coal seams belonging to the Lower Coal Measures have been found; but in the neighbourhood of the Sandfly mine the strata belong to a higher horizon than any of the above, being part of the Upper Coal Measures (probably Mesozoic). The most characteristic rock of this formation all over the Colony is a soft tufaceous sandstone, containing much felspathic or altered felspathic matter, and often exhibiting fossil ferns and carbonaceous markings, which also are frequent in the associated shales. The diabase greenstone is an altered dolerite which has been forced up through the coal-bearing strata subsequent to their deposition, and doubtless spread out to a great extent over them; it is met with in all our coal-fields in this Colony, and is without doubt the main cause of their so frequent occurrence in small detached areas. Being an igneous intrusive rock, besides breaking the sedimentary strata it is liable to cause serious alteration in the character of the contained coal, which is sometimes found to be altogether useless in the vicinity of the dykes. Where, however, there is a large area of ground free from the greenstone we may expect to find the coal unaffected by it; and this is the case with the property now under consideration. The nearest mass of greenstone is at the Saddle, and to the east from it, and this appears to be a very large dyke, but in the sections themselves no solid outcrops of it have been discovered, though loose superficial boulders are rather common in parts. These must have come down from a mass somewhere up the hill not yet discovered. The coal outcrops having been discovered for over a mile in length without indications of noteworthy disruptions, there are grounds for believing that no dykes of large size will be found in the coalfield. On the north side of the hill in the northern sections the greenstone is reported to be again present in large quantity, and will probably cut off the seams in that direction, though they may perhaps dip under it. The extent of probable coal-bearing ground is, however, sufficient to render this limitation of the field a matter of little consequence, being over 1000 acres, an area large enough to supply the demands of a large colliery for many years. After describing the various seams an attempt will be made to roughly calculate the available quantity of coal.

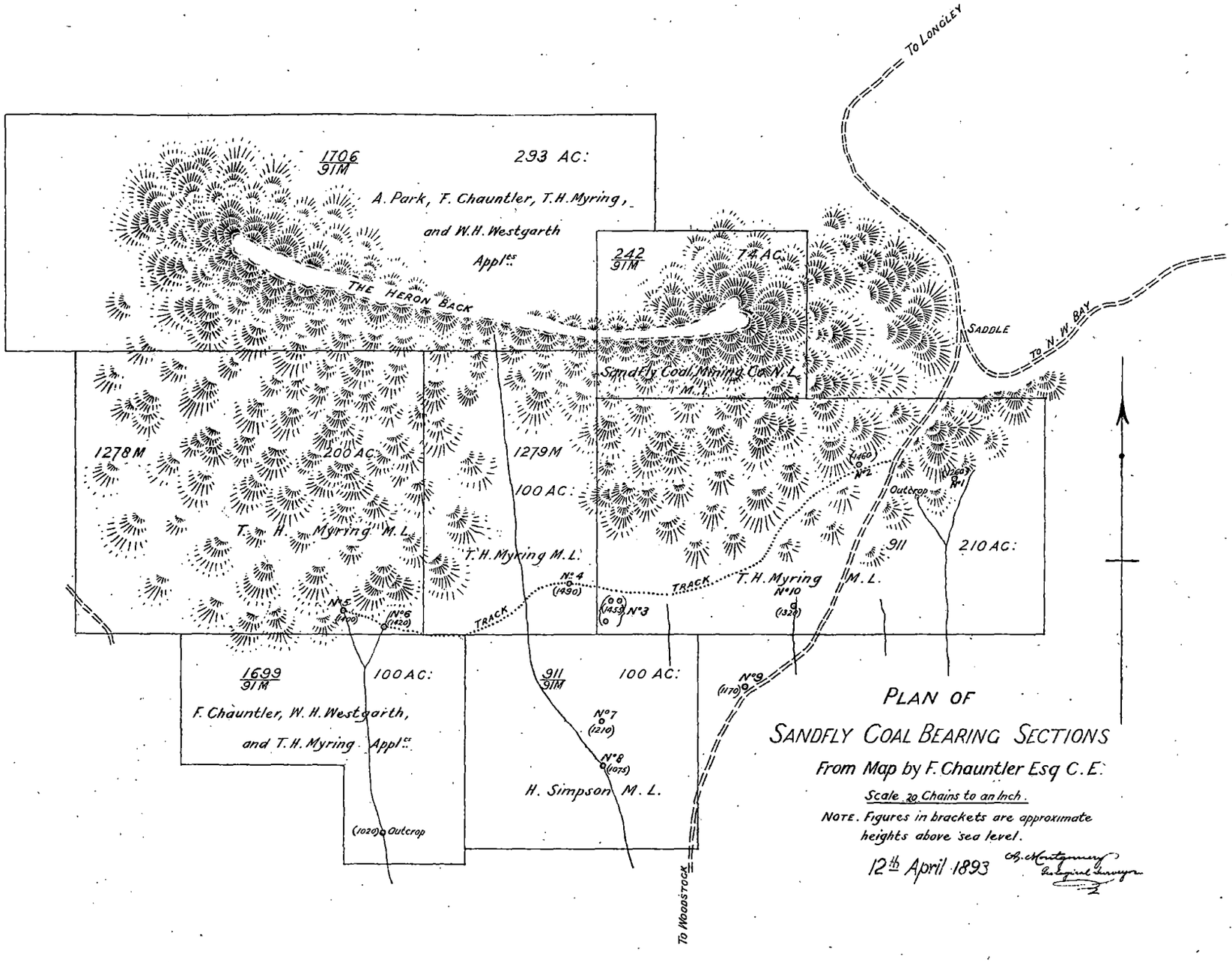
The map sent herewith shows the position of the various outcrops as located by a survey by Mr. Chauntler, C.E., kindly supplied to me by Mr. W. H. Westgarth, one of the owners of the leases. The heights given in figures at each outcrop are as determined by myself by aneroid barometer; they differ considerably from Mr. Chauntler's in absolute elevation, being generally about 260 feet higher than his, but agree very fairly as to the relative difference between the seams. Mineral lease No. 911-91M, of 100 acres, held by H. Simpson, it is to be observed, does not belong to the same proprietary as the other sections. The outcrops are numbered consecutively in the order in which they are most conveniently visited.

The general strike of the seams is N. 50° E., the dip being on the average 10° to N. 40° W. The line of strike follows the same course very much as the contour lines along the slope of the hill, but owing to the unevenness of the surface of the ground the outcrops of the same seam are not found quite at the same level in different places, being generally lower towards the western end than at the eastern. It is probable that one or more faults exist which have altered the levels of different parts of the same seams, for the differences of elevation of outcrops of the same coal do not seem to be explainable altogether satisfactorily as owing to the angle of dip alone. Such faults, however, cannot be of any great magnitude, and are not likely to seriously interfere with working.

No. 1 *Outcrop.*—(1260 feet above sea level). Two seams of coal have been found in the bed of a small watercourse towards the eastern side of Section 911. A drive has been put in to the dip in the lower seam some 30 or 40 feet, and in the end of this the coal is said to be 4 feet 9 inches in thickness: I could not examine this, however, as the drive was full of water. A few yards higher up the gully another heading has been driven 6 or 8 feet into this seam, and a small cutting has also been made into the upper seam. The section presented is as follows:—

	ft.	in.	
Tufaceous sandstone roof.			
Bright *Coal*	0	9	Upper seam 2 feet of Coal. Dip 13° to N. 35° W.
Soft clayey band	0	0¾	
Bright *Coal*	1	3	
Fireclay (about)	5	0	
Coal	1	2	Lower seam 3ft. 1in. of Coal. Dip 13½° to N. 40° W.
Soft clayey band	0	4	
Coal	1	0	
Soft clayey band	0	1	
Coal	0	11	
Hard sandy black shale floor.			

There is said to be another seam below these two, but I did not see it, the old workings having got covered up. The coal is good-looking, hard, and strong, and consists of interlaminated bright and dull layers: it is known as the anthracite seam, but is not a true anthracite by any means, but a non-caking steam coal. The 4-inch band in the lower seam would be a very useful "holing," as



PLAN OF SANDFLY COAL BEARING SECTIONS

From Map by F. Chauntler Esq C.E.

Scale 20 Chains to an Inch.

NOTE. Figures in brackets are approximate heights above sea level.

12th April 1893

A. McMontgomery
Provincial Surveyor

the floor is hard, and the small bands are so soft that they could easily be removed in working. The fireclay between the seams is fossiliferous: as far as I know, neither practical tests nor analysis have yet been made to determine its value for the manufacture of fire-bricks and other clay goods. As far as I could see in the old tunnel, the statement made that the seam increased in thickness appeared to be correct. This should be a very useful seam.

No. 2 *Outcrop.*—(1460 feet). About 13 chains W.N.W. from No. 1 outcrop two small seams of coal have been discovered about two chains apart. The eastern one has a roof of tufaceous sandstone and floor of fireclay, the seam being about 8 inches of rather poor coal. A heading has been driven some 6 feet or so to the dip of this seam. The western outcrop appears to be a seam lying below the fireclay bed which forms the floor of the first described, the roof being fireclay and soft sandy fireclay. The floor also is fireclay, the depth of which is not seen. A heading has been put in some 8 feet on the seam of coal, which is 15 inches thick, bright, and of laminated structure. It looks like a good coal, but the seam is rather small to work: it is possible, however, that there is more coal under the fireclay floor, as from its elevation this seam appears likely to be the top seam seen at the next outcrop. Dip 10° to N. 45° W.

No. 3 *Outcrop.*—(1455 feet). Three outcrops of what are evidently the same seams are found in the south-west corner of section 911. On the eastern one a heading has been driven about 75 feet on the lower of two seams lying close together. The upper seam has been driven into about four feet. The coal in this is a little "perished" by long exposure to the weather, but appears of fair quality in the face. The section shown is:—

	ft.	in.	
Soft clay roof.			
Coal	1	8	Upper seam 2ft. 4in. of Coal. Dip 5° to N. 40° W.
Clay band	0	1	
Coal	0	8	
Fireclay	3	0	(about).
Coal	0	10½	Lower seam 3ft. 3in. of Coal. Dip 5° to N. 40° W.
Clay band	0	1½	
Coal	0	11	
Shale band	0	1½	
Coal	1	0	
Hard clay band	0	9	
Bright Coal	0	6	
Fireclay floor.			

The coal is strong, hard, and full of bright layers, closely resembling the Mt. Nicholas coals in appearance. It forms a cinder in burning, and when retorted yields a coherent coke. A small parcel from here is said to have been tried by the chief engineer of H.M.S. "Orlando" in a steam launch, with very satisfactory results, being considered as good as the best Newcastle coal (N. S. Wales) generally used on board.

About 100 feet west from the above workings the lower seam has been laid bare for a length of about 50 feet by a drive run level along the outcrop. The coal is a little soft from prolonged weathering, and the upper seam does not show at all, the superficial soil being all loose and disintegrated on top of the main seam. The section is:—

	ft.	in.	
Soft clay roof.			
Soft weathered *Coal*	1	2	Seam 4ft. 7in. of Coal. Dip to N.W.
Soft clay band	0	2	
Coal	1	1	
Sandy clay band	0	0½	
Coal	1	7	
Clay band	0	1	
Coal	0	9	
Fireclay floor.			

About three chains S.S.W. from this the seam is again exposed in a heading driven about 16 feet into the coal. The crop is close under the grass roots, and the upper seam therefore is not seen. The section obtained was:—

	ft.	in.	
Fireclay roof.			
Coal	1	0	Seam 3 ft. 6 in. of Coal. Dip 10° to N.W.
Soft clay seam	0	3	
Coal	0	11½	
Clay band	0	4	
Coal	1	0½	
Fireclay	0	11	
Bright Coal	0	6	
Fireclay floor.			

This is a fair coal, but will no doubt improve in quality when cut further away from the action of the atmosphere.

Comparing the above three sections, it is evident that the second two are the lower seam seen in the first. The average thickness of this is therefore 3 ft. 9 in. of coal, a very nice workable seam.

No. 4 *Outcrop.*—This is about 7 chains N.W. from the last three, and at a height of 1490 feet above sea level, that is, 35 feet above them. From its position it should be a higher seam than the last, for it is situated fairly to the dip of these, and is nevertheless at a greater elevation. The section, however, is very similar, and I am disposed to think this is the same seam as those at No. 3, and that the latter have been thrown down by a fault, a distance of about 115 feet if we take the dip of the seams into account as well as the difference of elevation of the outcrops. I have omitted to mention that a small fault is seen in the drive on the easternmost of the No. 3 outcrops, which throws down the seam about 18 inches. No. 4 and No. 3 seams may, by a coincidence, have nearly the same section, however. The former shows :—

	ft.	in.	
Soft clay roof.			
Bright *Coal*	1	0	Seam 2 ft. 9 in of Coal. Dip to N.W.
Clayey band	0	2	
Bright *Coal*	1	0	
Band	0	1	
Coal	0	3	
Clay	0	8	
Bright *Coal*	0	6	
Clay floor.			

This outcrop had been driven into about 15 feet. The whole of it is a good deal broken by superficial disturbances, and the dip, therefore, was not measured. In order to ascertain if this is the same seam as at No. 3 outcrop, it would be advisable to cut into the hill above it so as to find out if there is an upper coal as in the latter case. The coal at this crop is of a bright appearance, and burns very well in an open fire, caking together to some extent while doing so. The ash does not appear to be excessive.

No. 5 *Outcrop* (1400 feet).—This is towards the south-east corner of Section 1278M. It has been cut into for 20 or 30 feet by a drive which goes in level for a distance, and then turns down the dip of the seam, holing into an old drive full of water in the face. This is a very nice seam, as will be seen from the section :—

	ft.	in.	
Fireclay roof.			
Coal	3	9	Workable Coal, 3 ft. 9 in. Dip 22° North.
Clay band	0	1½	
Bright *Coal*	0	1½	
Fireclay floor.			

There are a great many boulders of greenstone in the bed of the creek which comes over this outcrop. The coal is of good quality, but a little softened by long exposure to the weather. It is bituminous, and forms cinders on burning.

No. 6 *Outcrop* (1420 feet).—This is between six and seven chains south-east from No. 5, and is very probably the same seam. It has been cut into about 12 feet, and shows :—

	ft.	in.	
Fireclay roof.			
Coal	1	0	Coal 1 ft. 4 in. Dip 14° to N. 40° W.
Fireclay	0	7	
Bright *Coal*	0	4	
Fireclay floor.			

This coal burns well, caking together in doing so. If not identical with No. 5, it probably underlies it at no great depth.

No. 7 *Outcrop* (1210 feet).—This is near the middle of Simpson's Section, 911–91M. The drive on the coal is a good deal fallen in, and the exposure of the seam is consequently not very good. The old drive is said to go in some 35 feet. The section seen is :—

	ft.	in.	
Fireclay roof.			
Coal	1	0	Coal 1 ft. 8 in. Dip 17° to N. 5° W.
Clay parting	0	2	
Coal	0	8	
Fireclay floor.			

There is said to be three feet of coal in the end of the drive. The coal is full of bright streaks, and seems to be of good quality.

No. 8 *Outcrop* (1075 feet).—About six chains due south of No. 7 in the same section, the same seams as were seen at No. 1 outcrop are again laid bare. A drive has been put into the dip of the seam, but was full of water and could not be examined. The following section is, however, visible :—

	ft.	in.	
Fireclay roof.			
Shaly *Coal*	0	9	Workable Coal 3 ft. 6 in. Dip 5° to N.W.
Good *Coal*	0	8	
Carbonaceous clayey band	0	5	
Poor *Coal*	0	1½	
Clayey band	0	1	
Good *Coal*	1	0	
Clay parting	0	1½	
Hard dull *Coal*	1	1	
Hard dark shale floor.			

About three feet above this seam some black carbonaceous earth indicates the outcrop of the top seam seen at No. 1, and above this comes the tufaceous sandstone. Some 3 ft. 6 in. or 4 ft. below the main seam, another one, 14 or 15 inches thick, is said to have been worked, but could not be seen at the time of my visit. A heap of coal taken from the workings was lying outside the cutting, and is said to have been broken out some ten years ago. If so, and it has evidently been standing a long time, it has resisted the action of the atmosphere splendidly, being hard, strong, and clean. It is plentifully streaked with bright bands, but does not cake on burning, being quite similar to No. 1.

No. 9 *Outcrop* (1170 feet).—This is close to the old Woodstock Road to east of Section 911–91M, and to the south of 911. It has not been cut into any distance. It shows 13 inches in thickness of a fair looking hard coal, somewhat weathered by exposure, dipping 35° to N. 30° W. The floor is a poor fireclay, and the roof is a hard dark shale, similar to the floor of the last described seam and that at No. 1 outcrop. It is therefore probable that this is the seam underlying the main one of the two latter places, and that search would reveal two more seams accordingly overlying it.

No. 10 *Outcrop* (1320 feet).—From its elevation this is probably identical with the seam at No. 7. It is close to the south boundary of Section 911, and about half way between the east and west boundaries. A heading has gone about 20 feet into the seam, and lays bare the following section :—

	ft.	in.	
Fireclay roof.			
Clean good *coal*	2	10	Coal 3ft. 2in. Dip 11° to N. 40° W.
Shaly parting	0	1½	
Coal	0	4	
Band	0	4	
Bright *coal*	0	1	
Fireclay	3	0	
Bright *coal*	0	2	
Fireclay floor.			

This is a bright streaked coal, with cubical fracture, strong, and standing exposure to the weather well. It cakes on burning. As fireclay is found both above and below the seam it is very likely that there are other associated seams, and as the hillside is steep at this point a little trenching up and down the slope might be done with advantage to lay bare the strata.

Other Outrops.—Two other outcrops shown on the plan were not visited by me for want of time; neither of these has yet been opened up so as properly to expose the coal. One is in the extreme south of Section 1699-91M, and is likely to be either the No. 7 and 10 seam or that seen at No. 8; its height above sea-level is about 1020 feet; the other is about six chains south-west of No. 1 outcrop, and most likely belongs to the same seam.

Comparing the different sections and the positions and levels of the outcrops, it appears probable that there are the following seams, reading from the highest downwards :—

(A.) Seam seen at Nos. 5 and 6 outcrops. If these belong to one seam its average thickness is 2 ft. 6 in. of coal; if different, the total thickness is 5 ft. 1 in. of coal.

(B.) The seams seen at Nos. 4, 3, and 2 outcrops, giving a total thickness of, say 5 ft. 10 in. of coal (upper seam 2 ft. 4 in., lower seam average 3 ft. 6 in.) if No. 4 is the same seam as is seen at No. 3, and 8 ft. 10 in. if No. 4 is a separate seam.

(C.) The seam seen at Nos. 7 and 10 outcrops, giving an average thickness of 2 ft. 5 in. of coal.

(D.) The three seams seen at Nos. 1, 9, and 8 outcrops, aggregating 6 ft. 4 in. of coal (upper seam 2 ft., middle seam, average of Nos. 1 and 8, 3 ft. 3 in., and lower seam, No. 9, 1 ft. 1 in.)

Summing these up, the lowest calculation gives 17 ft. 1 in. of workable coal already exposed in these four seams or groups of seams, and it is probable that others exist in addition. Taking the area of the coalfield at 1000 acres, and reckoning an acre to contain 1600 tons of coal in a seam a foot thick, we find the quantity of coal to be 17 × 1600 × 1000 tons, that is 27,200,000 tons. Deducting one quarter for loss in working, we get approximately 20 millions of tons as the quantity of coal likely to be available in the field. In 1891 the total consumption of coal in Tasmania was between 85,000 and 90,000 tons, so it is evident that the Sandfly colliery could supply the wants of the whole Colony at the present demand for over 200 years. These figures are not of much absolute value, but serve to show the importance of the coalfield, and to give some approximate notion of what it could supply.

The Sandfly coal has been frequently analysed, and proved to be of good useful quality, confirming the favourable impression formed of it by ocular inspection. The first five of the following analyses are taken from the Tasmanian Official Record, 1892; No. 6 is one made by Mr. Ward, Government Analyst, on 17th February, 1888, quoted in a collection of reports circulated by the "Sandfly Bituminous Coal Syndicate"; and No. 7 is one made 25th February, 1893, also by Mr. Ward, and given to me by Mr. W. H. Westgarth :—

	1.	2.	3.	4.	5.	6.	7.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Fixed carbon	59·20	81·40	62·20	63·50	67·00	60·0	62·59
Mineral matter (ash)	9·20	14·00	8·70	14·70	14·30	12·0	4·60
Sulphur	?	0·80	0·80	0·80	0·60	0·9	0·88
Volatile hydro-carbons	25·8	2·85	23·30	16·70	12·70	24·9	25·43
Water (lost at 212° F.)	5·8	1·85	5·0	5·3	5·4	2·2	6·50

No. 2 is an anthracitic coal; the others more or less bituminous. No. 7 yields a firm and coherent coke, and has an evaporative power of 13·86.

The fireclay lying above and below several of the seams has never been tested, so far as I am aware, either by analysis or by practical tests: as the seams are of workable thickness this should be done. A seam of really good fireclay would be very valuable, and even inferior bricks, not good enough for smelting purposes, would command a ready sale.

In quality the coal appears to be quite up to the average of the Tasmanian coals in the market, and though not equal to the best New South Wales coal, is not far behind it. It is to be remembered that all the Sandfly coal has come from outcrops, where it is sure to be somewhat inferior to that from the unweathered portions of the seams. Some of it is caking coal, and if it should prove, on practical trial, to make a good quality of coke, there is likely to be a good demand for this on the West Coast mining fields for smelting purposes. Experiments should be made with coal-washing apparatus to determine if any large percentage of the mineral matter can be mechanically removed, as much better coke would result.

It is proposed to take the coal from the mine to North-West Bay by railway, a distance of from 10 to 12 miles, and ship it there. North-West Bay is a well-sheltered deep-water harbour, capable of accommodating the largest vessels, and is only about 18 miles by water from Hobart. It would therefore be a very convenient coaling station for the vessels of Her Majesty's Fleet and for the lines of ocean steamers that call at Hobart. This coal ought to be able, from the advantages of its position, to beat all other competitors in the Hobart market, and if a practical monopoly of this could be secured there would be little fear of the venture not being able to pay interest on the large capital required to make the railway, build the wharves at North-West Bay, and open the mine so that it would be capable of a large output. Probably not less than £50,000 would have to be expended before the coal could be freely put into the market, but it seems to me that there is a very good prospect that this would prove a payable investment. Till the estimates for making the railway and wharves, and sinking shafts, driving levels, and otherwise opening the mine have been gone into in detail, it is impossible to arrive at any conclusion as to the profit per ton of coal raised that could be fairly anticipated, other than a general one as given above. The matter presents itself to me in this light:—As far as one can judge without detailed estimates there are good prospects of this mine becoming a profitable investment: the amount of money required to be spent in getting details on which to found an accurate estimate is not large, and may be well hazarded on the strength of the prospects as they appear at the present time: if the detailed estimates bear out the opinion now formed on general grounds, the money will be well spent, for all the information obtained will be required in the construction of the permanent works; and, on the other hand, should they show that the mine could not be made to pay, the amount lost would not be considerable enough to be of much consequence to a strong company.

I would therefore recommend the formation of a company with an available capital of, say £75,000, of which £5000 should be subscribed in the first instance for the purpose of surveying the railway line permanently, designing and making estimates for the harbour works, getting all information as to marketing the coal, laying out the mining works, and, above all, proving the mine by diamond-drill borings. Not less than six bores should be put down in different parts of the field, and more would be desirable. These would, at a low cost, give complete data for estimating the area of the coal ground, the size and number of the seams, their relative position, and the depth to which shafts would have to be sunk, and would prove whether or not any trouble is to be anticipated through the influence of intrusions of the igneous greenstone. This diamond-drill boring is almost absolutely necessary for the proper location of the mining works. The money spent on all these preliminary works should be looked upon as an insurance premium, guarding against possible loss of a much larger amount through starting without sufficient information. The prospects of the property amply justify this preliminary expenditure, and there is much reason to believe that it will result in showing that the mine can be worked so as to be a very profitable investment.

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

A. MONTGOMERY, *M.A.*, *Geological Surveyor.*

The Secretary of Mines, Hobart.

WILLIAM GRAHAME JUN.,
ACTING GOVERNMENT PRINTER, TASMANIA.

REPORT ON THE PROGRESS OF THE MINERAL FIELDS OF THE COUNTY OF MONTAGU.

Geological Surveyor's Office, Launceston, 20th May, 1893.

SIR,

I HAVE the honor to forward to you the following Report on the state of the Mining Industry on the Mount Reid, Mount Dundas, Mount Zeehan, and Mount Heemskirk mineral fields. On the 11th April last I had the honor of submitting to you an *interim* Report on these fields, together with some observations on the coal and other discoveries near Mount Pelion, but the present more extended one will not deal with the latter, but leaves them for a separate Report. As I have also sent in a seperate Report on the Mount Lyell mine, dated April 6th, 1893, it is not further remarked on in the present one, though Mount Lyell field is in the County of Montagu.

Geological Structure.—In my previous Reports of the 25th April and 25th November, 1890, I have touched briefly on the geological structure of the Zeehan and Dundas fields, and it seems desirable now to go into this subject a little more fully. The time at my disposal when visiting the district was however so short and so much taken up with an examination of the mines from an economic aspect, that I have not yet been able to make any general geological survey for the purpose of mapping the various formations and for tracing out their relations to each other; the following account is therefore only a very general sketch. Like many other mineral districts, the Zeehan and Dundas fields have a somewhat complicated structure, consisting of ancient slates, sandstones, limestones, and other sedimentary rocks, much folded and contorted, and broken by igneous intrusions of various ages. The sedimentary strata, though much twisted, appear on the whole to have a strike about N.N.W. and S.S.E., parallel to to the West Coast Range and the West Coast line itself, but vary very much in dip. Rocks of very similar composition are found with very unlike lithological characters, some of the sandstones for example being hard, dense, and much metamorphosed, while others are soft and friable. This variability makes it very difficult to determine whether the strata belong to only one or to more than one geological period, though it seems most probable that the latter is the case. If so, the beds belonging to both the younger and the older formations have much the same strike and often resemble each other lithologically, so that their separation must be very difficult in the absence of fossils. Further south the limestones of the Gordon River have been referred to the Lower Silurian system, and the sandstones of the Queen River to the Upper Silurian, on pretty good palaeontological evidence, and very possibly both these formations are represented among the non-fossiliferous beds of the silver fields. On the Zeehan field fossils are found rather plentifully on the Despatch Company's section in limestone, and on the Silver King Company's ground in slate and sandstone, and the limestone near the Oceana mine also yields a good many species. These have not yet been examined and named by any professional palaeontologist, but seem likely to be Upper Silurian or perhaps even Devonian in age. The non-fossiliferous beds conformably associated with the fossil-bearing layers are not distinguishable on lithological grounds from some similar ones intercalated in the more metamorphic rocks of the Mount Dundas and Mount Reid Range, which again pass eastward into highly crystalline mica-schists and quartzites, so that it is not certain that the latter much older-looking beds are not also Upper Silurian. It seems to me most probable, however, that the Dundas and Reid Range, Mount Murchison and the West Coast Range, are of older date than the rocks of the Zeehan field, and that the latter lie on the flanks of a ridge of more ancient origin.

The fossiliferous beds are found at intervals up the Huskisson River, on the track from North Dundas to Waratah, and again at the Heazlewood Field, showing the latter to be of the same age as the Zeehan one.

The strata of the Dundas and Mount Reid Range seem more crystalline than those of the Zeehan Field on the whole, but otherwise do not differ much from them. They consist of slates, schists, sandstones, and conglomerates, of various colours and textures, much contorted and dipping generally at high angles. The conglomerates found near the saddle between Mount Dundas and Mount Reid, contain pebbles of quartz and numerous ones of older jasperoid slates. Lower down the slopes of the Range, along the North Dundas Road, and near the Dundas Township, beds of angular conglomerate or breccia occur in some quantity, chiefly formed of quartz and fragments of older archæan slates also, but differing from the previously mentioned conglomerates in the distinctly angular shape of the majority of the component pebbles. These breccias appear most likely to have been formed in the first instance by a volcanic outburst, which has shattered older rocks and distributed the fragments over the

surrounding country, a well-known phenomenon in the earlier phases of volcanic activity, and then carried into the sea and laid down in bedded form by ordinary aqueous action. The loose fragmentary materials thrown out by volcanoes are rapidly carried away by rains and streams, and the finer dust and sand are separated to some extent from the coarser particles. Not being subjected to prolonged attrition in the streams and on the sea-shore, the angular shape of the particles is to a great extent preserved, and we thus have bedded deposits of tuffs and breccias formed in layers interstratified with the ordinary slates and sandstones. I am not yet clear as to whether the breccias of the Dundas Township are stratified or not conformably with the main body of the strata, having come across no clear section showing their relations, and it is possible that the former are younger, and belong to the earlier stages of the volcanic activity which afterwards produced the serpentine dykes to be spoken of later on. With these breccias there are also tuffs of similar composition but finer texture, which are, doubtless, the finer dust and sand produced at the same time as the coarser angular fragments. Till these rocks have been miscroscopically examined it will not be certain that they are of volcanic origin; but I do not think there can be much doubt about it.

In the Western mine, at Zeehan, there is a belt of somewhat soft clayey country rock, often showing a distinctly brecciated appearance, and containing numerous fragments of apparently pumiceous and scoriaceous character. The rock is much altered by the decomposition of its felspathic constituents, but appears to me to be clearly a tuff-bed. The enclosing black slates are in this neighborhood very much contorted, and some of the sections exposed in the mine would almost give one the idea that the igneous rock was intrusive through them, but after a careful examination I became fairly satisfied that it was not so, but that the tuff-bed was conformably enclosed in the slates. In other parts of the Zeehan Field, in the Balstrup's, Manganese Hill, Maxim, Silver Queen Extended, Sylvester, and Silver Queen No. 2 mines, there are also tufaceous rocks which appear to be conformably bedded with the slates, and there can therefore be little doubt that layers of volcanic ejectamenta occur among the ordinary slate and sandstone strata. If the slates of Mount Dundas prove to be of the same age as those of Zeehan, it is therefore probable that the breccias and tuffs in the former district will be found to be intercalated among the ordinary sedimentary strata also.

Limestone occurs in several parts of the Zeehan district, near Argenton, at the New Pyramid Mine, on the Oceana section, on the Despatch ground, at the Comstock Mine, on the Mariposa, and also near the Success Mine at North Dundas. The Argenton limestone was used for flux at the Zeehan and Dundas Smelting Works during their run, and found very satisfactory.

Intruded through the sedimentary formations are igneous rocks of three distinct varieties, granite, serpentine, and diabase. The latter is quite unimportant: it forms the top of the peak of Mount Dundas and one or two dykes in its vicinity, and is probably of Mesozoic age, belonging to the extensive doleritic flows which form the great Central Plateau of Tasmania and the principal mountains of the Eastern side of the island. The other two formations are of great importance, and have probably had much influence on the formation of the metalliferous lodes. The granite forms the peaks of Mount Heemskirk and Mount Agnew, and further north reappears in the Meredith Range; the isolated Granite Tor to the north-east of Mount Reid also probably belongs to the same plutonic outburst. In the North Dundas Field also granite is found, and possibly elsewhere not yet noticed. Dykes of quartz porphyry, doubtless connected with the main granite masses, penetrate the slates of the North Dundas Field in more than one place, much in the same way as similar ones break through the slates and sandstones of Mount Bischoff, and the tin ore lately found there is no doubt due to their influence as at the latter place. In the vicinity of the granite of Mount Agnew some of the sedimentary rocks are very much altered to hard splintery stone, often like hornstone, which is probably a result of contact with the igneous mass. The granite country everywhere seems to be favorable for lodes of tin throughout Tasmania, and this district is no exception, tin being found wherever there is granite, but it seems not to have any connection with the silver-bearing lodes. The other igneous rock found on the West Coast, viz., the Serpentine, appears to stand, however, in a very close relation to the argentiferous lodes, which often are enclosed in it. It is found round Trial Harbour, on the westward slope of the Comstock Hill, on the west side of the Zeehan Field, on the Maxim Section as a small isolated patch, on the Adelaide, Bonanza, Anderson's, and Central Dundas Sections, and others in their vicinity, and in a large mass on the North Dundas Road. On the track from the Pieman River to Waratah up the Huskisson Valley, it crops out in two places, and in the Heazlewood and Whyte River Silver Field it is again largely developed. It is a rock which varies very much in composition and texture, but usually contains a good deal of serpentine, and occasionally is almost altogether composed of this mineral. In some parts it is not greatly altered, and shows its original state to have been a dolerite or gabbro. The serpentine generally contains some magnetic iron ore and occasionally chromite, and at the Heazlewood the hydrated carbonate of nickel (zaratite) has been found in it in some quantity. Where lodes containing galena pass through it their oxidised cappings generally contain a good deal of chromate of lead (crocoisite), the chromic acid of which is doubtless derived from the serpentine. In the Whyte River Field this rock is plainly intrusive through the slates and limestones, and is therefore younger than them, but I am not yet aware of any evidence that would show whether it is younger or older than the before-mentioned granite outbursts.

Lodes.—The Zeehan and Dundas Fields are traversed by a great number of lodes which may be divided into two groups, a north-westerly set and a north-easterly set. The former generally have a strike between N.W. and N.N.W., the latter between N.E. and N.N.E. The relations of each of these groups to the other have not yet been made out, and we cannot tell whether one is older than the other, or if they are contemporaneous. Neither group can be said to have proved richer than the other as yet, and the veinstuff filling them is very similar in both cases. The north-westerly lodes appear to have been traced over much longer distances than the other set, and are likely to prove the main lines of the district. Having a strike from N.N.W. to N.W., they lie very much in the planes of bedding of the country rock, and have therefore sometimes been considered to be layer-lodes, but I do not think this is the case. The lodes do not appear to follow the contortions of the enclosing strata, but cut right through

them, so that though agreeing in strike with the enclosing rocks, they do not do so going downwards: This point will, however, be better settled when the mines are deeper. The walls of the lodes of both groups are often striated and smoothed, having thus the most notable characteristic of "fissure veins," and the nature of the veinstuff is also in favour of their being considered to be of this type. The gangue consists largely of carbonate of iron, with sometimes also carbonate of manganese, together with quartz and lode-slate, while the metalliferous minerals are galena, blende, iron pyrites, copper pyrites, and a little Fahl-ore (Tetrahedrite) and other sulphides. The galena and Fahl-ore carry the bulk of the silver, the other sulphides being very poor. The lodes often have their contents arranged in layers parallel to the walls, showing a "banded" structure, and at other times are "brecciated;" these two types of structure being very characteristic of "fissure" lodes. Near the outcrops a great deal of chemical alteration has frequently taken place in the lode-stuff, owing to the action of surface waters containing air, carbonic acid, and organic matters in solution, the carbonates of iron and manganese being changed to oxides, and the sulphides of lead, iron, copper, and zinc to sulphates, carbonates, and oxides, while many of the compounds formed have been leached out altogether. The ferruginous gossans are in consequence usually poor in lead and silver, and the unaltered lode-stuff is not met with till sinking has proceeded to well below the water level. In some instances rich argentiferous material has been met with, carrying chloride of silver and carbonate of lead, before getting down to the unaltered galena, which indicates a redeposition at a lower level in the lodes of the metallic materials dissolved from the gossans. There is much reason to hope that this feature will be found beneath many of the large gossan outcrops so common throughout the Dundas district, and if so, we may expect some very rich deposits. In some of the large gossan lodes at Dundas it would appear as if galena was redeposited by secondary chemical action; for we find veins of it enclosed in walls of brown iron ore, and it is possible that some of the very rich pure galena found in some of the Zeehan lodes near the surface, and which did not live down, is similarly a secondary product concentrated from the higher parts of the veins now destroyed. I do not, however, think that this is very generally the case, for the arrangement of the sulphides and gangue in the lodes near the surface is usually the same as at greater depths, and the value of the surface galena is not appreciably higher than at the lowest levels. If the upper portions were enriched by solutions percolating from above we should expect to find a different arrangement of the constituents and a higher value of the ore near the surface than deeper down. It is more probable that the dying out of some of the patches of ore cropping to surface is simply due to their being of limited extent, and that in the same way when other patches are found in the lodes they also will die out in all directions. The rich portions of a lode cropping to surface are naturally the first to be worked, and their coming to an end at a small depth implies only that the valuable constituents are likely to be distributed throughout the vein in patches, and not that the ore is confined to a short distance below the surface. If we take a sheet of paper to represent a lode, and splash upon it a number of large blots of ink, the dark portions of the paper will exemplify the ore in the vein, and the white paper the barren matter. Let the paper be held on edge, the upper edge representing the outcrop of the lode, and the blotches which reach the edge will stand for the croping out patches of galena: they will soon be mined out, but if shafts are sunk and levels driven in the lode, other patches will be encountered. If we now draw a brush with ink across the paper from the upper edge downwards several times in roughly parallel strokes, we get a diagram of the occurrence of "shoots" or "chutes" of ore, which are bodies of more or less restricted length, but fairly continuous in depth, Such shoots are very common in lodes and often constitute the only portions worth working. None of the Zeehan mines are yet of such depth that the shoots can be said to be *proved* to be living downward, but so far as the evidence goes it is satisfactory in this respect, and there is no reason to believe that the Zeehan lodes will not behave in the same way as those that have been longer proved elsewhere: there will be shoots and patches of rich ore down to great depths, separated by poor lodestuff containing little or no ore and their value will depend upon the relative quantities of the poorer and richer portions. We can only judge of the probable amount of richer ore by the portions exposed by actual working, and though this is yet a very small fraction of the known area of the veins, it is, in my judgment, sufficiently rich to justify sanguine expectations as to the high average value of the lodes when more extensively opened up. I do not see the slightest ground for supposing that the lodes will not continue downwards as far as mining can follow them, nor for anticipating any considerable enrichment or impoverishment of them in depth unless a change in the character of the country rock should be met with: on the contrary the character of the lodes should lead us to expect them to be very persistent going downwards, and there seems to be no good reason why they should not maintain the same average ore-value as we know them to have in the present workings.

On the Zeehan field the lodes are generally of not very great width, averaging from about two to six feet from wall to wall, though often both larger and smaller than this. Many of them crop out in low ground, and are practically below the water-level from the surface downwards, and are not much oxidised at the outcrop. Some, however, like the Balstrup line of lode, the Sylvester main lode, and the Silver Queen No. 2 lode, have a considerable portion of their material lying above the water-level, and in these the upper portions are strongly oxidised, and the valuable metals once contained have been dissolved out to a great extent, leaving occasional patches of pyromorphite, and in a few instances chloride of silver, to testify to their former presence. The larger the lodes the more thorough appears to be the oxidation, the large Balstrup lode, for example, being more thoroughly converted into gossan above the water-level than the smaller Sylvester lode or the still smaller Silver Queen No. 2 one. In the Dundas field, which is more rugged and hilly than the Zeehan one, very few indeed of the lodes show galena at surface and then only in the case of small veins, or, when they are larger, when the lodes have been deeply cut into by creeks and watercourses. Above the water-level the oxidation of the lode matter is generally very complete, and instead of the hilly nature of the ground facilitating the opening of mines as is usual, it has hindered progress, as working by means of adits has been found to be not very usually possible, and the ruggedness of the ground has stood greatly in the way of transporting machinery on to the mines. Much money has been spent in driving tunnels below gossan outcrop, only to find the lodes still oxidised and valueless. This has been discouraging, as there was much reason to hope that many of these mines could have been raising ore from adits without requiring

to get expensive machinery. The consequence of this difficulty is that very little has yet been done towards determining the value of the lodes lying beneath the huge gossan outcrops so common in the Dundas District. The most important evidence on this question has been yielded by the workings of the Oceana, Balstrup's, Manganese Hill, Adelaide, Central Dundas, Dundas P.A., Comet, and Maestrie's Broken Hill mines. These will be described in detail later on, and it will be sufficient now to say that in every case rich ore has been found beneath the poor gossan when the water-level was neared or reached. None of these mines are yet deep enough to be quite below the zone of oxidation, and are, in fact, only coming upon the top of the ore deposits; but their success, only partial though it may be, augurs very well for the value of the lodes at lower levels. No doubt some of the large gossan outcrops simply result from the alteration of carbonate of iron; but as this mineral throughout the district seems always associated with galena, there is every hope of even those that may be barren siderite when first struck becoming good mines when opened up so as to discover the shoots of galena.

Access.—Towards the end of 1891, the Railway from Strahan to Zeehan was completed and opened for traffic, and shortly afterwards that also from Zeehan to Dundas. The latter has two branches, one ending close to Maestrie's Broken Hill and the Comet mines, and the other near the Adelaide Proprietary mine. A projected branch from Argenton to the Mariposa and other South Dundas mines has been begun, and the earthwork has been partly finished, but, owing to various causes, has been abandoned, for the present, at any rate. A small branch line runs from the Zeehan Station to the Zeehan and Dundas Smelting Works. Grubb's mine is also connected with the railway by means of a light railway which passes close to the Central Balstrup shaft, and has a short branch to the Nubeena workings. The Oceana and New Pyramid mines connect at Argenton with the Strahan to Zeehan Railway by means of a narrow-gauge iron tramway capable of carrying a small locomotive, and the Silver Bell nearer Zeehan by means of a wooden tramway. Not connected directly with the railway system, but coming into the main street of the town of Zeehan, are tramways from the Argent and Silver Queen Extended (Mount Zeehan, Tasmania, Silver-Lead Mines, Limited) mines, the Sylvester mine, the Tasmanian Crown, the Western, and the Montana mines. Yet another tramway has been made from the New Tasmanian mine to the Zeehan to Remine road, joining the latter near the Comstock mine. It will thus be seen that the field is becoming pretty well opened up by tramways, and that much money had been spent on these. The lines are of a substantial character in general, and will be of the greatest service in getting in supplies and machinery, and getting ore out. It is now pretty generally agreed by practical men at Zeehan that tramways are both cheaper and better than roads, if the latter are to be anything better than mere sloughs and to be of a character to sustain heavy and continuous traffic. The tramway system is likely therefore to become very much extended in the course of a few years.

The road from Trial Harbor to Zeehan is still much used, especially between the latter place and the Comstock; it has been extended out to the Dundas township, and a branch from this extension goes northward towards North Dundas for some four miles. From the end of this there are very rough pack-tracks to the Success mine, the Pieman River crossing, and the Commonwealth mine. A corduroy pack-track has also been made from it to the Madam Melba and Grey Ore mines, and is continued on as a rough track to the Fahl Ore. Another pack-track has been made from the end of the Dundas road at the Comet mine to Mount Reid; this is laid with corduroy as far as the Pimple, but from there onwards is very rough. From the Pimple a very steep and bad track, unfit for pack-horses to travel, leads down to the Ring River gold field, and another similar one goes from this to Mount Reid. The great bulk of the Dundas sections are still only to be reached by means of bush tracks connected with these various better opened lines. A great deal of track-cutting and road-making has therefore yet to be done before much mining can go on.

The projected Waratah-to-Zeehan Railway would be a great boon to the northern portion of the Dundas field, even if only carried from Zeehan to the Pieman River to begin with. Pending a definite settlement as to whether it is to be constructed or not, owners of sections along its route do not know what to do; they do not want to wait indefinitely for the railway, and at the same time do not care to incur the expense of putting in tramways of their own, which would become useless as soon as the railway was made. The very promising Success line of lode is quite locked up owing to this consideration; and others also would attract much more attention if there was any reasonable probability of their being able to send away their ore when raised. A silver field differs very considerably from a tin or alluvial gold field, for the latter can be worked in spite of great difficulties of access, little or no machinery being required, and the mineral produced being of small bulk and high value. It is one thing to pack out tin ore worth from £50 to £60 a ton over bad bush tracks, and quite another to do the same with ore worth under £10 a ton. The now proved fact that in most instances in the Dundas field it is necessary to go below water level to obtain ore, and therefore is impossible to mine without machinery for drainage, is another essential difference to be borne in mind when comparing this with, say, the North-East Coast tin fields, which were opened up under great difficulties of transport. In the latter case labor only was required, not heavy machinery. A very little consideration shows that the very first requirement of a mine requiring engines for its development is a road by which they can be brought on to the ground, and practically all the North Dundas mines are in this category. Either the railway or an extension of the North Dundas road to the Pieman River, is therefore urgently required. Possibly, a light narrow gauge line along the route of the surveyed railway would be sufficient in the first instance, and could be enlarged and re-laid to standard gauge later on if the development of the mines justified the outlay. The principal objection to this solution of the difficulty that I can see at present is, that there is a considerable tunnel to be made through the watershed between the Henty and Argent Rivers, which would have to be made even for the narrow-gauge line.

While, therefore, the means of access to the Zeehan and Dundas Fields have been immensely improved during the last two years, a great deal yet remains to be done before mines at a distance from the railways and roads can become producers of ore. As, however, the area of the fields is, roughly speaking, one hundred square miles, it is unreasonable to expect them to be completely laid open for

many years to come, both time and capital being required for even the preliminary work on so much ground, and under the circumstances it seems to me that the progress made is highly creditable to the Colony.

Progress of the Mines.—The severe depression in business of all sorts which has existed throughout the Australian Colonies for the last two years, has told very heavily against the rapid development of the mines that was so confidently expected formerly. It has led to an almost complete stoppage of the supplies of capital required for the preliminary deadwork, and caused the abandonment of hundreds of mineral leases. Then the delay in raising ore, generally due to the want of adequate machinery being provided in time, had a very bad effect upon the public mind, as investors generally believed that as soon as the railway was completed there would be an immediate output of ore, and their confidence was destroyed accordingly. The conditions of mining on the West Coast have not yet been generally realised by investors, and the expense of gaining access to the mines, opening them by underground works, and fitting them with necessary machinery, has been altogether under-estimated, while the value of the lodes has been almost always rated far too high. In most instances, the working capital provided has not been anything like sufficient to put the mines on a producing basis, and their consequent failure to realise expectations has so disappointed the shareholders that more money could not be raised, and many promising ventures have therefore been shut down. A frequent consequence of the want of capital has been that cheap machinery has been provided, which soon proved unable to do the work required of it, and the failure of the mines in these instances, though plainly due to bad management, has too often been ascribed to the inherent worthlessness of the properties. If the ardour of genuine investors was thus damped by delays and disappointments, what shall I say as to the enthusiasm of the great crowd of mining speculators once so busy with West Coast shares, who care for nothing but the rise and fall of the market: it was extinguished altogether. For some time past the consequence of the revulsion of feeling against the West Coast fields has been that, except in a few cases, money could not be obtained from the shareholders in the mining companies, and the mines have been thrown on their own resources. Many had to shut down, but those that were in a position to put out ore well justified the confidence formerly put in them, and not only paid their way, but also in several cases paid off old debts as well, and the output has been so good for the last six months or more that the fields are being restored to public favor. Some particulars of the amount of ore produced will be given later on, but at present I wish to point out that the greater part of the produce has been first-class ore, of value to pay for shipment to smelting works in Australia and Europe: it is only quite lately that concentrates from the second-class ore have largely swelled the returns. It speaks very highly for the district that so much high-grade ore should be so easily obtained, and gives great confidence that when the lodes are properly worked, and the poorer stuff taken out as well as the richer, the results will be highly payable. In most settled mining districts the mainstay of the mines is not the rich ore which is generally in comparatively small quantity, but the large masses of low-grade stuff requiring concentration, and no doubt it will be so at Zeehan also. The present output from quite a few mines in all may be looked on as an earnest of the success which will follow when a great many more are opened up so as to become producers. The great want now is capital to extend present workings and open new ones, and it is too much to expect that the mines themselves will be able to produce all that is required: it will mostly have to be subscribed outside in the first instance. The district is doing very well out of ore raised, but still wants much help from the public in order to show still better results. Even those that are paying their way would mostly be greatly benefitted by the expenditure of some more money upon them to enable them to get more ground open for stoping and better appliances for dealing with the stuff raised. The Western mine and Grubb's mine are in a position to pay for everything they require out of ore raised and in sight, but all the other producing mines, though probably able to keep going in many cases without help, would be the better of a little more working capital. Of course they may, perhaps, strike rich ore and require no assistance from the shareholders, but on their present average value they cannot be expected to provide funds for extensive deadwork, while fully warranting the owners in expecting a good return for their money if they do this out of capital. The Silver Queen, Argent, New Tasmanian, Silver King, Adelaide Proprietary, Dundas P.A., and Maestrie's Broken Hill mines have been for some time past considerable producers of ore, and have been getting enough to pay working expenses, and yield perhaps a little profit, but all require development work, especially opening at deeper levels. The Mount Zeehan Silver-Lead Mining Company have lately been forced to shut down, but have a property that a further expenditure of a moderate capital would most likely make payable. The Oceana mine is in very much the same state, and others might also be mentioned. Several claims worked by tributors are yielding payable returns, but will have to be provided with machinery before the lodes can be worked to any depth, and therefore also require capital. I dwell upon this at some length as the good returns of ore lately yielded by the field might lead to a belief that the mines ought all now to be self-supporting, which is very far from being the case. The present production is a sample of the value of the lodes and a guarantee that they will be remunerative when more extensively exploited, and should give confidence to investors that the money they may sink in so exploiting them will bring them in a good profit.

The depression from which the West Coasts Fields have been suffering is a phase in the history of mining districts quite familiar to mining men, having been seen repeated over and over again in other countries. The almost universal experience may be briefly summed up as follows :—First, there is the period when new discoveries rapidly follow one upon another, and excite ever-increasing expectations ; land is taken up in every direction, companies are floated in scores, speculation is rampant, there is a "boom," everything is over-valued, a great deal of desultory and badly arranged work is done, and real mining is confined to a few properties ruled by cool and judicious management. Next comes the reaction ; the output of ore is not up to expectations, returns do not come in upon the money spent, investors see no chance of recovering their expenditure, the cry goes forth that the field is an utter failure, shares are thrown up in all directions, and work is at a standstill except in a few cases, as before, where mining is steadily pursued. Lastly comes the revival of confidence ; the mines which have gone on working through both good and bad times put out increasing supplies of ore, and prove that payable returns follow judicious investment and prudent management, and gradually the field settles down to steady work on a reasonable basis.

The very large number of promising lodes and the wide area of country over which they have been found add greatly to the cost of opening up the West Coast Mineral District, necessitating the starting of a great many separate enterprises, and the spending of much money on roads, machinery, surveys, and surface works of all sorts. The field is much too big for the small Colony of Tasmania to develope all at once, and our efforts will have to be concentrated for a time on a few of the more likely looking ventures. As time goes on no doubt the whole of the lodes will be tested and foreign capital brought in to work them, but in the meantime it is rather a matter for regret that so much money has been spent in taking up ground that cannot be worked. Some idea of the amount of money that would be required to thoroughly prospect the whole field may be arrived at from the following calculation:—In the Zeehan and Dundas Districts over 80,000 acres of land have been taken up for mining purposes, or say 1000 eighty-acre sections. Now a sum of £1000 does not go very far in prospecting an eighty-acre section, and is quite insufficient if much driving, sinking, trenching, and so on have to be done to prove the lodes found on it; but if there were an expenditure on an average of £1000 on every eighty-acre block it would require one million sterling to prospect the whole of the district; and probably when the entire cost of roads, railways, shafts, and engines, and all other preliminary expenses are added up in future, it will be found that the opening of these fields came to an even larger sum.

While going over the field I obtained from various sources statements of the quantities of ore sent out from the mines. These were up to different dates, some to the end of 1892, some to date of giving the information, and some to the end of the first quarter of 1893, the latter being obtained since my return. With the aid of the reports appearing from time to time in the newspapers I have attempted to estimate the total production of the field up to the end of March, 1893, and find that approximately 13,800 tons of ore have been either smelted locally or exported in the raw state, the average gross value being not less than £10 per ton. We may reckon accordingly that up to the end of March, 1893, the Zeehan and Dundas Fields have exported silver and lead in bullion, concentrates, and raw ore, to the value of, say, £140,000. There has been produced, besides, a large quantity of second-class ore, which is on the ground awaiting treatment. The Government Statistician, in the "Handbook of Tasmania, 1892," page 34, shows galena and silver ore in the table of exports from the colony for the first time in 1889, in which year 202 tons of galena and silver ore were sent away. In 1890, 554 tons are recorded, and in 1891, 2359 tons, making a total up to the end of 1891 of 3115 tons. Some of this was probably from the Heazlewood Field, but we shall be pretty safe in estimating the produce of Zeehan and Dundas at 2600 tons. I have not been able to get the exact figures for 1892, but if we deduct from the total of 13,800 tons the above 2600, and also 3347 tons exported during the first quarter of 1893, we get approximately 7850 tons as the export in 1892. The following figures would therefore indicate generally the progress of production of the district:—

In 1889	say	200	tons	were	exported.
„ 1890	„	500	„	„	„
„ 1891	„	2000	„	„	„
„ 1892	„	7800	„	„	„
„ 1893 (first quarter)		3347	„	„	„

(Or at the rate of 13,400 tons per annum.)

It does not seem likely that there will be any difficulty in keeping up the present rate of production, and it will probably continue to show a rapid increase.

Though none of the mines are yet deep, a fair start has been made, there being about twenty mines which have shafts of over 100 feet in depth, and nearly thirty that are provided with steam machinery. The deepest shaft is that of the Comet Company, 270 feet; next to it coming the Silver Queen No. 1 shaft, 222 feet; the New Tasmanian, 186 feet; and the Adelaide, 176 feet. The best winding and pumping machinery on the field are the plants provided at the Grubb's and Silver Bell mines. A great many companies have provided steam pumps of the Worthington type in their shafts, but the experience of the field has proved decidedly unfavourable to their use; for though of great capacity for the steam used in comparison with the Cornish pump, they have shown themselves very liable to get out of order, especially when sinking.

Concentrating Mills.—In my first Report on the Zeehan Field (April 25th, 1890) the necessity of having the poorer ore concentrated was pointed out, but it was not till nearly two years later that this patent fact appeared to come home to the directors of mining companies, and a start was made at erecting mills. The New Tasmanian Company were first in the field, with a plant made by Green of Aberystwith, Wales, a description and plan of which by the manager, Mr. R. Provis, appeared as an Appendix to the Secretary of Mines Report for the year ending June 30th, 1892. Another mill by the same maker has been erected at the Argent Mine by the "Mount Zeehan (Tasmania) Silver Lead Mines, Limited" Company. The Silver Queen and Mount Zeehan Silver-Lead Mining Companies have provided themselves with mills made by May Bros. of Gawler, South Australia; the Silver King Company are putting up one by Messrs. Parke and Lacy, of U.S. and Sydney; and the Western Company one designed by C. Lühring. In Green's Mills the ore is broken first by a stonebreaker and then by rolls; the crushed material is sized by trommels; the coarser portion is treated on jigs with sieves of different degrees of fineness of mesh: the sand and slimes are separated by a hydraulic classifier, and the former washed in one set of centre-head buddles, while the latter are concentrated separately in another set of buddles. The treatment is thus fairly complete, but the buddles are not very efficient machines, requiring much time and labour. It seems to me that much more attention might with advantage be paid to sizing and classifying the ore before concentrating, though I quite recognise that there are commercial limits to the economy of doing so. I did not take any samples of the tailings of these mills, so cannot tell what percentage of the total value of the ore they were losing; but I was surprised to find that regular tests were not being made to determine this. In my opinion, any dressing works worthy of the name should regularly sample the escaping tailings, so as to know exactly the loss that is going on. As the tailings issue from several different machines, and it is somewhat difficult to determine the proportion coming from each, the same end is attained if the ore is carefully sampled and assayed.

before going into the mills so that the percentage saved can be at once estimated on cleaning up the concentrates. An automatic sampling machine ought, therefore, to be placed so as to catch the ore coming from the stonebreaker, so that regular and correct assays may be obtained. Rule-of-thumb work is getting out of date in ore concentration as in other technical processes, and the sooner it is superseded by scientific methods the sooner will the mills improve in efficiency. Directors of mining companies should insist most strongly on getting daily, or at least weekly, accurate returns of the losses in their reduction works, as a very salutary check would thus be established upon the work being done. None of the Zeehan Mills at present know exactly what percentage of the value of the crude ore is being saved, and in such an important matter something better than rough estimates should be made. Automatic sampling machines can be erected at quite small expense, and the labour attached to attending to them and assaying the product is nothing in comparison with the importance of the result.

Messrs Parke and Lacy's and the Luhrig concentrators were not erected at the time of my visit; the former plant is to consist of stonebreaker and rolls for crushing, jigs for treating the coarser crushed material, and Frue vanners for the sands and slimes: the latter will use Luhrig vanners, and is to be the most complete and elaborate plant on the field. The Luhrig vanner has the advantage over the Frue for treating mixed sulphides, such as occur at Zeehan, that different classes of concentrates may be obtained separate from each other, while the Frue vanner only yields "headings" and "tailings," or concentrates and refuse. Either blende and pyrites must be saved on it with the galena, giving a bad smelting product, or the washing action must be so violent that these heavy minerals are sent into the tailings, in which case there must be heavy loss of galena as well. The Luhrig vanner acts on much the same principle as the well-known Rittinger Percussion Table, but differs from it in that the surface on which the washing of the material is effected, is a revolving endless belt and not a fixed table.

The two mills erected by Messrs. May Bros, at the Mount Zeehan and Silver Queen mines, are very compact and well-arranged plants, but are by no means complete. The material, after being crushed by stonebreakers and rolls, is jigged on sets of four-sieved jigs and is not then further treated, no attempt being yet made to concentrate the sands and slimes. Only the first stage of dressing has thus been reached, and the mills will require many additional appliances before they will be able to extract the maximum possible amount of silver and lead from the ore. They have answered their immediate purpose by returning to the companies owning them a large quantity of clean marketable galena from their accumulated piles of second-class ore, but it appears to me that the loss in doing so has not been seriously enough considered. Take the Silver Queen experience for an instance:—According to Mr. Brockmann's report to the shareholders at the half-yearly meeting on the 31st August, 1892, "The various ore heaps at the No. 1 and No. 2 shafts were very carefully measured in my pre-"sence by Mr. G. P. Sinclair, the mining manager, and his two sons, and found to contain close upon "4000 tons of excellent concentrating material, the metal contents of which vary from 24oz. to 30oz. of "silver, and 25 to 30 per cent. of lead per ton of ore." At the following general meeting, on 28th February, 1893, the Chairman of Directors reports:—"Since the concentrator was started on January "9th, about 1800 tons of second-class ore have been put through the machine, giving a result of about "500 tons of clean concentrates, the average assay of which has been—Lead 65 per cent, and silver "54oz. per ton." Now taking the 1800 tons of material treated at the lowest value mentioned by Mr. Brockmann, namely, 24oz. silver and 25 per cent. of lead, the total silver contained was 43,200oz. and lead 450 tons. The 500 tons concentrates contained 27,000oz. of silver, and 325 tons of lead. The loss in treatment was therefore 16,200oz. of silver and 125 tons of lead, or 37½ per cent. of the total silver, and 27·8 per cent. of the total lead. If we reckon the value of the crude ore at the higher values given by Mr. Brockmann, the loss is still greater, being 50 per cent. of the silver and 39·8 per cent. of the lead. These are very heavy losses, but not greater than anyone conversant with the performance of concentrating machines would expect from such an incomplete plant: indeed, it speaks very well for Messrs. May Bros'. machines that the result is so good as it is. The percentage loss may also be arrived at in another way, and it will be found that this confirms the above result, namely, by assay of the tailings. I took some trouble to take tolerable correct samples of the tailings from the Silver Queen mill, taking small portions with a sampling auger from all parts of the heaps. Two samples were obtained in this way, one (No. 1) of the coarse tailings from the jigs, and the other (No. 2) of the sands and slimes collected in the settling pits. These were sent to Mr. W. F. Ward, Government Analyst, to be analysed, assayed, and concentrated by panning, and returned the following results:—

Analysis:	No. 1. Per cent.	No. 2. Per cent.
Lead	7·92	17·50
Zinc	15·00	5·63
Iron (as sulphide)	4·83	5·67
Oxide of iron / Oxide of manganese	16.10	13 40
Sulphur	11·00	15·50
Silica, etc., insoluble in acids	34·70	34·10

Carbonic acid, moisture, etc., not determined.

Fire Assay.	No. 1.	No. 2.
Lead per cent.	4·00	10·5
	oz. dwt. gr.	oz. dwt. gr.
Silver per ton	11 5 9	21 19 8
Gold „ „	Traces	Traces

Results obtained by Washing.	No. 1.	No. 2.
Concentrated sulphides per cent.	4·91	13·8
Lead in concentrated sulphides per cent. ...	45·35	47·82
	oz. dwt. gr.	oz. dwt. gr.
Silver „ „ ton	35 18 6	44 2 0
Silver in rewashed tailings per ton	9 16 0	17 4 15

In this last test the galena was washed as free as possible from all other sulphides.

I had no means of finding out what percentage of the whole of the ore treated went into the heap of tailings from which No. 1 sample was taken, and how much into the settling pits. An estimate of one-sixth of the whole as going away as sands and slimes is, however, likely to be lower than the truth, so I take it in getting an approximation to the average value of the whole of the tailings, thus:—

5 parts at 7·92 per cent. = 39.6
1 „ 17·5 per cent. = 17·5
} therefore average lead = $9\frac{1}{2}$ per cent.

5 parts at 11·27 oz. = 56·35
1 „ 21·96 oz. = 21·96
} „ „ silver = 13·05 oz.

Taking these values, and the values of the concentrates as before, we find the value of the 1800 tons treated to be as follows:—

500 tons concentrates at 65 per cent. lead and 54oz. silver, contain 325 tons lead and 27,000oz. silver.

1300 tons tailings at $9\frac{1}{2}$ per cent. lead and 13·05oz. silver, contain $123\frac{1}{2}$ tons lead and 16,965oz. silver.

Therefore 1800 tons of ore contained $448\frac{1}{2}$ tons lead and 43,965oz. silver, an amount which agrees very well with the lower estimate given by Mr. Brockmann, namely, 450 tons of lead and 43,200oz. of silver. Calculating percentage losses as before, we find a loss of $27\frac{1}{2}$ per cent. of the lead and 38·6 per cent. of the silver. It is therefore very clear that the efficiency of the mill is by no means what it should be, and that the tailings are quite rich enough to pay for further treatment: the sooner the concentrating appliances are added to, therefore, the better for the company.

A very much worse result than the above was obtained in treating a parcel of ore from the Tasmanian Crown mine at the Mount Zeehan mill. The parcel was ten tons, and a bulk assay of it yielded 12 per cent. of lead, and 15oz. of silver to the ton: it therefore contained in all 1·2 tons of lead and 150oz. of silver. The return from the concentrator was 13cwt. of galena, assaying 75 per cent. lead and 52oz. 11dwt. and 20gr. of silver to the ton, that is an actual return of ·4875 tons lead and 34·185oz. silver, being a loss of 59·4 per cent. of the total lead, and 77·21 per cent. of the total silver.

Such losses as proved by the above figures, would never be borne with equanimity by mining investors if they were generally known; but instead of this being the case, the belief is, to my own knowledge, very general that the mills are doing excellent work, and that it would not pay to put up further appliances for saving the supposed small quantities lost in the tailings. The results quoted show the absolute necessity of checking the mill returns by assays of the crude ore in bulk, and of the tailings, not only now and then, but regularly and systematically. No business man will willingly remain in a fool's paradise, yet most assuredly those do so who are content to take for granted that any stamp battery, concentrating mill, or smelting works, is doing perfect work, without the clear proof afforded by regular bulk assays of the crude ore and the residues after treatment.

The confidence shown in the results of work done by the concentrating mills is largely due to the pernicious and ignorant practice of estimating the lead in poor tailings by fire assay alone. The fire assay method is an excellent one for rich galena, but when the lead ores are associated with a large amount of foreign sulphides and earthy matter, it always gives results much below the truth. Take for example the two parcels examined by Mr. Ward: chemical analysis shows them to contain 7·92 and 17·5 per cent. of lead respectively, while the fire assay yielded only 4 and $10\frac{1}{2}$ per cent. It is idle to urge that as lead ores are always sold to smelters on fire assay, this should be the method used for testing tailings; for tailings are never sold to the smelters, but only the concentrates and richer ores, in the case of which the small loss of lead in the assay is to some degree commensurate with the smelting loss on a large scale. The loss of lead by fire assay amounts to, say, 1 or 2 per cent. in the case of a rich ore, one containing 80 per cent. of lead yielding say 79 per cent. in the crucible, but in case of poor tailings it is often 50 per cent. or more of the total lead present. An example will serve to show the absurdity of valuing tailings by fire assay for lead. Suppose we have a parcel containing in reality 8 per cent of lead, but returning only 4 per cent. by fire assay: this is concentrated on a good machine and yields 80 per cent. of the total lead: we thus get an actual saving of 6.4 per cent. of lead, or 160 per cent. according to fire assay, while the tailings contain 1·6 per cent, or 40 per cent. of the fire assay, in addition.

Mr. May, who was in charge of the Silver Queen mine at the time of my visit, was good enough to show me the assays of tailings made from time to time by the Company's assayer, Mr. M. M. Sinclair. These results are lower than the average sample taken by me from the tailings heap yields, but as the

return from the latter agrees with the sampling before treatment made by Messrs. Brockmann and Sinclair, I prefer to regard it as the more correct. Mr. Sinclair's assays are as follows :—

				oz.	dwt.	grs.	
Slimes.	*Lead*	$1\frac{1}{2}$	per cent. *Silver*	8	9	20	per ton
	,,	11	,, ,,	18	3	20	,,
Jig Tailings.	,,	2	,, ,,	6	13	22	,,
	,,	5	,, ,,	10	0	0	,,
	,,	$4\frac{1}{4}$	,, ,,	8	0	20	,,
	,,	$4\frac{3}{4}$	,, ,,	9	16	0	,,
	,,	2	,, ,,	6	4	3	,,
	,,	$3\frac{1}{2}$	,, ,,	8	3	8	,,
	,,	$2\frac{1}{3}$	,, ,,	8	2	8	,,
	,,	2	,, ,,	7	0	11	,,
	,,	2	,, ,,	7	3	17	,,
	,,	$2\frac{1}{2}$	,, ,,	6	17	4	,,

The mean of these ten assays of jig tailings is Lead 3 per cent. and silver 7oz. 16dwt. 5grs. per ton. As the lead was determined by fire assay we may safely say there was in reality 6 per cent. present,

Some very interesting results may be deduced from the above figures, bearing on a question of great importance in the problem of concentration, namely that of the proportions of silver contained in the galena and other sulphides respectively. Taking mean results from the above we find that

				oz.	dwt.	grs.	
When Lead = $4\frac{1}{4}$ to 5 per cent.,	1 unit of lead is associated with			1	19	19	of silver
,, ,, = $3\frac{1}{2}$ per cent.,	1	,,	,, ,, ,,	2	6	16	,,
,, ,, = $2\frac{1}{2}$,,	1	,,	,, ,, ,,	2	19	$21\frac{1}{3}$	,,
,, ,, = 2 ,,	1	,,	,, ,, ,,	3	7	$18\frac{1}{3}$	,,

Apparently, therefore, the proportion of silver to the unit of lead increases as the quantity of lead decreases, and this must mean that an appreciable quantity of silver is carried by other minerals than the galena. To determine this point Mr. Sinclair had made some assays of pieces of blende, siderite, and pyrites, as free from other minerals as he could find them :—

				oz.	dwt.	grs.	
Clean Blende	yielded	*Silver*		2	0	0	per ton
	and	,, ...		1	19	4	,,
Clean Pyrites	,,	,, ...		1	10	8	,,
	and	,, ...		3	10	8	,,
Clean Siderite	yielded	,, ...		1	6	3	,,
	and	,, ...		9	16	0	,,

Silver might also be present as chloride, and in other combinations incapable of being saved by concentration. The tailings assays, however, afford data for approximately determining the proportion of silver carried by the unit of lead, and also that in each unit of the other constituents of the ore taken as a whole. Taking the mean of of Mr. Sinclair's results as before, we get

				oz.	dwt.	grs.	per ton	
(A.)	When Lead = 2 per cent.	Silver =	6	15	13	=	6·7773oz.	
(B.)	,, = $2\frac{1}{2}$	,, ,,	7	9	18	=	7·4876oz.	
(C.)	,, = $3\frac{1}{2}$	,, ,,	8	3	8	=	8·1667oz.	
(D.)	,, = $4\frac{1}{3}$	,, ,,	8	18	10	=	8.9209oz.	
(E.)	,, = 5	,, ,,	10	0	0	=	10·0000oz.	

Let x = No. of ounces Silver per unit of Lead

then	(A.)	contains 2 x	ounces in Lead and	6·7773	$2x$	in other constituents
	(B.)	,, $2\frac{1}{2}x$	,, ,, ,,	7·4876 − $2\frac{1}{2}x$	,, ,, ,,	
	(C.)	,, $3\frac{1}{2}x$	,, ,, ,,	8·1667 − $3\frac{1}{2}x$	,, ,, ,,	
	(D.)	,, $4\frac{1}{2}x$	,, ,, ,,	8·9209 − $4\frac{1}{2}x$	,, ,, ,,	
	(E.)	,, 5 x	,, ,, ,,	10·0000 − 5x	,, ,, ,,	

Let y = No. of ounces Silver per unit of constituents of ore other than Lead

then

(A.) $y = \dfrac{6{\cdot}7773 - 2x}{98}$

(B.) $y = \dfrac{7{\cdot}4876 - 2\frac{1}{2}x}{97\frac{1}{2}}$

(C.) $y = \dfrac{8{\cdot}1667 - 3\frac{1}{2}x}{96\frac{1}{2}}$

(D.) $y = \dfrac{8{\cdot}9209 - 4\frac{1}{2}x}{95\frac{1}{3}}$

(E.) $y = \dfrac{10 - 5x}{95}$

therefore $\dfrac{6{\cdot}7773 - 2x}{98} = \dfrac{7{\cdot}4876 - 2\frac{1}{2}x}{97\frac{1}{2}} = \dfrac{8{\cdot}1667 - 3\frac{1}{2}x}{96\frac{1}{2}} = \dfrac{8{\cdot}9209 - 4\frac{1}{2}x}{95\frac{1}{2}} = \dfrac{10 - 5x}{95}$

from which set of equations we get the mean values

$x = 1{\cdot}1$

$y = {\cdot}046$

that is, if a sample of ore contains 30 per cent. of lead for example, it will contain 33oz. of silver in the lead and 3·22oz. in the remaining 70 per cent. of other constituents. The results are, however, vitiated

by the fact that the returns of lead in the assays quoted only represent about one-half of the actual amount. Taking Mr. Ward's analyses in the same way, let us again calculate the values of x and y.

No. 1. 100 tons ore contain 7·92 tons Lead and 1126·89oz. Silver
4·91 „ concentrates „ 2.227 „ „ „ 176·331oz. „
∴ 95·09 „ tailings „ 5·693 „ „ „ 950·559oz. „
∴ the tailings contains 5·987 per cent. Lead and 9·9964oz. Silver per ton.

(A.) $$y = \frac{11{\cdot}2689 - 7{\cdot}92x}{92{\cdot}08}$$

(B.) $$y = \frac{9{\cdot}9964 - 5{\cdot}987x}{94{\cdot}013}$$

Therefore $x = {\cdot}719$, $y = {\cdot}0605$

No. 2. 100 tons ore contain 17·5 tons Lead and 2196·68oz. Silver
13·8 „ concentrates „ 6·6 „ „ „ 608·58oz. „
∴ 86·2 „ tailings „ 10·9 „ „ „ 1588·10oz. „
∴ the tailings contain 12·64 per cent. Lead and 18·423oz. Silver per ton.

(A.) $$y = \frac{21{\cdot}9668 - 17{\cdot}5x}{82{\cdot}5}$$

(B.) $$y = \frac{18{\cdot}423 - 12{\cdot}64x}{87{\cdot}36}$$

Therefore $x = {\cdot}821$, $y = {\cdot}092$

The mean of the two results is probably the nearest approximation to the truth that we can obtain, namely $x = {\cdot}77$, $y = {\cdot}076$, so that if the ore contained 20 per cent. of lead we should expect it to carry 15·4oz. silver in the lead and 6·08oz. in the other constituents of the ore. The portion carried in the lead would be possible to be saved by concentration, but the residue would all be lost. Of course a certain amount of loss of lead, and with it silver, is inevitable, as well as the loss of silver in the lighter minerals. It is noticeable that the mean assay of the 500 tons of concentrates from the Silver Queen mill, viz., 65 per cent. lead and 54oz. silver, gives ·83 ounces of silver to each unit of lead, a result which agrees sufficiently closely with the proportion calculated from the tailings assays to show that the fine galena which escapes carries silver in just about the same proportion as the coarser stuff saved on the machines.

Investigations such as the above are of great importance for determining how much of the silver can be expected to be saved by concentration, and should be frequently repeated with very carefully analysed samples representing average ore, so that a reliable result might be arrived at. Of course the galena and gangue vary considerably in their amounts of contained silver ; for example, when the lode is barren of galena it will probably be found that the other constituents are also barren of silver or nearly so; but by investigating the distribution of the silver in bulk samples of average ore it is likely that the variation will not greatly affect the mean result, and that very valuable information will be obtained.

At the Mount Zeehan mill Mr. W. H. Wesley has obtained some very interesting results, which I give in his own words :—"I beg to enclose you statistical result of our dressing plant, from the 1st September to the 30th December 1892, as follows :

" Machinery worked... ... ... 783⅓ hours
" Lode stuff treated ... ... 3249$\frac{13}{20}$ tons
" Lode stuff treated per hour ... ... 4 tons 2cwt. 3qr. 24lb
" Yield concentrates... ... ... 415 tons
" Yield of Galena per ton of stuff... ... ... 12·7 per cent.
" Assay value of concentrates—Lead ... ... 66·2 per cent.
" Assay value of concentrates—Silver ... ... 65·37oz.
" Collected products for future treatment from No. 3 Jig, that require grinding, 500 tons, assaying Lead 4·7 per cent., Silver 10oz. 18dwt.
" Value of assay, Galena in the 500 tons when dressed, Lead 75 per cent., carries Silver 58oz. per ton.
" This leaves over 7oz. in the tailings after extracting all the galena.
" Slimes collected 80 tons, assaying Lead 8·5 per cent., and Silver 13oz. 17dwts. The galena in slimes carries 53oz. Silver to each 70 units of Lead. Thus the tailings from slimes contain over 8oz. of Silver per ton, but not associated with lead in the form of Galena.
" Tailings vary in assay value from lead 0·75 to 1·5 per cent., and silver from 3oz. to 5½oz. From a bulk sample of our concentrates, 7000 grains, when graded, gives the following, showing the different classes of ore concentrated together in our direct treatment system, and the percentage of each.

	grs.	
" Portion No. 1 not go through 5 holes to lineal inch ...	762	= 10·88 per cent.
„ No. 2 „ „ „ 24 „ „ „ „ ...	3571	= 51 „ „
„ No. 3 „ „ „ 60 „ „ „ „ ...	1286	= 18·03 „ „
„ No. 4 will go through 60 „ „ „ „ ...	1376	= 19.65 „ „
Loss in manipulation	5	

" The following is the assay of each portion as graded above :—

Portion No. 1, coarse ...	Lead, 63 per cent.	Silver, 66oz.
„ No. 2	„ 62 per cent.	„ 61oz.
„ No. 3	„ 70 per cent.	„ 67oz.
„ No. 4	„ 66 per cent.	„ 59oz.

"By the above it is clearly shown that it is possible to crush too fine, and that care must be taken to promote the best interests of the Company in getting the most silver and lead value from the lode stuff.

"We have crushed to date for Company 4801 tons, yielding 574 tons concentrates, and crushed for public 1302 tons, making total treated 6103 tons. Have changed cracker jaws once and wire netting around cylindrical sieves once."

The data given by Mr. Wesley allow of an approximate estimate being made of the percentages of the lead and silver saved by the mill, though not so satisfactorily as in the case of the Silver Queen, where the heaps of ore had been sampled before going through the dressing works. Allowing for the difference of the lead shown by fire assay and that actually present at about the rates shown by Mr. Ward's analyses and assays, and reckoning that as much slime escapes as has been collected, which is probably an under-estimate, we find that there have been produced from 3250 tons treated:—

(i.)	Concentrates ...	415	tons,	with	66·27	per cent.	Lead	and	65·37	ozs.	Silver
(ii.)	From No. 3 Jig	500	„	„	8	„	„	„	10·9	„	„
(iii.)	Slimes ...	160	„	„	14	„	„	„	13·85	„	„
(iv.)	Tailings ...	2175	„	„	3	„	„	„	4·00	„	„

Therefore (i.) contains 274·73 tons Lead and 27,128·55 ozs. Silver

(ii.)	„	40·00	„	„	„	5450·00	„	„
(iii.)	„	22·40	„	„	„	2216·00	„	„
(iv.)	„	65·25	„	„	„	8700.00	„	„
Total	...	402·38	„	„	„	43494·55	„	„

The ore to begin with therefore carried about 12.4 per cent. Lead and 13·4 ounces Silver to the ton. In Mr. Wesley's report of 2nd January, 1892, he estimates the ore at surface at 1300 tons, containing 13·86 per cent. of Galena and 17 ounces of Silver to the ton, so that the above calculation is probably pretty correct. The stuff from No. 3 Jig being rather poorer than the crude ore cannot be considered to be a valuable product saved by the machine, but only as so much poor ore to be treated over again, so we may take it that 274·73 tons of Lead and 27,128½ ounces of Silver have been saved out of 402·38 tons of Lead and 43,494½ ounces of Silver actually in the ore—that is, the extraction of Lead amounts to 68·3 per cent. and of Silver to 62·4 per cent. of the total. The percentages of Silver and Lead lost, 37·6 per cent. of the former and 31·7 per cent. of the latter, do not differ greatly from those found in the case of the Silver Queen, and it is probably pretty near the mark if we say that both these mills lose nearly 30 per cent. of the Lead and 40 per cent. of the Silver in the ore treated.

The Silver in minerals other than galena appears to be higher in proportion to that in the lead ore in the Mount Zeehan Mine than in the Silver Queen. This is probably due to the presence of fahlore, small quantities of which, very rich in silver, are pretty frequently seen. Being a very friable mineral, it is easily crushed to fine powder and carried away in the slimes. It is very likely also due to this mineral that the coarser galena is found to be richer than the more finely ground, as shown by Mr. Wesley's assays of the different grades of concentrates, for the grinding would tend to pulverise the fahlore more than the galena. Analyses of the different grades of concentrates for copper and antimony would show if this theory is correct.

The cost of crushing and concentrating at the Silver Queen plant, was given to me as follows by Mr. May:—

Trucking from heap to crusher at the rate of 28 tons per shift of 8 hours ...	£0	18	8
Wages of man feeding crusher per shift	0	10	0
„ „ two men at jigs, @ 10s.	1	0	0
„ „ one engine driver, @ 10s....	0	10	0
Firewood, oil, etc., per shift	0	11	4
Total	£3	10	0

or equal to 2s. 6d. per ton of ore treated. If the ore were sent direct from the mine brace to the crusher floor, and this cost charged to mining account, the cost of crushing and concentration would fall to 1s. 10d. a ton.

Besides the six larger mills that have been or are being erected, several small hand jigging machines have been put up at various mines to enable a little of the best galena to be saved from the second-class stuff, The work done on these is very crude and inefficient, but is a help to the owners.

It is quite evident that every mine will produce more ore requiring concentration than rich stuff needing none, and it comes to be an important point for consideration whether each mine should have its own dressing works, or whether several should unite in supporting one belonging to all in conjunction, or to a private individual, or company. When a mine is producing enough ore to keep a concentrating plant at work, it is without doubt most satisfactory to the owners to possess a mill of their own, but when the output is small it would probably pay them better to have their ore-dressing done by a "customs" works. In order to have the best results, a concentrating mill must be on a scale large enough to keep all the men employed in it constantly busy at their several sorts of work, and to make it worth while to have elaborate appliances for treating and re-treating the material so long as the metallic contents will pay for further handling. Such a plant will require from 600 to 1000 tons of ore a week, or even more. Smaller mills are not able to work so cheaply, nor to obtain so high an extraction of ore, and it, therefore, seems to me that it would be better for the district to have a few well equipped dressing-works of large capacity, located so as to be able to get ore from several adjacent mines, than for each mine to have its own small and probably inefficient mill. The competition between

the different works for the ore would be sure to lead to improvements in dressing practice, as every mill-manager would be on his mettle to get better results than his neighbors, and so get more custom. Whether the concentrators are owned by private parties, or by companies formed out of those supplying the ore, I should strongly urge that in the contracts for milling entered into between the parties owning the mines and mills, the latter should be made to guarantee the extraction of an agreed upon percentage of the value of the ore as shown by bulk assay prior to treatment, or else that the mills should buy the ore outright on its assay value. The latter would probably be the better plan, as then parcels of ore, however small, might be taken in and treated without the necessity of cleaning up the whole or a great part of the mill for each.

Most of the ore from the unoxidised portions of the lodes of the Zeehan and Dundas fields is, as far as I have seen, very suitable for concentration. Some of the very fine black pulverulent galena found mixed with clay in some of the mines may prove difficult to deal with, and will certainly require slime-tables, and other appliances for treating very fine ore, but the great bulk of the ore should be easily dealt with in the dressing-works. There are cases, however, where it will be a question for careful calculation, whether it will be better to smelt a somewhat low-grade ore directly, or to concentrate it before smelting. When both mills and smelting works are in the district it will not be difficult to determine which treatment gives the best commercial result in such cases.

The oxidised portions of the lodes carrying oxides of iron, manganese, and lead, silica, carbonate sulphate and chromate of lead, galena, chloride of silver and oxidised silver compounds, etc., are not generally fit for concentration, the silver escaping into the tailings, but fortunately, are very usually excellent smelting ore, and most valuable in the furnaces as flux for more refractory stuff.

Smelting Works.—Two smelting companies have made a start with furnace work at Zeehan, having put up works at Argenton and at Zeehan itself. Very little smelting has been done at Argenton, and not a very great deal at Zeehan, and both works were soon shut up. The principal reason of their failure appears to have been that neither company had sufficient capital to buy ore and lie out of their money until the product was sold, and consequently they were only able to undertake smelting at fixed charges, the owners of the ore receiving back the argentiferous lead, and selling it themselves. The most considerable parcel of ore dealt with was one of 3073 tons (dry weight) from the Maestric's Broken Hill mine at Dundas, which was smelted at the Zeehan and Dundas smelting works. The bulk assays before smelting showed the parcel to contain 80,087 ounces of silver and 1189 tons of lead, and the yield was 76,844 ounces silver and 866 tons of lead, the loss in smelting being therefore 3243 ounces of silver, or 1·055 ounces per ton of dried ore, and 323 tons of lead, or 10½ per cent. per ton of ore. Otherwise expressed the loss of silver was 4·05 per cent. of the total in the ore, and of lead 27·16 per cent., the latter being higher than it probably would be in continuous working, when the slags and flue-dust would be from time to time retreated.

The greater part of the ore exported from Strahan lately has been bought at Zeehan by representatives of the Queensland Smelting Co., and the Hamburg Metal Co.; the Western and Silver Queen Companies have, however, lately been shipping to Europe on their own account, and about a year ago the latter also sent a good deal of ore to the Clyde Works in Sydney. Only first-class ore, concentrates, and good fluxing ore of low silver value, have been exported. It is a question of great moment to the district, and to the Colony, whether it would be better to have the smelting done at Zeehan or Strahan or to continue exporting the ore, and a little discussion of this will not be amiss. Mr. Augustus Simson, Manager of the Western Co., has been good enough to let me have a copy of the Hamburg Metal Co's. tariff, dated 8th July, 1892. It is as follows, the ore being delivered at Zeehan:—

"SILVER LEAD ORES

"*Containing over 50 per cent. of Lead and less than 7 per cent. of Zinc.*

"*Silver*—To be paid for at rate ruling in London for standard silver during the week in which assay is agreed upon.

"The following deductions will be made from the contents found by assay, to cover losses in smelting, realization, etc.:—

30	ounces	and	under,	deduct	5oz.	per	ton.
40	"	"	"	"	6 "	"	
50	"	"	"	"	7 "	"	
65	"	"	"	"	8 "	"	
80	"	"	"	"	9 "	"	
100	"	"	"	"	10 "	"	
120	"	"	"	"	11 "	"	
140	"	"	"	"	12 "	"	
160	"	"	"	"	13 "	"	
180	"	"	"	"	14 "	"	
200	"	"	"	"	15 "	"	
225	"	"	"	"	16 "	"	
250	"	"	"	"	17 "	"	

"*Lead*, at 60/- per ton, less than rate ruling in London for soft Spanish lead during the week in which assay is agreed upon, 12 per cent. to be deducted from the contents found by assay to cover loss in smelting, etc. The sum of £3 per ton of ore will be deducted to cover all charges such as smelting, sampling, assaying, freight, etc.

"*Fractions* of an ounce of silver and unit of lead, not allowed for.

"*Moisture* deducted.

"*Terms.*—Cash on delivery of agreement of assay.

"*Ore* to be in approved bags and marked as may be directed."

Mr. Armstrong, the local agent of the Company at Zeehan, told me that the charge for smelting, freight, etc., was £3 15s. 0d. per ton of ore, so that it would appear that the Western Coy. have been able to get better terms than usual; he also explained that the 12 per cent. deducted from the assay value in lead was not $\frac{3}{25}$ths of the number of units shown as might be supposed, but actually 12 units from whatever the per centage might be. The Company do not care to buy any ore containing less than 40 per cent. lead and 40oz. silver per ton, or 50 per cent. lead and 25oz. silver per ton, their great anxiety being to secure stuff rich in lead to aid them in smelting their own ore. The value of the lead on the field has varied from £6 7s. 6d. to £7 a ton, and of silver, from 3s. 1½d. to 3s. 4d. an ounce. Let us see what ore of the above minimum values yields to the seller, taking lead at £7 a ton and silver at 3s. 4d., the most favourable figures:—

(i)	40 per cent. Lead—12 per cent. = 28 per cent. @ £7 =	£1	19	2	a ton.
	40 ounces Silver—6 ounces = 34 ounces @ 3s. 4d. =	5	13	4	,,
	Total =	£7	12	6	,,
	Deduct	3	15	0	
	Net return to seller =	£3	17	6	,,
(ii)	50 per cent. Lead—12 per cent. = 38 per cent. @ £7 =	£2	13	2	a ton.
	25 ounces Silver—5 ounces = 20 ounces @ 3s. 4d. =	3	6	8	,,
	Total =	£5	19	10	,,
	Deduct	3	15	0	
	Net return to seller =	£2	4	10	,,

Out of these returns, the mine-owner has to pay all expenses of mining, sampling, bagging, and transporting the ore to Zeehan, which does not leave him much profit; yet stuff of these values must be considered very fairly rich, and is considerably above the average of the second-class ore on the field. It is clear, therefore, that only very good stuff and concentrates will pay for export at these rates.

The Oceana Company having a quantity of excellent fluxing ore averaging about 14½ ounces of silver, 39 per cent. of lead, and 25 per cent. of iron, were able to get rather better terms than the above from the Queensland Company for it, but it netted them not quite £2 a ton, and left a very small margin of profit. A heap of good fluxing ore at the Dundas P.A. Mine, assaying 28oz. silver per ton and 25 per cent. lead, could not, however, be sold at all, and had to be thrown to one side for the present. Yet it was of almost the same value as the ore from the Maestrie's Broken Hill mine which was smelted at Zeehan, and quite equal to the average grade of ore put through the furnaces at the Broken Hill Proprietary mine at Broken Hill, N.S. Wales. The Maestrie's ore returned a profit on smelting, so it is clear that a local furnace can handle ore which it would not pay the ore buyers to export. Let us take the figures supplied by the Maestrie's test, as given in the half-yearly reports of the directors of the Company at the general meetings of July 28th, 1892, and 31st January, 1893, and try to find out from them where the profit has arisen.

3490 tons of ore as sent from the mine contained 11·95 per cent. of moisture, and was equal to 3073 tons of dried ore. It contained 80,087oz. of silver and 1189 tons of lead, or 23oz. silver per ton of undried ore, and 34·1 per cent. of lead (38·7 per cent. lead and 26oz. silver per ton of dried ore).

Freight from Dundas to Zeehan cost 6s. a ton, and shunting charges from Zeehan to the Smelting Works 2s. 6d. a ton, the actual amount paid for these items being £1483 8s. 10d.

The ore yielded 866 tons bullion, containing 76,844 ounces (= 2·35 tons) of silver and 863·65 tons of lead, or at the rate of 22oz. silver and 24·8 per cent. lead per ton of undried ore (= 25oz. silver and 28·1 per cent. lead per ton of dried ore). The smelting losses were at the rate of 1 ounce silver and 9·3 per cent. lead per ton of ore as mined, or 1 ounce silver and 10·6 per cent. lead per ton of dried ore.

The freight on 866 tons of lead bullion from Zeehan to Strahan at 14s. 6d. a ton and 2s. 6d. shunting charges, and from Strahan to Hobart at 4s. 2d., amounted to £915 8s. 10d., equal to to 5s. 3d a ton of undried ore.

The freight from Hobart to London and realization charges there were estimated at 12½ per cent. of the value of the bullion, or £2907 12s. 3d., equal to 16s. 8d. per ton of raw ore.

Insurance on the bullion came to £206 9s. 9d., or 1s. 2d. per ton of ore.

The smelting account was £6976 16s. 10d., and charges for receiving, checking, assaying, and sampling at the works £180 0s. 5d.; total, £7156 17s. 3d., or £2 1s. per ton of undried ore.

Collecting these items we have the following expenses per ton of ore as sent from the mine:—

Freight to Smelting Works	£0	8	6
Sampling and Smelting Charges	2	1	0
Freight to Hobart	0	5	3
Freight to London and Selling Charges	0	16	8
Insurance	0	1	2
Total	£3	12	7

Had it been sold to the Hamburg Metal Company in accordance with their tariff, the expenses would have been as follows, the ore being sold delivered at Zeehan :—

Freight to Zeehan	£0	6	0	per ton
20 Bags, @ 3s. 6d. a dozen	0	5	10	„ „
Filling and Sewing Bags	0	1	9	„ „
Tariff Deductions { 5oz. Silver, @ 3s. 4d....	0	16	8	„ „
Tariff Deductions { 12 per cent. Lead, at £7	0	16	10	„ „
Smelting and Freights Charge	3	15	0	„ „
Total	£6	2	1	per ton

The ore at 3s. 4d. an ounce for Silver, and £7 a ton for Lead, the highest local prices quoted by Mr. Armstrong, has a gross value of only £6 4s. 5d. a ton or only 2s. 4d. more than the export charges. The actual return from the furnaces at the same rates amounted to £5 8s. 1d. per ton, leaving a profit on the local smelting of £1 15s. 6d. per ton of ore as sent from the mine, without drying. A not inconsiderable item in the saving shown by local smelting over foreign export is that while the ore buyers deduct 5 ounces of Silver and 12 units of lead for smelting losses, the actual furnace returns showed a loss of only 1 ounce of Silver and 10·6 units of lead, the difference in favour of the mine owners, at the above prices, being 15s. 4d. per ton. When we further consider that the loss of lead was abnormally high, and would be reduced in continuous working by the re-smelting of the slags, flue-dust, and other bye-products, it is seen that the deductions made by the ore buyers represent a great deal more than the actual furnace losses. No European smelter would like to admit that such very high losses actually took place in his furnace practice, and I think it would be fairer if the ore buyers made the deductions as nearly as possible what the actual losses come to, and increased the lump sum charged for smelting, freights, and realization. Also, instead of paying for the Lead and Silver at rates considerably lower than current London prices, it would appear to be fairer, as the product is sold in Europe, to pay, say, 2s. 6d. an ounce for Silver, and £6 10s. per ton for Lead at the time of sale, and the balance of the money three months later at the then prevailing market prices. The seller would then get full value for his Silver and Lead; if the buyers cannot do this without increasing their general charges for smelting, freights, &c., by all means let them do so, and thus make the items of their tariff more clearly intelligible. At present it appears to me that the charge of £3 15s. a ton does not cover the freights, smelting charges, expenses of realisation, profits, and other sundry items for which it ostensibly provides, but that a considerable portion of these is met out of the differences between the deductions for smelting losses and the actual loss, and between the prices paid for Lead and Silver in Zeehan and those at which the metals are sold in Europe. As will be seen from the tariff, the Zeehan price of Lead is £3 a ton less than the London price, and the price of Silver is taken at the London value of standard Silver. But standard Silver is not pure Silver, but an alloy containing 925 parts of pure Silver and 75 parts of Copper in 1000, and the value of pure Silver is, therefore, 1·0811 times that of standard Silver per ounce. When bar Silver is quoted at 3s. an ounce the value of pure Silver is 3s. $2\frac{7}{9}$d., and when the former is 3s. 4d. the latter is 3s. $6\frac{3}{4}$d. As the Silver shown by the assays of ore is pure Silver, not standard, it will be seen that the ore buyers gain nearly threepence an ounce by buying at the latter price. Of course they take the risk of the market falling before the shipments can get to Europe, but it seems to me that it would be more satisfactory if they would adopt the above-mentioned suggestion, and pay the sellers in full only after the ore had got to market, then giving them full value for the metal extracted from the ore, and charging a sufficient lump sum for profit and all expenses. The present tariff seems purposely designed to make the expenses of transport and reduction appear considerably less than they are in reality.

In smelting on the field a great gain arises through the reduction in weight of the stuff treated from that of the crude ore to that of bullion; in Maestrie's case for example, from 3490 tons to 866 tons. Charges for freight are consequently much reduced, though a little higher per ton on account of the greater value and marketability of the product. With concentrated ore the gain is not so great, but is still quite considerable. Local smelting would yield not more on an average than two-thirds ($66\frac{2}{3}$ per cent.) of the total weight of ore as bullion, and probably rather less, but let us take the figure as $\frac{2}{3}$rds for comparison. In transit from Zeehan to Strahan, one ton of concentrates would cost 12s. 1d., while the $\frac{2}{3}$rds of a ton of bullion therefrom, at 14s. 6d. a ton, would cost 9s. 8d., a difference of 2s. 5d. to the mine-owner. Moreover, the ton of concentrates would cost 7s. 7d. for bags, and filling and sewing them in addition: but there is no reason why concentrates should not be carted or trucked to the smelting works without bagging, if suitable trucks be provided. The expenses from Strahan to Europe for bullion would be somewhat greater than for concentrates *per ton;* probably only one-fourth instead of one-third less than the latter, therefore, for equivalent quantities. On Maestrie's bullion they were close on £4 a ton: a corresponding parcel of galena would cost say £3 11s. 1d. a ton, but there would be half as much again in weight of it as of the bars. Equal quantities of lead carried as bars and as galena would therefore cost £4 and £5 6s. 8d. respectively. There would thus be a difference of £1 9s. 1d. per ton of lead in freights and other charges in favor of sending it in the metallic form instead of as concentrates from Zeehan to London; and, adding bags and bagging, £1 16s. 8d. In the case of rich ore carrying less lead, the saving would be still greater, as the quantity of lead bars carried would be less.

If local smelting works were reducing all the ore from the field and selling the product, I have no doubt that they would be able to make better terms with selling agents, shipping companies, and the desilverizing and refining works, in Europe, than could be obtained by each mine-owner selling his own bullion, and business competition would soon reduce realisation expenses to their lowest limit. Once in thorough working order the cost to the Smelting Company of marketing their lead bars would probably be much less than the Maestrie's Broken Hill Company had to pay, and the difference in favor of local smelting would then be even more marked than above shown.

Zeehan is really very well situated for the establishment of local smelting works, having a seaport only twenty-nine miles away, and all necessary fluxes on the field. There is not much to choose between Zeehan and Strahan as to which is the better site for reduction works, but at present railway rates between the two places it is probably cheaper to smelt at Zeehan, for the carriage of coke up and bullion down amounts to less than that of the raw ore down to Strahan. It is possible that it might pay some of the Dundas mining companies better to have furnaces on the mines than to send their ore even to Zeehan, but it would be inadvisable to put them up just yet, until the fields are more fully developed and it is seen that there is plenty of ore to keep them going. The smelting problem depends largely on the expense with which the low-grade fluxing ores can be carried to the smelting works, and as the bulk of these as yet discovered are at Dundas, it will rest very much with the management of the Zeehan and Dundas railway whether local smelters are established there or not. If the ore is carried at low rates, it can be taken to Zeehan and smelted there, but at present figures it will probably have to remain in the mines till there are furnaces close at hand. This is very much against the best interests of the district as a whole, for the use of these fluxing ores is very desirable in smelting those that are less easily dealt with, and would reduce the cost of doing so very considerably. In the Maestrie's Broken Hill mine it is estimated that there are some six or seven thousand tons of ore above the tunnel level and at grass, assaying from 16 to 20oz. silver and 15 per cent. lead, of good fluxing quality. In the Dundas P.A. mine the manager stated to me that he could take out the ore thirty feet in width if there were a furnace on the ground. The Comet, Adelaide, Mariposa, and Oceana mines could also supply a good deal of ore of this class, and the Balstrup line of lode, when opened up, would almost certainly also yield a large quantity. Considering the beneficial effect of this sort of ore in assisting the reduction of richer stuff, it seems to me that it would be good policy for the railways to carry it at specially low rates. The same might be said of ironstone flux, limestone and coke: the more the expenses of getting these to the smelters can be lowered, the greater will be the output from the latter of rich lead bars, on which high rates of freight may be legitimately charged. Local smelting works are now, in my opinion, among the most urgent needs of the West Coast silver fields, and I would strongly recommend that every assistance should be given by the Government to their establishment.

With furnaces on the field it will pay to smelt ores which now must be concentrated before export. It is a question, for example, whether it would not have paid better to smelt the second-class ore of the Silver Queen mine above spoken of directly, instead of concentrating it, the loss of lead and silver in the latter process going far to make up for the greater cost of smelting the crude ore, as compared with that of treating concentrates. The second-class ore at the Western mine, too, would probably be just as profitably smelted as concentrated. It is likely that in course of time the local furnaces will be found treating all ore as it comes from the mine that contains over 30 ounces of silver and 30 per cent. of lead, and that the concentrators will be kept working upon the grades poorer than this, down to figures which at present could not be touched. Such a lowering of the grade of immediately marketable ore will undoubtedly result in great extension of mining operations. Let us hope, therefore, that it will not be long before there is a local smelting company in the field as buyers of ore, with capital sufficient to be able to pay cash down to the miners in the same way as the foreign companies.

Mines Visited.—The length of my stay in the district did not permit of making close examination of each mine, and the following notes upon them are rather intended to give a general idea as to their present position and prospects, than to afford accurate information as to details.

Silver Queen.—This mine is worked from two main shafts, known as No. 1 and No. 2, one close to the south boundary of section 1636-87M (No. 1), and the other in section 1638-87M (No. 2). Both the main lodes, to work which these shafts have been sunk, run to the east of north; but there are several others known to exist in the property, on which a little trenching has been done, and some of these belong to the north-easterly, and others to the north-westerly series of lodes. The workings from the No. 1 shaft have been on the whole somewhat poor, though a good deal of rich ore has also been obtained: at the time of my visit, however, a winze below the bottom level was showing some rich ore, giving hope of an improvement. The lode is strong and well defined, but consists largely of carbonate of iron and slaty gangue: towards the north end it seems to be either very much disordered or lost altogether, a large irregular-looking reef of quartz and iron pyrites, which appears on the western side of the drive in two or three small crosscuts probably having much to do with this disturbance. A good deal of work may be required to find the continuation of the ore in this direction. The shaft is 222 feet deep, and has two levels opening from it, No. 1 at 105 feet, and No. 2 at 208 feet. The main crosscut west at No. 2 level is in 236 feet, and east 200 feet. As there are other known lines of lode both east and west of the shaft, it would appear advisable to continue cross-cutting both ways in order to cut these or other parallel lodes not yet discovered. The present levels being somewhat poor, it is also desirable that sinking the main shaft should be resumed as soon as possible, so as to open up new ground and find better ore. A few chains to the north-east from the shaft on surface an outcrop has been lately cut into which reveals a nice body of concentrating ore, 5 or 6 feet wide, with some good bunches and streaks of pure galena in it. This had only been sunk upon 15 feet at the time I saw it, and was not well exposed, but it seemed to be running about N.N.W., and would be cut by the eastern crosscut if extended.

The No. 2 shaft is about 170 feet deep, and has two levels opened from it at 115 feet and 155 feet. From No. 1 level to surface the ground has mostly been stoped out for a length of 225 feet. All this ground was very good, the ore being rich galena and siliceous pulverulent matter carrying carbonate and oxide of lead and chloride of silver. At the bottom level the lode was poor, but appeared to be improving a little in both the north and south ends. Here as in No. 1 workings the only policy to pursue is to drive and sink on the lode in the hope of again coming upon good ore. A few chains east of the main shaft another lode running N.15° W. has been cut in some trenches and prospecting holes: it should run into or cross the main lode to the north of the shaft, and seems good for a consider-

able supply of concentrating ore. There are altogether more than twelve known lodes in the Silver Queen Company's property, and several of them very promising ones: it seems to be only a question of time and money to open them up so as to produce plentiful supplies of ore.

Up to the end of 1892 the Silver Queen mine had exported 2601 tons of first-class ore, which yielded 876½ tons of lead, and 251,215oz. silver, or a cash return of £40,246 13s. 11d.; 319 tons of second-class ore were also sold for a net return of £293 5s. 1d.

Montana Mine.—(Section 2154-87M)—40 acres). At the time of my visit work was confined to sinking a main shaft, and I did not see the lodes. A good deal of ore has been already extracted from this ground, and when I saw it previously I formed a very favorable opinion of its prospects, which seems to be shared by those who have watched its further development.

The New Great Eastern Mine.—This is situated in section 1666M, formerly belonging to the Silver Queen Company: the same owners also hold section 841-87M. A main shaft was sunk, but the flow of water was so great that it overcame the steam pump provided, and the mine was shut down. At the time of my visit a little prospecting was going on on section 841-87M, but without result up till then.

Despatch Mine.—(Section 243-87M). The owners of this mine also were unable to overcome the water met with in sinking their shaft, and had to stop working. Some parties of tributors were getting some nice-looking galena on the the southern part of the section, from some of the lodes which run into the Mount Zeehan Company's ground, but no other work was in progress at the time I saw the property. The surface prospects have been described in my former reports.

Western Mine.—(Sections 754-87M, 755-87M, and 756-87M). In my former reports I described the work then done on two north-westerly lodes that had been cut by means of two adits. Since then a much larger lode has been discovered running north-easterly, and has been driven on for about 750 feet at No. 1 level. A main shaft has been sunk to a depth of 153 feet, and levels opened at 55 feet and 120 feet. In the lower level the lode looks just as well as in the upper one. A good deal of stoping has been done above the upper level with very satisfactory results, the ore being clean galena of high silver value. Near the main shaft the country is the tufaceous and brecciated rock above mentioned, but in both ends of the workings the lode passes out of this into black slate, and does not diminish in size or value in the latter, though the southern workings have been extended into it some two or three hundred feet. The tufaceous rock is soft and easily worked, but stands well without much timber, and seems to be very favorable for veins of galena, several of which have been passed through in the crosscuts. There seem very frequently to be small veins and lodes close to the main one, and parallel to it, or joining it at a very acute angle, and it will therefore be necessary to crosscut pretty often while working out the ore so as not to miss these bodies. The lodes worked in the adits, if they had kept their course and size, ought to have been cut in driving on the main lode, but it does not appear certain that they have been met with, though some veins of galena crossing the No. 2 crosscut at the bottom level, are probably part of No. 2 lode. If so, the latter would appear to join the main lode without passing through it. A small lode known as No. 4, some 480 feet south of the main shaft, might possibly be a continuation of No. 2, on the east side of the main lode. It seems probable that the whole of the ground in the vicinity of the main lode has been more or less fissured, and that there are numerous strings and veins of ore through it, some perhaps continuous for considerable distances, others quite short. When the Nos. 1 and 2 lodes have been followed up to the main lode it will probably be seen whether they join it or are faulted by it. Throughout the whole length of the workings the main lode has been more or less payable, the ore being fairly continuous. In the Junction Company's ground to the south of the Western mine, tributors are working a lode which I take to be identical with the main lode of the latter, which would show that the end of the ore going southwards has by no means yet been reached. The mine promises very well, looking likely to continue ore-bearing considerably deeper than the present bottom level at any rate. Sinking is to be continued when the pumping machinery ordered has been fixed in the shaft, and it should soon be proved whether or not the lode is as good at 200 or 300 feet as at the upper levels. The ore-body in this mine is by far the longest yet proved on the field, being over 750 feet in length at the least, and if it lives in depth also, as there is every reason to believe it will, the mine will be a very valuable one. The quantity of ore at grass and in sight in the stopes is even now very considerable, and from my examination of the mine, though I did not myself measure the ore, I am quite prepared to accept the mining manager's estimate of 15,000 tons in sight, as in no way excessive. In his report to the chairman and directors, read at the half-yearly meeting of the company on the 28th April, 1893, he says:—"*Reserves.*—There are now fully 3010 tons of second-class ore at surface. These piles have been very carefully sampled, and the following are the average results obtained:—

2400 tons at No. 1 and 2 shafts, silver 44oz., lead 23 per cent.
400 tons at main shaft, silver 46oz., lead 26 per cent.
60 tons at No. 3 shaft, silver 58oz., lead 29 per cent.
150 tons at lower tunnel, silver 27oz., lead 22 per cent.

Total ... 3010 tons at surface.

"The winzes below the No. 1 level prove the lode of a greater average width than I anticipated, and I now estimate the available ore proved to exist between the Nos. 1 and 2 levels at 9500 tons, and remaining above the No. 1. level 2500 tons, or an available total of about 15,000 tons of ore in sight on the main lode only.

"After making allowances for cost of mining and timbering mine, loss in concentration, cost of concentration, weighing, bagging, and smelters' charges, I estimate the net value of the reserves at £60,000."

Up to the end of March, 1893, the mine has exported 1418 tons of first-class ore, assaying on the average a little over 100 ounces of Silver and 58 per cent. Lead, which has realised £19,345 14s. 0d.

net value. The 3000 tons of second-class ore on surface have been raised while taking out this richer stuff, and if the proportion of each sort of ore remains the same in the ground not yet stoped the first-class ore alone should realise more than the mining manager's estimate, so that this may be looked upon as safe and conservative. This mine has paid its way out of ore raised from the beginning, and will soon be provided with a very fine dressing plant also paid for out of produce; and, as its prospects underground are as good or better than they have ever been hitherto, there is every reason to expect for it a highly profitable future.

Junction Mine—(Section 819-87M: section 818-87M is also held by the same owners.)—About two chains South of the southern boundary of the Western Co's. ground a shaft has been sunk on the line of the latter's main lode to a depth of 56 feet. At 50 feet a level has been opened, a cross-cut being driven about 37ft westward to the line of lode, which has then been followed for about 60feet to the South and 30ft to the North. At the time of my visit very little galena was visible in the lode in the level, but in the stopes there were from two to twelve inches of very clean good ore, exactly like that in the Western mine. The course of the lode is N. 20° E., and its position agrees very well with the line where the continuation of the Western main lode might be looked for. As it is also drained by the Western Co.'s workings I do not think there can be much doubt as to its being the same lode. The galena is likewise of similar high value. The mine is being worked by tributors; at the time of my visit they were just beginning to get the ore, but since then they are reported to have sent out several parcels of extremely rich stuff.

About 3 chains S.E. of the shaft some work has been done on a small lode known as No. 3, running about N.30°,E. A quantity of very siliceous gossany ore has been raised from this, and also some siliceous galena. As there is no sale for dry ores of this sort on the field at present, the tributors were not working this lode.

The Oonah lode crosses the south boundary of this section, and working through their neighbor's tunnel the Junction tributors are said to have been able to get some very good ore from it: they then drove a branch tunnel to intersect the lode, but had not been successful in finding ore at the time of my visit.

The prospects of this property are pretty good, and should encourage the owners to sink a main shaft and put machinery on it.

Oonah Mine.—(1110-87M and 1111-87M.)—This mine is also in the hands of tributors, who were fortunate shortly after taking it in finding very good ore in a vein passing through the company's prospecting tunnel near the Junction boundary. The country is black slate and brecciated tuff as in the Western mine. The lode runs about N.10°.W., but bends a good deal: it had been driven on about 135 feet to the south at the time of my visit, and up to the Junction boundary to the north. In the Oonah workings the lode has been from twelve inches to five feet wide, consisting in the upper portions of rich oxidised gossan, and lower down of galena, veins of the latter up to 12 inches in thickness having been found very pure, while there was a good deal of concentrating ore in addition. The ore from this mine has been of very good quality, one parcel of 11 tons averaging 535oz. of silver per ton, and 20 per cent. of lead, and another of 18 tons 7cwt., giving 109oz. 8dwt. 16gr. of silver per ton, and 71 per cent. of lead.

About 2 chains from the mouth of the tunnel down a small creek passing through section 1110-87M., another small lode of very pure galena, 2 inches to 8 inches in width, was cut in making an excavation for the foundations of a small hand-jigging machine. When I saw this about 6 tons of ore had been raised from it, assaying 100oz. of silver to the ton, and 83 per cent. of lead.

I have not been able to obtain the total amount of ore raised by the Oonah tributors. The mine promises exceedingly well, and is likely to be a very considerable producer. Driving southwards on the lode the height of backs above the level increases from 45 feet at the end of the tunnel to 100 or 150 feet. The lode may not rise to surface, but there is a probability of there being a good deal of ground still to be stoped above the tunnel level. When the tribute party's time has expired, the company should at once sink a shaft and prepare to work below the water level.

It is noticeable that the tufaceous rock is found in close connection with the Western, Oonah, and Silver Queen No. 2 lodes, all of which have been rich, and special attention should therefore be given to this class of country.

Tasmania Crown Mine.—(Formerly known as the Silver Crown, 197-87M, 198-87M, 199-87M, 736-87M, 201-87M)—Work on this property was confined at the time of my visit to the field to sinking the main shaft, with which good progress was being made. Several lodes are known to exist in the sections, and the mine has very fair prospects. As the ground is mostly low-lying and wet, it has not been possible to raise much ore from the outcrops of the lodes. One parcel of 40 tons yielded, on concentration at the Mount Zeehan mill, 11 tons 9cwt. of galena, assaying 92oz. 2dwt. 9gr. of silver, and 71½ per cent. of lead per ton. Another of 10 tons yielded 13cwt. of concentrates, with 75 per cent. of lead, and silver 52oz. 11dwt. 20gr. per ton. The main shaft is now down about 200 feet, and the results of driving for the various lodes will be watched with much interest.

New Silver Stream. (1642-87M, 3224-87M.)—This mine is situated towards the western side of the Zeehan field, not far from the contact of the slate and sandstone formation with the granite of Mount Agnew. A little further west, in the Tasmanian Silver Prospecting Co's ground, the sedimentary rocks show strong evidence of contact metamorphism, and it is probable that the magnetite in the large lode of this mineral, which runs through sections 1919-87M and 2661-87M into 1642-87M, is due to metamorphism also, siderite or limonite having been changed to the magnetic oxide of iron. In the lower tunnel of the Silver Stream mine a good deal of very dense quartzite was passed through, also a metamorphic rock, and in the lode and near it further evidence of alteration is found in the presence of epidote and garnet. The outcrop of the magnetite lode is very strong and well-defined, and should indicate a large lode

below: its course is about N.W. and S.E. In the New Silver Stream workings it seems probable that the large broken formation met with has some connection with this north-westerly lode, for it is full of similar magnetite, sometimes pulverulent, and sometimes dense, but the galena veins run about N.10 ° E., and it is therefore not at all clear whether the latter are separate lodes passing through an older one, or if they are ore-bodies lying obliquely across a large lode mass in the same way as the galena appears to occur in some of the Dundas lodes. Two shallow adits have been driven to test the ground: No. 1 is 252 feet in length, and there are about 250 feet of branches and crosscuts from it. Throughout this level the stuff passed through is soft and weathered, and it would be hard to say whether a great deal of it is lode stuff or rotten country rock. In a winze from this adit to the No. 2 one, which is 28 feet lower, some very nice solid galena is exposed, the ore-bearing body being from 18 inches to three feet in width. The upper adit is only about 40 feet below the surface of the ground at the shaft first sunk on the galena vein. The underlay of this seen in the winze is about 1 in 3 to the eastward. The lower tunnel is 596 feet in length, and from it a drive has gone 66 feet on the course of what is called No. 2 lode. A short distance from the mouth of the adit a lode formation carrying much magnetite, mostly pulverulent, was passed through, and then hard slate and quartzite were met with. At 532 feet what is called No. 1 lode was encountered, containing a good deal of galena and blende, some copper pyrites and a little pyrrhotite. At 546 feet No. 2 lode was cut, containing the same minerals, and from this onwards to the end of the tunnel a more or less broken mullocky lode mass was passed through. In fact we may say that from No. 1 lode in to the face is all lode matter, containing a little galena all through it, but with the greatest amount of it concentrated in the two shoots or lodes. Much magnetite occurs at intervals throughout the mass. A fairly large quantity of ore could be extracted from above the adit, but most of it would require concentration. Quite a strong stream of water flows from the lode, and it is evident that powerful pumps will have to be provided before it will be possible to sink on it. The adit being very shallow it would not be worth while to put up concentrating machinery for the ore that could be got above its level, and the future of the mine therefore depends on whether the owners can raise the capital required to open it at a depth: the prospects quite warrant spending the money necessary to do so.

Should the work in the Silver Stream mine result profitably, there will be great inducement to sink under the large magnetite outcrop in the Tasmanian Silver Prospecting Company's ground as well.

Forty-six tons of galena, averaging 23oz. of silver per ton, and 41 per cent. of lead, have been sold from the New Silver Stream mine, realising £267 2s. 1d., and there is a considerable stock of second-class ore on hand waiting for concentration. A tramway to connect with the main Remine to Zeehan road and the New Tasmanian Company's tramway, is one of the first requisites for opening up the mine.

Comstock.—(712-87M).—This mine has been let to a tribute party, who are raising all the first-class ore they can get from the outcrop, and as deep as their rather primitive appliances will allow them to go. The lode runs almost along the bottom of a small valley, in which there is a constantly running stream of water, consequently the workings are pretty wet. It has now been proved ore-bearing for some 7 or 8 chains, and the tribute party have taken from it some £400 to £500 worth of clean ore. The second-class ore, which is much more plentiful, they had not been able to touch when I saw the mine, but they intended getting some simple crushing and jigging appliances. The total amount of first-class ore sold since the mine started is 298 tons, which realised £3923 16s. 7d. The average assay is about 60oz. of silver per ton, and 50 per cent. of lead.

The work now being done on the outcrop will necessitate fluming the creek for a long distance by and by, when the mine comes to be worked in the regular fashion. The company ought to have driven from their low level tunnel along the lode to below the known ore-carrying portion of it long ago, but lost heart.

Boss.—(1240-87M.—No work was being done on this property when I visited it, except by the caretaker. A little galena is said to have been obtained in a shaft now full of water from a lode running N.10° E. A trench cut across this course two or three chains south of the shaft has revealed a lode of pyrites and dense blende, about 4 feet wide, and also the ferruginous and silicious capping of what is probably another lode. There are three or more large ironstone outcrops also on the section; one of these near the north-west corner is a well-defined lode outcrop, running N. 25 ° W. Two small shafts and a small tunnel have been made to test this, but have got nothing but oxidised lode matter. The section deserves prospecting more thoroughly below water level.

Sylvester (820-87M., 821-87M., 877-87M., 878-87M., 879-87M.).—Two tribute parties were at work in sections 878-87M. and 879-87M. raising galena associated with much pyrites: I did not see the underground workings of these. The Company's workings are in section 820-87M. on a north-easterly lode. An adit has been driven from the bottom of a valley to cut the lode: this was met with at 74 feet, and the drive was then continued to 300 feet without meeting more lode matter. The lode has been driven on to the northward about 290 feet; at first it was barren, but before long it improved and carried a good deal of pyromorphite and chloride of silver. Some 38 tons were taken from the stopes assaying 76ozs. silver and 40 to 50 per cent. of lead per ton, and there is still a good deal of ore in them containing up to 50ozs. of silver that would pay to take out if there were smelting works at Zeehan. In the end of the drive on the lode carbonate of iron suddenly took the place of the gossan up till then passed through. When I went through the mine a winze had been sunk below the adit level, and from this some nice galena, assaying over 100ozs. silver to the ton had been extracted; the vein was about eighteen inches wide of galena streaked with oxide of iron, and looked very promising.

A main shaft is being sunk, and was down 46 feet below the adit level when I saw it; the tunnel is 60 feet below the collar of the shaft. When this is sunk and the mine is opened from it there is ground for expecting good returns from the lode. A good deal of tufaceous rock occurs in the Sylvester mine.

Mount Zeehan (559M. and 909M.).—The main workings of this mine are on one of the north-easterly series of lodes. This has been opened to 60 feet in depth from a shaft now used as an air shaft, and to 124 feet by a main shaft. At the 124 feet level the lode has been followed north and south about 300 feet each way; at the upper level it has been driven for about 200 feet to the south and 400 feet to the north. At the bottom level the lode has been generally very poor, but in several places ore was found in the floor of the drive and rising up into it a foot or two, as if it had been just too shallow to strike new shoots of ore going downwards. The lode is very well defined with smooth walls; it has now been noted however, in several cases in the Zeehan field that where the walls are smooth and hard the lode is poor in ore. In the upper level the ground was richer, and near the air shaft a good deal of stoping has been done. On the whole, however, the workings have not been profitable, and the mine has lately been shut down.

While this work has been very discouraging, the Company should not by any means lose confidence in their property. There are a great many lodes in it not yet touched except by surface trenches, and some of these give very much better prospects on surface than the one to which work has been confined. Towards the north-east angle of section 909M six lodes of various sizes, all running about N.N.W., have been discovered; one of these crosses the main street of Zeehan in front of the Telegraph Office, and from the cap of it, 2½ feet in width, two large stones, one 2 tons, the other 2½cwt in weight, were taken, containing galena and carbonate of lead: assay of galena:—Lead, 76 per cent., and silver 73ozs. per ton. This lode has been traced for several chains, and is undoubtedly well worth a mining trial. Unfortunately for the Company the corner of their section containing these lodes is in one of the busiest parts of the town of Zeehan, and they will have some difficulty in securing a suitable site for their shaft and machinery. The whole of the six lodes in this part of the property will be able to be worked from one main shaft. In the western part of section 909M there are some four known lodes, including the one that has been worked; and in section 559M the No. 4 lode of the Argent mine has been picked up, and three or four other veins which may prove of importance, some of them north-westerly and others north-easterly in their courses. In order to know what is in these two sections it will really be necessary to drive right across them, and three main shafts at least will be required to work them. With so many lodes it is difficult to decide on which to begin working first, and a good deal more surface trenching ought still to be done to trace the position of each before coming to a decision. A good deal of capital must clearly be sunk before the ground can be properly opened up, but with so many lodes and such good surface prospects to warrant the expense, there need be no hesitation in recommending this property as well worthy of attention from mining adventurers.

The yield of ore from this mine has already been quoted above; I understand some 40 tons or more had been previously exported in addition, containing about 76ozs. silver per ton and 59 per cent. lead.

This mine belongs to "The Mount Zeehan Silver Lead Mining Company, Limited," a Tasmanian corporation, which is not to be confounded with the one that owns the next mine to be mentioned.

Argent Mine.—(Section 192-87M, belonging to "The Mount Zeehan (Tasmania) Silver Lead Mines, Limited," Company.) The English Company owning this property hold several other sections in addition, but work has been practically confined of late to the Argent and Silver Queen Extended sections (as they are locally called, from the names of the Companies that first held them). The Montana section, 2154-87M, which formerly was also held by the above Company, has since been made over to a separate one, "The Zeehan Montana Silver Mine, Limited."

The Argent main shaft is 140 feet deep, and levels have been opened from it at 72 feet and 132 feet. There are five known lodes in the section, four running north-easterly and one north-westerly, but only two, known as Nos. 4 and 6, are being worked from the main shaft as yet. Both of these lodes were looking very well at the time of my visit, being strong bodies 4 to 8 feet in width with well-defined walls, and in both payable ground was being stoped out, much of the galena being very pure. The value of the galena in silver is very much the same as in the adjoining Mount Zeehan claim, rarely less than 65ozs. to the ton.

An underlay shaft has been sunk on the north-westerly lode to the south-east from the main shaft, and shows it to be a strong vein carrying a good deal of ore. This should join or intersect Nos. 4 and 6 lodes to the south of the main shaft, and may thus be worked from the latter.

The Silver Queen Extended main shaft in section 189-87M. has been abandoned for the present, it being intended to work mainly from the Argent shaft, from which crosscuts will be made to intersect the other lodes. Another shaft towards the western boundary of this section will probably be utilised in course of time as an air shaft, the main western crosscut terminating at it. A crosscut from the Argent main shaft to this one will cut the Balstrup lode and the Silver Queen Extended lodes, and will prospect a lot of very likely ground. After it is completed it will be readily seen what would be the best position for one or more new main shafts to work all the lodes to a depth.

Balstrup's Manganese Hill mine (section 1209M.) has also fallen into the hands of "The Mount Zeehan (Tasmania) Silver Lead Mines Company," and is a very important addition to their property. Two long tunnels have been driven on the lode above water level with the effect of showing that it is a strong and well-defined vein up to 12 and more feet in width in parts, but consisting almost entirely of oxidised material. In several places rich oxidised lead ores were found carrying chloride of silver, but always going under foot and not rising above the tunnels, and it became clear that there was no use expecting any quantity of ore until greater depth was attained and the lode was struck below the zone of oxidation. But by the time this work was done the shareholders had lost faith in the mine and the Company went into liquidation, with the result that the English Company bought the lease of this section. I still have much faith in the future of this mine, the work done having proved nothing to its detriment, and given many indications of its probably carrying good ore below the gossan. A main shaft was begun by the old company and carried down, I believe, to some 60 feet below the level of the lower

adit, but I understand it is not intended by the manager of the company now owning the ground to go on with this shaft, but rather to prospect the lode from the Argent shaft after intersecting it in the main western crosscut.

The Argent, Silver Queen Extended, and Balstrup's blocks, comprising several important lodes, form a valuable property which should be remunerative when opened up. For the sake of the district I should like to see it worked from more shafts than one, so as to be developed more rapidly than will be possible from the Argent shaft alone. In all, about 470 tons of ore have been sent from the English Company's sections.

Balstrup's Central Mine (741-87M.)—This was shut down at the time of my visit, and the main shaft, said to be 110 feet deep, was full of water up to the adit level. The outcrop of the lode is very distinct and over 12 feet in width: it is traceable with ease from Balstrup's Manganese Hill through the north-east corner of 724-87M. into this section. A great deal of driving and trenching has been done on this property on the lode, but only to find that it is thoroughly oxidised above the water-level. The gossan is of a very favorable appearance, stalactitic, botryoidal, and full of vughs, showing extensive chemical action: it consists of limonite and oxide of manganese mainly. The property deserves a thorough mining trial at a depth below the zone of oxidation.

South Balstrup's Mine (1055-87M).—This also is at a standstill, and the shaft, some 140 feet deep, is full of water. Some rather nice-looking galena mixed with siderite was lying near the shaft, but I did not learn what was the size of the lode from which it came.

Grubb's Mine (1562-87M. and 1580-87M).—This was at the time of my visit one of the best producing mines on the field and has every prospect of soon being in a dividend-paying condition. The owners deserve success, having spent £11,356 on the mine, and £13,549 on connecting it with the Zeehan-Dundas Railway by the Grubb's tramway. The mine has been provided with an excellent winding and pumping plant, and is being opened out in a style which does credit to the management. The main shaft was 145 feet deep at the time I saw it and sinking was proceeding: it has since, I believe, been carried down to 215 feet and a level is being opened out at 200 feet. An upper level has been driven at 130 feet and connected by a rise with the prospecting shaft and the 80ft. level driven therefrom: this 80ft., or intermediate level, is 50 feet below the main adit first driven on the lode. The course of the latter is about N.W.; it has been cut again in what are known as the western workings across the creek (a branch of McClean's Creek) which traverses the property. In these a winze has been sunk 70 feet below the level of the adit in which the lode was cut and a level has been opened from it at 54 feet corresponding pretty closely with the 80 feet level in the main workings. The lode in the western workings has been smaller than in the eastern, but has yielded a good deal of very clean high-grade galena. In the main workings the lode has rarely been less than 18 inches in width and often up to six feet or more: it has very well-defined smooth walls in places, and is plainly a fissure lode. In the 130ft crosscut a mass of stuff coloured green by a light green serpentinous mineral, was passed through, which appears to belong to the lode, though not carrying ore to any extent. The intermediate level has been driven north-west 210 feet and the 130ft. level 236 feet from the prospecting shaft, and the latter level also 41 feet to the south-east from it. Some portions of the lode passed through have been poor, but there is a good deal of stoping ground opened up, especially near the shaft, where the ore seems to form a shoot. The western workings are in another shoot. Only first-class ore and very good seconds have yet been sent away, and the reserves in the mine will yield a great deal more than has been yet raised when the ground comes to be stoped out. As the Company does not yet possess a concentrating mill, the policy of the management has been only to raise the first-class, immediately saleable ore, at present, together with such poorer stuff as had to be taken out along with it, leaving that requiring dressing in the mine, to be stoped out later on, when there is an ore-dressing plant at hand. Previous to the formation of the Company about 75 tons of ore had been raised and sold, realising £750; including this there have been sent away from the mine up to the 31st March, 1893, 562 tons of first-class ore (running from 65 to 80 per cent. lead and 70 to 120ozs. silver per ton), which realised £7,086, and 25 tons of rather poorer stuff (47 to 67 per cent. lead, and 45 to 55ozs silver per ton), which gave £182, or a total of 587 tons, worth £7,268 net, a very good result indeed from so small an extent of stoped ground. The manager estimates that he has at grass 500 tons and in the stopes 1,500 tons of second class ore, which will require concentration: this does not seem to me to be an over-estimate. There is sometimes a good deal of blende with the galena in this mine, and rich fahlore has also been obtained: if it should turn out that there is much of the latter, slime tables will be a necessity in concentrating.

Nubeena (2230-87M).—This mine has been connected with Grubb's tramway by a short branch line. A small lode has been discovered running north and south: it is from 3 to 8 inches wide, but consists of very pure galena, assaying up to 100ozs. of silver to the ton. Very little underground work has yet been done, only a small adit and short drive on the course of the vein. At this level there is not so much galena as on surface, the vein being a mere string. A party of tributors are working the ground.

New Tasmanian (1467-87M., 1468-87M., 1469-87M., 1470-87M., and 1688-87M).—There are two separate sets of workings in this property, from shafts known as No. 1 and No. 2 shafts, a considerable distance apart, and on separate lodes, both of which have a north-westerly course. At the No. 1 workings a main shaft has been sunk 57ft to the level of the adit first driven on the course of the lode, and 120 feet below this. At 60 feet below the adit a tunnel has been opened: in this the lode is very poor towards the north end but fair towards the south, and the ground between here and the adit has been mostly stoped out. At the time of my visit a new level was being opened out at 120 feet in conglomerate country.

The North or No. 2 shaft is 72 feet deep, or 60 feet below a shallow adit driven on the course of the lode. A winze has been sunk from this adit to the bottom level, and the ground between the two levels is being stoped out. The lode is from 6 inches to 4 feet in width, and averages perhaps 18 inches. In the stopes the ore has been found rather patchy, coming in and going out again very suddenly: there is a good deal of blende with the galena.

In both these lodes the galena does not carry as much silver as the generality of those above described, which makes it considerably more difficult to get payable returns. It is possible that the silver value may improve in depth, though there is no certainty that it will do so. Though the mine has had a hard struggle to pay its way as yet it seems to me to be worth further exploration, as the lines of lode are strong and continuous over long distances, and better shoots may be found any day in them.

The total amount of ore sold from this property up to March 6th, 1893, was 870 tons, of which 620 tons were sold during the six months immediately preceding that date. The average assay is given as 64 per cent. lead and 36ozs. silver per ton. Almost all the ore raised passes through the concentrating mill, as it is found impossible to separate the blende satisfactorily by hand picking.

Oceana.—(419-87M., 420-87M., 421-87M., 422-87M.)—No work was being done in this mine at the time of my visit. The lode is a large one, running about N. 30° W., and on surface is almost entirely composed of gossan, in which a little carbonate of lead is often seen. Three prospecting shafts have been sunk and connected by a drive along the lode about 700 feet in length. A main shaft has also been begun, but is only down 45 feet, and has not yet been provided with machinery; it is proposed to sink it when work is resumed and open out at 100 and 150 feet. The present level is only 32 feet below the surface at the main shaft, and 54 feet at the northernmost prospecting shaft. Three shoots of ore have heen passed through; the southernmost or carbonate shoot beginning about 30 feet north of the main shaft; this was stoped out for 60 feet in length and 14 feet wide nearly up to surface, the square-set system of timbering being employed. The best ore contained in bulk 17ozs. of silver per ton and 47 per cent. of lead, and was of very good fluxing quality on account of containing a large percentage of oxide of iron. Some native silver was occasionally found in it. The second shoot was small, and consisted of galena in black clayey matter; it was found about 170 feet north of the main shaft. The third shoot was met with about 450 feet north of the main shaft, and from it were taken 270 tons of galena, assaying 18ozs. of silver per ton and 66 per cent. lead, and the ore is said to be improving in quality going downwards. The lode is of unknown width, and must be very large; one crosscut is said to have been driven eastward 70 feet from the level before it struck the wall, which proved to be limestone, but the other wall has not yet been driven to. At the north end of the level a crosscut proved the lode to be 38 feet in width without reaching either wall.

Altogether some 1000 tons of ore have been sold from this mine, averaging about 14½ozs. of silver per ton and 39 per cent. of lead, and realising to the mine owners about £2 a ton. At the present level there is still a large quantity of low-grade ore containing a little lead and silver, which will not pay for export, but which would be most useful flux for local smelters. The low value of the ore in silver has been unfortunate for the Company, but may improve lower down. The lode deserves a trial at a greater depth, and I have little doubt will well repay the owners for putting machinery upon it.

In my former report I took the limestone rock which occurs on this property to be of Carboniferous Age, on the strength of some very fragmentary fossils; the further evidence now obtainable, however, shows it to be of the same period as the rest of the field, probably Upper Silurian, but possibly Devonian.

The Oceana mine is connected with the Zeehan to Strahan Railway by an iron tramway or light railway, on which a small locomotive can be run, which joins the main line at Argenton.

New Pyramid (370-87M.)—No one was working here at the time of my visit, the mine having been shut down for some time. A shaft has been sunk, but I do not know to what depth, and a very small winding engine, altogether inadequate for serious work, has been provided. As the mine is certain to be a wet one no development can be hoped for until a good pumping engine and plant have been put upon it. Several tons of ore were lying about the surface, all ready bagged, but I was informed that the stuff was too poor in silver to pay for removal at present prices, containing only from 8 to 15 ozs. of silver per ton. There are two strong lodes in the property, both containing a good deal of galena, and though this as yet has been poor in silver, it is premature to assert that this poverty will continue throughout the mine in depth. Already on the field we have instances of the value of the galena in contained silver varying very much at different points; for example, in the Adelaide mine the value was very much higher at the lowest level than at surface. Again, the galena from the Sunrise lode, which is almost certainly identical with that of the Silver Bell, is much richer in silver than that of the latter.

A theory which seems to be believed in a good deal locally, is that in the neighborhood of the bands of limestone the galena is poor in silver, the low grade of the Oceana and New Pyramid galenas being cited in support of this, but it does not appear to me that the evidence is at all conclusive, for poor galena is found in several mines where no limestone is known to exist, and rich galena is found in limestone or with this rock in the near vicinity, at the Comstock, Success, and Godkin mines.

Section 1659-91m.—Some prospecting lately done on this section has resulted in finding what are taken to be two separate lodes in close proximity to one another, right alongside the railway line. On the day of my visit both the small shafts were full of water and I could not see the lodes. I was informed that one contained galena for eighteen inches in width, and the other for about eight feet in width. The galena is very pure, assaying 80 per cent. lead and over, but is very poor in silver, the smaller lode only having some 4ozs. of silver in the clean ore, and the larger 15 to 25ozs. The country rock is not exposed much, but there appears to be a belt of limestone somewhere close by, as pieces of this rock are not uncommon. These finds are pretty well on the line of the Balstrup lode, and may be portion of it. The find deserves further working in spite of the poor quality of the ore.

Sunrise.—The Sunrise P.A. hold several sections, but the only work of any consequence is that done on Section 534-87M., where a tribute party have been working on a continuation of the Silver King and Silver Bell line of lode. The lode was found in the bed of the Little Henty River, and has been somewhat difficult to work in consequence, but by making a race and water-wheel the tributers have been able to work a small pump and sink about 26 feet. The lode is about 2 feet wide in the face in the

workings from this shaft, and shows from two to eight inches of very pure galena. About 30 tons of ore have been raised and sold up to the end of February last, assaying from 69 to 73 per cent. of lead and 80 to 90ozs. of silver per ton. This seems a nice shoot of ore, and worth working on a larger scale than is possible for the tributors with their limited means.

New Silver Bell.—(298-87M. and 480-87M.).—Very little has been done to develope this mine for the last two years. A main shaft has been begun, and a very good winding and pumping engine partly erected, but otherwise the property is in very much the same state as when I reported on it formerly. The ore heaps taken from the drive on the lode did not, I understand, turn out nearly so well either in quantity or quality as they were estimated. 450 tons sent to the Mount Zeehan Mill yielded 116 tons of concentrates, assaying 70 per cent. lead and 30ozs. of silver to the ton. One hundred tons were also smelted at the Zeehan and Dundas Smelting Works, and some more at Messrs. Kennedy and Son's furnace in Hobart, but I have been unable to procure the results of these trials.

Silver King.—I was unable to see the underground workings of this mine as it was full of water at the time of my visit, and the only work in progress was the erection of the concentrating mill. It is to to be hoped that the Company will now push on vigorously with the work of exploring their mine: it is one of the most important lines of lode in the district.

Other Zeehan Mines.—I did not visit the Monte Christo, Silver King Extended, Austral, New Maxim, and several other mines in the Zeehan district on which no work was in progress. From what I saw on my former visits I am convinced that several of these are very likely properties, and deserve to be worked. I was informed that tribute parties were anxious to work one of the lodes in the Silver King Extended ground in which galena is showing, and if so, the refusal to allow them to do so is not creditable to owners who have done so little work themselves.

Dundas District.

Maestrie's Broken Hill Mine.—(Sections 2355-87M. and 2356-87M.). A great deal of interest attaches to this and the adjacent Comet Mine, which is on the same lode, for several reasons, the principal one at present being that there is a great likelihood of its soon being seen in the crosscut from the Comet shaft at the bottom level what is the nature and value of the lode matter lying beneath the enormous ironstone outcrop. The size of the lode, the value of the ore found in it, and the excellence of the indications of more beneath, have led most people who have seen these mines to entertain high expectations as to what will be found on sinking below the oxidised outcrop, and a great deal depends on the success of the work now in progress, for this is looked upon as a test case. If good ore is found below the gossan, other large outcrops will be worked, but if not there can be no doubt that the exploration of the Dundas lodes will receive a very severe check. The lode also excites interest on account of several peculiarities: though very wide it has not been traced for any great length, and there is still a great deal of doubt as to its course; again, its outline appears to be very uneven, and unlike that of most lodes, the wall seemingly being very irregular; and further, the ore veins appear to be of later formation than the main mass of the gossan, lie in it like lodes in ordinary country rock, and not appear to coincide in strike with the main lode. I shall, therefore, give a somewhat more detailed description of these two mines than of the others in the district, first describing the Maestrie's workings, and then those of the Comet mine, and then proceeding to remarks on the lode generally.

The workings of the Maestrie's Broken Hill mine are situated in the south-west angle of section 2356-87M, and consist of three levels, known as the main tunnel level, the intermediate level, and the lower level. The first is that which was put in on the first discovery of the mine: its entrance is 90 feet from the western boundary of the section, and about 320 feet from the southern one. It runs N. 13° 38′ E. for 441 feet, and then branches, one branch going N. 36° 55′ E. for 210 feet, and the other N. 44° W. 246 feet, to connect with a prospecting shaft sunk in iron oxide and other lode matter: from here it goes N. 17° 16′ W. for 236 feet, and comes out to daylight once more, having penetrated right through the high spur which runs east and west through the section. A tramway runs from this northern end of the tunnel to connect with the Zeehan and Dundas Railway at the Maestrie's station.

The southern entrance to the tunnel was in lodestuff, galena and cerussite occurring pretty freely through the oxides of iron and manganese which composed the main body of material. This ground has been stoped out for about 65ft from the mouth of the tunnel. At 20 feet in, a winze has been sunk 47 feet: opposite this in the tunnel there is a body of somewhat broken country slate, which is also seen again at the two lower levels, and is no doubt a "horse," or block of country rock enclosed in the lode matter. At 90 feet in, a vein of galena from ½ to 24 inches wide has been followed south-east for 60 feet; it has been stoped out for about 12 feet above the level, but runs out in the face and does not appear to go into the floor, so it has not yet been driven for in the lower levels. This vein like the other galena veins nearer the tunnel mouth, has walls of ironstone gossan, and is practically a lode within a lode. At 120 feet from the entrance a band of carbonate of iron was struck running about N. 25° W.; so it would seem that in this part of the tunnel everything points to the course of the lode being from N.N.W. to N.W. Certainly this is the general direction of strike of the shoots of ore. After passing through the band of siderite the lodestuff is denser and more earthy than before, and appears to lie in bands running roughly east and west, and this also is the course of the footwall of the lode, which is met with at 210 feet in, dipping south 30° to 40°. This dip, however, does not appear to be permanent, for a main shaft which is on the east side of the tunnel at 169 feet in, was in country rock for first 60ft before it reached the lodestuff, which would show the dip to be to the north or east, making the the eastern wall the hanging wall instead of the foot wall. This is only one of the contradictory features presented by this lode. The main shaft is 93 feet deep down to the tunnel level, and 126 feet to the bottom: it has not yet been equipped with winding or pumping machinery. From the footwall in to the end of its north-eastern branch, the tunnel passes through stratified slate and sandstone country, a

good deal broken and stained with oxide of iron. At 85 feet back from the face, a small lode consisting of from 2 to 5 feet of manganic ironstone was passed through, and this has been followed on a course nearly due east for 78 feet: it contains a little silver, and is probably a "leader" or branch vein from the main lode. In the north-west branch of the tunnel, the stratified country rock was passed through for 155 feet, after which lodestuff was once more met with. The wall at this point runs across the drive about N. 30° E. The lode matter consists mainly of oxides of iron and manganese, similar to the stuff passed through in the first part of the tunnel: it is gossan of a sort that would generally be considered favorable for deposits of ore beneath it. The drive passes through it for about 230 feet, and then gets into slate and sandstone country once more. Two small seams of "canary ore" (mainly oxide of lead) were passed through, one of which runs about N. 10° W. across the tunnel, the other I did not take the course of: these contained silver. From the huge size of this lode, and its proximity to the other huge mass first passed through, there can be little doubt that both are closely connected: in fact, when the work in the Comet mine is also taken into consideration, it is pretty evident that they are one and the same lode, and its course would therefore be on the whole north and south, or perhaps a little to the east of north.

The intermediate level is 14 feet below the main tunnel, and has been driven from a point as low down in the bed of the creek as it was possible to get with an adit. It is connected with the main tunnel by the winze near the southern entrance to the latter. About 30ft east of the winze it struck country rock, and was then turned northward, and sandstone country was again struck on the east side in two crosscuts, bearing out the idea that the lode is running a more or less north and south course. West of the winze a drive has been extended nearly to the Comet boundary, and from the point where this drive is intersected by the adit from surface, another drive has been put in to the north 154 feet. All through this level there was more or less lead and silver in the ore, the lead being commonly in the form of carbonate; but still the main bodies of rich ore were in shoots running a little west of north, and underlaying westward, and in these the best ore was galena. Several bodies of dolomite were met with in the workings, locally called "intrusions;" these are in all probability simply portions of the original lode, which from their composition have not suffered chemical change through oxidation, as they do not contain any constituents capable of further oxidation.

The lowest level is 33 feet below the main tunnel, and also connected with it by the winze. About 50 feet east of the winze the country rock was met with as in the intermediate level, the underlay of the wall of the lode being here, therefore, 20 feet in 19, or say 1 in 1 to the eastward: this agrees with the main shaft in giving an easterly underlay to the lode. The principal drive at this level is one running about N. 30° W., nearly to the Comet boundary, a total distance of over 260 feet: it runs right under the mouth of the main tunnel, and ends 30 feet to the south-east from this, with good ore underfoot. The drive followed a shoot of ore which was over 12 feet wide at first, and averaged perhaps 2 feet right through. The galena lay between walls of iron oxide gossan, containing a great deal of carbonate of lead in crystals, but not rich enough to take out at present. This gossan would be very good flux for the smelting furnaces. Towards the north end of the drive the ore dipped underfoot, and could not be followed deeper till the country was drained. This level is about 4 feet above the No. 2 level of the Comet mine, with which it has been connected.

About 18 feet above the main tunnel and 18 or 20 feet east of the top of the winze, a small drive has been made from the side of the hill into the ironstone capping, following a vein of canary ore, which in about 12ft made into galena. This has been followed for 110 feet on a course about N. 30° W., and has been from six inches to two feet wide, averaging about ten inches. It has been stoped up to 30 feet above the main tunnel: the canary ore is very rich, assaying from 200 to 300 ounces of silver. The underlay is to the westward, so it corresponds pretty well with the shoot followed at the bottom level, and like it, and also the other shoots in this mine, it lies between walls of ironstone gossan—just as most lodes lie between walls of ordinary country rock. The explanation of this feature is not very satisfactory at present for the want of sufficient evidence as to the behaviour of these shoots in depth, and when they reach the wall rock of the main lode, across which latter they appear to run obliquely: it would almost appear as if the galena veins had been formed subsequently to the oxidation of the lode mass to gossan, but any theory on this line seems to me very hard of acceptance, and I should rather incline to believe that the galena has remained unoxidised, while the carbonate of iron has changed to oxide. I have frequently observed in the outcrops of the Mount Zeehan lodes that partially oxidised specimens of siderite contain unaltered galena, the oxidation of the former apparently therefore preceding that of the latter; if this is the case on a larger scale also, it is possible that veins of galena might remain unoxidised for some time after the enclosing gangue had been pretty thoroughly converted into gossan. On this theory the shoots of ore in the gossan capping would probably correspond with those in the lower unaltered parts of the lode.

The ore raised and smelted from this mine has already been mentioned above, but since the stoppage of the furnaces a little ore has been raised and sold in addition. Up to the end of January 1893, some 60 tons had been disposed of at a net price of a little over £7 a ton, the average assay being 55oz of silver and 49 per cent. of lead per ton. It is estimated that there are some 1200 tons of second-class ore at grass, and 7000 tons in sight in the mine, that would be worth smelting if furnaces were close at hand.

This seems likely to be a good mine, but of course requires to be opened out at a depth below the water level. Even if the large gossan capping covers nothing but low grade concentrating ore, the quantity of stuff in the lode is so great that, probably, very poor material might be made to yield a profit. In this connection it has occurred to me that a good deal of prospecting could be cheaply done by means of a diamond drill. In cases where lodes are small, boring with this machine is liable to give very unsatisfactory results, as the lode may be passed through where it is small or broken up, and very little information gained, but in this instance, with a lode mass 200 to 300 feet or more in width, there would be little fear of a series of ten or twelve bores failing to yield reliable samples of the average contents of the lode, and much information would probably be gained as to the shoots of ore, the underlay of the lode, and other points of value in laying out the mining works.

Comet Mine—(1794-87M and 1796-87M).—As in the Maestrie's Mine, work on the big lode was begun on the South side of the ridge running through both properties, an adit being driven from the bottom of the valley nearly due North 364 feet. The entrance to this is about 145 feet West from that to Maestrie's main tunnel. This adit, or No. 1 level, passed through lode matter mostly iron and manganese oxides, for its whole distance, and terminated within a few feet of the North-east corner of section 1796-87M. In the end some very much broken country rock was met with, which was very naturally taken for the wall of the lode, though as subsequent developments have shown, it is really nearly in the middle of it. Twenty-seven feet back from the end a winze was sunk, and soon plentiful crystals of cerussite (carbonate of lead) and some canary ore (oxide of lead) rich in silver began to be found. The winze is now down 37 feet and connects with the No. 2 level and with an intermediate level 16 feet above the latter. The ore in the winze corresponding with the position in which the shoot found in the mouth of Maestrie's tunnel ought to be found if it continued on its apparent course of N. 25 ° to 30 ° W., it was at this stage supposed that the lode ran in this direction, and an adit was begun from the North side of the hill in the expectation of soon cutting it. It was driven 712ft on a course about S. 7 ° W. through stratified slate and sandstone country without finding the lode however, the point at which it stopped being only 40 feet north of the south boundary and 333 feet west of the eastern one of the section (1794-87M). Its termination was, therefore, nearly due west of where the No. 1 adit had left off. At about 385 feet from the entrance to No. 2 tunnel a break in the rock was met with, not far from where the lode was expected, and as there was a considerable flow of water from this, which deposited much oxide of iron on exposure to the air, it was thought at the time to be probably part of the lode channel. The bearing of this break is N. 25 ° W. corresponding with the strike of the shoots of ore in Maestrie's mine, and it has an underlay to the S.W. similarly to these also. It appears to be a fault, the hard country rock to the South being cut clean off by it. It is very probable that this fault is very closely connected with the shoots of ore, it being very like to have passed through the big lode as well as through the country, and it is not unlikely that the shoots of ore are concentrated in the fissures caused by it, the galena being then leached out of the surrounding lode stuff and redeposited in these. If this is the case it is probable that the ore will follow this line of fracture into the country for some distance on each side of the main lode, and possibly, too, ore will be found along it at intervals elsewhere.

At 644 feet from the entrance to No. 2 adit, a branch drive was driven eastward from it straight to the winze from No. 1 adit, and on to Maestrie's boundary. At 150 feet from the adit the wall of the lode was reached, striking N. 55 ° E., and underlaying westerly about one 1 in 1, the underlay being thus in the opposite direction to that of the eastern wall in the Maestrie's mine. The underlay will, however, be better ascertainable when the bottom level has reached the lode; it is already proved by this, that it is not as flat as 1 in 1, or the wall would have been met with before now. In the No. 2 adit, and east drive from it, it is noticeable that the beds of the country rock are striking about N.E. and S.W., which is nearly at right angles to the usual course of the sedimentary rocks of the district; this indicates great disturbance of the country, probably owing to the intrusion of the large masses of serpentine found about quarter of a mile or less further westward.

The western part of the lode matter passed through by the No. 2 level is rather clayey, a good deal resembling the eastern portion in Maestrie's tunnel just before the wall rock was first cut, but it gets better looking going eastward, and for the last 60 or 70 feet before reaching the boundary it has a very favourable appearance. At 295 feet from the main No. 2 adit, a drive has been put in to the northward, 183 feet through very nice-looking gossan. At 141 feet in this, soft slate was met with, and also again in the end of the drive; this country wall runs about N. 35 ° W., and dips N.E. about 1 in 2, increasing the confusion in which we find ourselves whenever we attempt to form a definite opinion as to the course of this lode. At the end of the East drive another drive goes northward in lode stuff all the way for 110 feet, crystals of cerussite and a little pyromorphite being found through the gossan, the former rather plentifully. Close to where this drive leaves the East crosscut, traces are to be seen of the broken country rock, in which the No. 1 adit terminated, and it is seen that this must be a crushed block of sandstone enclosed in the lode matter. Another drive has gone southward along the boundary or just West of it for 130 feet; at about 50 feet very good cerussite and canary ore was obtained on what is clearly a continuation of Maestrie's shoot. The shoot is about 3 feet wide, and runs about N. 10 ° W., underlaying westward 2 feet in 3. All through this southern drive crystals of cerussite in clusters of beautiful white glittering needles and spicules were plentifully obtained in the vughs in the gossan.

A main shaft has been sunk from the top of the ridge, about 35 feet south-east of the point where the eastern crosscut leaves the main No. 2 tunnel; it is 270 feet in depth. At 161 feet it is connected with the No. 2 tunnel, and at 261 feet a drive is being made eastward, parallel to the eastern crosscut at the upper level, through hard sandstone and slate. Towards the end of February last this crosscut had been extended a little over 100 feet from the shaft, when the water, which had all along been pretty heavy, burst in from the face, mastered the pump which was raising about 30,000 gallons an hour, and rose up to the 161 feet level in the shaft. A tank was put on to assist the Worthington steam pump, and water was raised at the rate of about 50,000 gallons an hour with both appliances, but though it was got down so low that it was possible to wade into the bottom level, it has not yet been drained low enough to allow of work being resumed. It is almost certain that the striking of this large quantity of water means that the lode is close at hand, as indeed we should expect from the position of the western wall in the level above. Since the lode has been drained by this work, winzes have, I understand, been sunk by both the Comet and Maestrie's Companies to some distance below the upper level, and it is probable that much useful knowledge will be gained by these, even if it is impossible to extend the bottom crosscut for some time to come. As a great deal of interest is being taken in this work, it is perhaps well to point out that all the western part of the lode in the upper crosscut was composed of rather poor and earthy gossan, such as would result from the oxidation of lode matter consisting mostly of lode slate and carbonate of iron, and that no disappointment should be felt if this is what is first obtained at the lower level. The good ore above lies over near Maestrie's

boundary, and it will probably be necessary to get well to the eastward of the western lode wall before valuable ore comes in. At the upper level the known shoot of good ore lies 300 feet east of the shaft,, and supposing it to underlay 1 in 1, it would therefore be necessary to drive 200 feet at the lower level or 100 feet past the present face; if the underlay is less the distance will be greater. Of course, however, it is also possible that there may be ore in the lode outside this shoot, and it is very much to be hoped that it will be so.

On the southern part of section 1796-87M, belonging to the Comet Company, very little has been done on the north-westerly lode exposed on the top of the high hill on the south boundary A shaft was sunk about 80 feet and some driving done in a mixture of gossan and siderite containing some galena. Two adits have been begun lower down the hill, but neither was carried very far on account of the very hard country rock met with, and the lode was not found in them.

About 38 feet S.W. from the S.W. corner of Maestrie's section 2356-87M, a shaft has been sunk 100 feet by the Comet, Maestrie's, and Kozminsky Companies in conjunction. The top of this is 110 feet below the top of the Comet shaft, and the bottom is therefore not so deep as that of the latter by 60 feet. The water makes in it at the rate of about 18,000 gallons an hour, but I have not heard whether this has decreased since the Comet Company got the burst of water. For 90 feet this shaft passed through black slate country, and then got into vesicular, cellular quartz, often so porous as almost to resemble pumice, a good deal stained with oxide of iron. This is still in the bottom of the shaft: some of it is almost like siliceous sinter. It probably is connected with the main lode in some way not yet clear.

The small creek that passes close to the entrances to the Maestrie's and Comet No. 1 tunnels passes over portion of the outcrop of the big lode. When the Comet and Joint shafts had drained the country beneath, a subsidence took place opposite the entrance to the Maestrie's tunnels, and the creek disappeared into this entirely. In the roof of the small cave formed the rock showing was dolomite containing galena, evidently portion of the lode. Dolomite is again seen in the bed of the creek a little lower down the stream. The subsidence was flumed over by a short fluming, but this accident appears to me to indicate the necessity for cleaning out the bed of the creek till solid rock is reached well above the crossing of the lode, and fluming down from there on to the solid rock on the western side of the latter. It is pretty certain that a large volume of water must otherwise find its way from the creek down into the workings, and it is very probable that by diverting this on surface the work of the pumps would be very materially lessened.

The course of the big lode is still not at all satisfactorily determined, though, as seen in the foregoing, there is now a good deal of evidence collected as to it. The western wall crosses Maestrie's main tunnel about 100 feet in from the Northern entrance; it is again seen in the end of the North drive of the Comet No. 2 level and crossing the east crosscut at the same level about 110 feet east of the main shaft. The eastern wall is seen in Maestrie's main tunnel, about 330 feet in from the North entrance, again at 210 feet from the south entrance, and in the ends of the drives eastward from the winze at the intermediate level. The general course of the eastern wall is about N. and S., but appears to be running W. of N. in the South part of Maestrie's mine and E. of N. in the North portion. The general course of the western wall appears to be N.E., but it bears much more to the E. of N. in the Comet mine than in the portion connecting the wall seen furthest North in this with that in Maestrie's North tunnel. Connecting the various known points on the map, the lode is seen to be about 150 feet wide, measured square across on a horizontal plane, where it passes through Maestrie's North tunnel, and over 400 feet in the main part of the workings of the two mines. But what becomes of it on the south side of the creek? It is not found in the Joint shaft as we should expect if it continued south on its apparent course, unless, indeed, the vesicular quartz be part of it, and it has not been seen on the high hill side on the Comet's south section, which has now been bared and prospected so much as to make its discovery almost certain if it had existed. In Kozminsky's section, 2332-87M, a large outcrop of gossan has been traced on a course a little west of north for some 16 chains: this would strike into the main lode body about Maestrie's main workings, and may be the north-westerly lode which yields the shoots of ore. The large lode body would have to turn round very sharply to the south-east, especially on the western wall, to get round to join this lode, and I am inclined to think that another branch going down the creek must also be looked for. The large mass in the Comet and Maestrie's mines might very well be formed by the junction of Kozminsky's lode with another one coming up from the big lode-mass in the Central Dundas property, and after joining a new course might be taken to the north-east, towards the Talune sections, in which there is a large lode of gossan running north-easterly on a line which, when continued southward, runs into the Comet and Maestrie's ground. It is clear that the lode-mass is a somewhat abnormal one in its behaviour, and the only way in which we shall be able to learn its course definitely will be by following it underground.

Seeing that the sedimentary formation is penetrated by large dykes of serpentine only a short distance west of the Comet mine, and that the strata in the latter are running almost fairly across the usual line (N.E. instead of N.N.W.), I have been led to speculate on the possibility of this lode turning out to be a contact mass lying between the slates and a buried dyke or intrusion of plutonic rock which has not come through to surface: this would explain the irregular features, but is only a speculation.

Kozminsky's.—(2332-87M, 2333-87M, and 2297-87M.)—No work worth mentioning has been yet done on these sections as far as I could learn, and I only speak of them now to add that about 7 chains east of the N.W. corner of 2332-87M a shaft was sunk 40 feet on about the line of the large gossan lode which, as above-mentioned, traverses this section, and a drive was put in 17 feet to the westward from this, which came upon a ferruginous loose body of stuff, considered to be lode matter. A large quantity of water came from this, and made progress impossible without machinery. This would confirm the idea that the gossan lode strikes into the Maestrie's main body.

Mount Dundas Prospecting and Mining Company, No Liability.—Sections 1708-87M, and 1724-87M.—This is the full title of the company generally known locally as the "Dundas P.A.," under which name I have referred to it several times in the foregoing. The workings on the boundary between the two

sections, described in my former report, have been abandoned, and the mine now to be spoken of lies near the south boundary of section 1724-87M, the lode being the same as that worked by the Central Dundas Company in section 1851-87M. It is pretty certain that there is a close connection between the lodes in this property and the serpentine dyke which also passes through it. In the old western tunnel the lode-stuff was at the contact between the slate and serpentine formations, and in some of the prospecting tunnels on the eastern side the same appears to be again the case. The ironstone outcrop goes through the Central Dundas property, into that of the Adelaide Prospecting Company, following the serpentine country also. The body now being worked crosses the southern boundary of 1724-87M about the middle, and then seems to fork into two branches, which run into the Hassett Company's section, 1783-87M. There is so much ironstone about the surface in this locality, however, that it is difficult to know how many lines of it there are, and a lot of underground work will have to be done before much knowledge will he gained as to these bodies. I suspect that they will prove to be mainly contact lodes lying betwen the serpentine intrusions and the enclosing slates.

The main shaft is down 110 feet, or about 70 feet below a tunnel put in from the side of the hill, which is connected with the workings at the bottom level by means of a winze. The shaft is in the Central Dundas Company's ground (1851-87M), and drives have been made from it into both companies' portions of the lode. Some rich gossan, found in the Central Dundas mine near surface, containing chloride of silver, has not, I believe, been found again at the lower level, but these workings were shut down at the time of my visit, and I was not able to get much information about them. Going northward the Mount Dundas Company found a great deal of chromate of lead in the gossan, and after a time came upon a vein or shoot of galena, running about N. 20° W., which has been followed for a considerable distance. In places it has been 4 feet wide, of good galena, and as in the case of Maestrie's shoots, it runs between walls of iron oxides. These walls carry a good deal of silver and lead through them, and the mining manager stated to me that he could take out ore for 30 feet in width if there was a local smelting works. At present he takes nothing assaying under 30oz. of silver, unless it is very rich in lead.

The gossan in the workings in the shaft is of a highly favorable appearance, and seems likely to lie upon ore. The mine requires more powerful machinery, and to have the shaft sunk down well below water level, so as to reach the unaltered parts of the lode. According to the surface tunnel the width of the latter is 70 feet.

The mining manager was good enough to allow me to examine his assay book, showing the results of tests made during progress of working: these were stated to be all bulk assays. The average of 31 assays of ore, described as "Ironstone and Galena," gave 66oz. 14dwt. 11gr. of silver per ton, and 31 per cent. lead; the highest and lowest assays in silver being respectively 129oz. 3dwt. 22gr., and 16oz. 6dwt. 16gr. per ton, and of lead 72 per cent. and 10 per cent.

The average of 18 assays of stuff described as "ironstone" and "gossan," was 21oz. 8dwt. 11gr. of silver, and 5 per cent. of lead: the highest and lowest silver assays were respectively 117oz. 5dwt. 17gr., and 5oz. 1dwt. 6gr. per ton, and of lead 19 per cent. and none.

The average of 17 assays of "ironstone and chromate" (of lead), was 18oz. 3dwt. 12gr. silver per ton, and 4½ per cent. lead, the silver ranging from 72oz. 10dwt. 9gr. to 3oz. 5dwt. 8gr. per ton, and the lead from 12 per cent. to none.

The average of 4 assays of "ironstone and canary ore" was 78oz. 12dwt. 9gr of silver per ton, and 8½ per cent. lead, the silver ranging from 134oz. 1dwt. 22gr. to 41oz. 12dwt. 16gr. per ton, and the lead from 19 per cent. to 4 per cent.

"Ironstone and siderite," 4 assays gave on the average 14oz. 5dwt. 20gr. silver per ton and 13 per cent. lead, the highest silver assay being 24oz. 3dwt. 11gr., and the lowest 6oz. 10dwt. 16gr. per ton, and the lead ranging from 18 per cent. to 9 per cent.

One sample of "chromate and galena," no doubt also containing much oxide of iron, gave 17oz. 9dwt. 12gr. silver per ton, and 6 per cent. lead.

Another of "ironstone and sulphate" (of lead) gave 18oz. 5dwt. 20gr. of silver per ton, and 3½ per cent. lead.

Two samples of "dressed ore" gave 106oz. 16dwt. 9gr. and 107oz. 16dwt. 0gr. of silver respectively, and 25½ per cent. and 35 per cent. of lead per ton.

One piece of "clean galena" yielded at the rate of 107oz. 2dwt. 22gr. of silver, and 75 per cent. lead per ton.

One of "siderite" contained 19oz. 12dwt. silver per ton, and 2 per cent. lead.

A picked specimen of "chloride and canary ore" yielded 16,922oz. 18dwt. 18gr. of silver per ton and 4 per cent lead.

These assays show the galena to be of very good quality, and that the ironstone does not, as a rule, contain much lead, though generally fairly rich in silver. It is good fluxing material, but would require the addition of rich lead ores. There may be more lead in it at a lower level.

Up to the end of February, 1893, this mine had sold 95 tons 8cwt. of ore, assaying on the average 94½oz. silver per ton, and 39 per cent. lead, the net prices realised per ton ranging from £8 15s. 0d. to £14 10s. 0d.

This property has, in my opinion, uncommonly good prospects, and should be vigorously worked. The lode being a wide one, diamond drill boring might be here resorted to for prospecting purposes, as in the Comet and Maestrie's mines, with much probable advantage.

Adelaide Proprietary Mine.—(2302-87M.)—In this section there are three or more lines of large gossan outcrops, which converge to a point on the north boundary, about 8 chains from the N.E. corner peg. A good deal of tunnelling was done without much result, and finally work was confined to sinking a main shaft and opening out from it. The shaft is 44 feet south of the northern boundary, and 595 feet west of the eastern one, close to the spot where the lines of gossan outcrops appear to come together. It is 176 feet deep, and levels have been opened from it at 116 and 170 feet. From the old No. 1 tunnel, which is some 90 feet east of the shaft, a winze has been sunk 32 feet, and some driving has been done from the bottom of this, forming the 32 feet level. The mine is pretty wet, lying almost under the creek which runs through this property, Anderson's, the Central Dundas section, and the Comet ground. The lode passes right under this creek into section 2303-87M (Anderson's S.M. Company's), and it has been found necessary to flume the water over it, as a strong stream kept pouring down into the mine till this was done. The Adelaide mine is said to be over 200 feet lower than Maestrie's Broken Hill workings, so that its main shaft is actually to the greatest depth yet reached in this part of the field. Still even at its lowest level the lode matter is yet much oxidised, and it will be necessary to sink still further in order to reach the parts of the lode unaffected by atmospheric influences. This renders it very doubtful if the low level of the Comet mine will prove to be low enough to be below the oxidised lode matter.

Though the workings at No. 2 level from the main shaft have gone 87 feet N.E. and 90 feet S.E. from it, the walls of the lode have not yet been met with, the stuff passed through being mostly gossan and dolomite; the lode must, therefore, be a very large one. At both No. 1 and No. 2 levels a vein of galena of good quality has been found striking N.W. and S.E., and dipping S.W. about 45°; this averages from 3 to 6 inches, but has been at times as much as 2 feet wide. Its walls are smooth, distinct, and slickensided, showing the vein to be of subsequent formation to the main mass of the lode. In its northwesterly strike it agrees with the ore-veins in Maestrie's Broken Hill, and the Mount Dundas mines; and this coincidence renders it somewhat likely that all the north-westerly veins in the Dundas District are of later origin than the lodes which run to the north-east. If so, there seems much probability that where they pass through the older lodes they will often be greatly enriched. In the gossan in the Adelaide mine, especially near the galena vein, very fine crystals of crocoisite (chromate of lead) and cerussite (carbonate of lead) are found somewhat plentifully, beautiful specimens being frequently obtained.

Since my visit the adjoining Anderson's S. M. Company, working on the same lode, are said to have got some good ore. Both companies will probably have to do a good deal of exploring work yet, but had best sink further before doing much more driving. I understand the Adelaide shaft is now being sunk deeper. The mine gives a good deal of promise, and deserves to be thoroughly tried. Since 1st July, 1892, up to 24th February, 1893, 214 tons 4cwt. of ore have been sold, realising £1828 1s 4d. An improvement is shown in the silver value of the ore as greater depth is attained, the average assay of the stuff from the 32ft level being 34oz. silver per ton and 44 per cent. lead, from the 116ft level 57oz silver per ton and 63 per cent. lead, and from the 170ft level 64oz silver and 63 per cent. lead. Some of the second-class ore is concentrated by hand-jigging, but a good deal more could be got if there were a concentrating plant at hand to treat it. There is also more than a little good fluxing gossan in the mine, carrying some silver and lead, which would be worth smelting if the works were close at hand. Inquiry should be made, too, as to the possibility of getting a price for the chromate of lead that would pay for its shipment to European chemical works, for the manufacture of bi-chromate of potash and other chrome chemicals.

Mariposa (2415-87M, 2416-87M).—In the north east angle of section 2415-87M. a lode has been found running about N. 30° W., which would soon take it out of the Mariposa Company's ground into the Alameda Company's section 1410-87M. on the North, and the Martini and South Nevada companies sections 3325-87M. and 2446-87M. on the South. The underlay being to the westward, however, the Mariposa Company would get an increasingly greater length upon it as greater depth was attained.

Two large surface excavations have been made on the outcrop, one on each side of the North boundary of section 2415-87M. In these the lode is about 8 feet wide, composed of oxide of iron, and a good deal of galena; the oxide of iron often carries much carbonate of lead. In the Mariposa ground a winze was sunk 23 feet on the lode, which was found to consist of galena, carbonate and oxide of lead, and iron oxide all the way down, showing the superficial oxidation of the vein stuff to have gone down some little distance. The outcrop being in a flat low-lying valley at the foot of a hill, it might have been expected that the unaltered lode would have been met with almost at once on sinking, and from the quantity of galena in it I am inclined to believe that the oxidation will not be found to go very deep.

A main shaft has been sunk about 3 chains from the northern, and one chain from the eastern boundary of section 2415-87M., its depth being 144 feet. In sinking it first 25 feet of sandstone were passed through, then soft black sand and mud full of pyrites and nodules of galena to 95 feet, after which hard blue limestone came in. At 130 feet a drive was put in to the eastward for 50 feet; at 21 feet the lode was met with, running N. 30° W. and underlaying westerly about 1 in $5\frac{1}{2}$ or 6; where passed through it was only 2 feet wide, but on being followed 4 feet to the South it opened out to 4 feet in thickness. There was not much clean galena in it at this point, but most of the ore would be worth concentrating; the gangue is siderite, dolomite, and calcite. Some doubt has been expressed as to whether this is really the lode seen at surface, but from its position, course, and underlay, I do not think there can be any question of their being identical.

When sinking the shaft in the limestone a heavy burst of water occurred, and mud and "slurry" with it; on pumping this out, a subsidence took place on the hillside above the engine-house, so that it is pretty clear that a fissure in the limestone must have been cut into. The black soft stuff passed through in the shaft may be really portion of the limestone from which the calcareous matter has been dissolved out; it is not uncommon for this rock to be so altered in places where water is able to circulate through it.

When I visited the mine the men were just beginning to drive on the lode at the bottom level, and very little could therefore be seen. The lode seems a strong one, and at the outcrop appears to contain a good deal of galena, so its further development will be worth watching.

The surface stuff is rather poor in silver, a bulk assay across the lode being said to have yielded 26 ounces of silver per ton, and 36 per cent. lead; the first assays from the lode in the bottom level were also poor, from 12 to 23ozs. silver per ton and 65 per cent. lead, but I have since heard that galena very much richer in silver was obtained later on. If so, the fact is interesting in connection with the theory mentioned above in my remarks on the New Pyramid mine as to the galena being poor in silver when in limestone country; if both poor and rich galena are got in the limestone at the Mariposa it is pretty evident that the silver contained in the lead ore does not depend alone on the sort of rock enclosing the lodes.

About 215 tons are estimated to have been raised from the winze and surface excavation on the Mariposa lode, mostly good fluxing ore, but not good enough to send away at present. The tramway or railway from Argenton to Dundas has been partly finished as far as this mine, and when completed would furnish it with an outlet, but as yet access is very difficult for horses and carts on account of the swampy nature of the country to be passed over, and no ore could be sent out just now if it had been raised, except at very heavy expense.

Alameda (1410-87M. and 2243-87M.)—On the Mariposa lode about 80 tons of ore have been mined and stacked from an excavation on the outcrop close to the south boundary of 1410-87M. Some 4 chains further North an adit was driven westward into a high hill in the hope of cutting the lode again, but was not successful in doing so. A large loose block of ironstone was met with just at the mouth of this adit, and I think that it is very likely that if a small shaft were sunk here the lode would be found close beneath.

Martini (Section 3325-87M.)—Starting near the N.E. corner of section 2415-87M. an adit was driven by this Company southward along the Mariposa boundary, and cut the lode, but found it very much oxidised. Some 20 or 30 tons of gossan ore were stacked at the mouth of this tunnel, but I did not learn what was its assay value.

The Mariposa lode seems a very promising one, and should have a good working trial. It is unfortunate, however, that it should happen to lie in such a way that neither the Mariposa nor the Martini Companies have any great length of it in their sections, and an amalgamation of interests would probably be for the benefit of all concerned.

M'Kimmie's Section (996-91M).—This lies considerably to the south of the Dundas District proper, being 4 miles S.E. from Eden Station on the Zeehan to Strahan Railway and 8 miles N.N.E. from Strahan. The country in this vicinity is much broken by deep ravines in which run various branches of the Henty River. Very little work has yet been done to lay bare the lodes which have been discovered, and though sufficient is seen to show that the ground deserves opening up and to give reason for hoping that it will be payable, it is still too little developed to allow more than this to be said in its favour. The country seems to be mostly sandstone in this vicinity, though I saw some impure limestone about quarter of a mile west of where the lodes are found. At the centre of the section a lode 8 or 10 feet wide is seen crossing what is now called "Lode Creek"; it is here that most work has been done. The course of the lode is about N. and S., and it underlays westward about 1 in 4; on the North side of the creek the excavation that has been made shows it to have become narrower, and to contain much lode slate. The galena is mainly confined to a streak from 8 inches to 2 feet wide on the western wall, but there are also veins and strings of it distributed through the rest of the lode matter. It is often very pure, but is very poor in silver. About 12 feet down the creek from this another lode, or more probably part of the same one, is seen crossing on a course about N. 17° W., and standing vertical; it is about 2½ feet wide, and consists mainly of quartz heavily charged with galena, and also containing a good deal of iron and copper pyrites and blende. It would be fair concentrating ore. About 4 chains further down the creek, that is to the south-west, some lodestuff has been cut, but is not exposed enough to say anything more about it, and another 3 or 4 chains lower we find another large lode mass in the creek. The nature of this is not at all clear at present; it seems to be the junction of two lodes, one running N. 5° E. and underlaying 1 in 2 to the west, and the other running N. 60° E., and also underlaying westerly about 1 in 2. The first one shows about 18 inches on the hanging wall of galena and quartz, passing into quartzose lode-slate or altered country rock on the footwall side; the width of the entire formation is not evident, and some cutting should be done to prove it. This lode appears to go right across the north-easterly one, reminding us of the fact that in the Adelaide, Mount Dundas, and Maestrie's mines northeasterly lodes appear to be similarly cut through by later ones. The northeasterly lode is about 6 feet wide, and shows from 6 to 8 inches of galena and quartz along the footwall. The lodestuff is largely of a brecciated character, composed of fragments of country rock cemented together by quartz, and galena, blende, and pyrites are scattered more or less through the whole of it.

In all these lodes it is noticeable that the gangue is principally quartz, the carbonate of iron so plentiful in most of the Zeehan and Dundas lodes being absent or only in small quantity. There are at least two large and strong lode bodies, which would supply a good deal of concentrating ore, and the discovery is well worth following up. Should more silver be found there would be every probability of a good mine resulting, but at the present low value in silver it would be difficult to make galena pay. A concentrating mill on the property, or some little distance lower down the creek could, I think, be driven by water-power, but, of course, one visit is not sufficient to allow of a reliable judgment to be formed as to the quantity of water that would be available in the stream at the least favourable season of the year, and this matter would require further investigation before an opinion could be definitely expressed upon it.

Madam Melba, No. 1, (Section 2595 87M).—Work had been suspended for some time when I visited this mine, and I understand the Company had transferred their operations to a mine in Victoria. I was not able to pay more than a very short visit to the property, but from what I could see and learn it appears to me that it has been abandoned prematurely and without sufficient trial. The lode traverses serpentine country, and is distinct and strong, but the owners seem to have lost heart on finding that the known shoot of ore is apparently a short one, and that the galena is rather poor in silver. Some 10 or 12 feet below where the lode crops out in the creek, as described in my former report, a small tunnel has been driven, and the lode proved to be 4 feet wide; the outcrop has also been traced some distance on surface by trenching, but soon becomes gossany, though at times showing oxides of lead and antimony in the oxide of iron. The stuff won from the outcrop and the small surface tunnel mostly requires dressing, especially as there is a good deal of blende in it which cannot otherwise be removed.

I was not able to get into the drive on the lode from the small tunnel as an underhand stope had been taken out and was filled with water. I was informed that after driving 72 feet northerly along it, the lode pinched out, and 8 feet to the South of the tunnel it contained only a few strings of ore. About 240 feet North of this adit, a shaft was sunk 70 feet on the lode, which was very poor, and then the flow of water became so great as to stop the work. A lower adit, about 80 feet below the first, and 267 feet below the top of the shaft was then driven straight towards the latter, and cut the lode at a distance a little over 400 feet in. The lode being poor at this point the mine was abandoned. After doing so much work to get to the vein it was surely worth while driving on it some distance before giving up; the shaft had already proved that there was a poor place in the lode at this part. Now that the tunnel is in, it is probable that sooner or later the lode will be followed along its course and till a good deal of work has been done in this direction there is no need to despair of success.

Section ?—On the right hand side of the track from the North Dundas road to the Grey Ore mine near the top of the watershed between the Henty and Ring Rivers, I noticed some workings which I have not been able to locate exactly. The men had gone away for the day, and I have not been able to find in what section they were working. They had exposed a small galena lode running about N. W. and S. E., consisting of from 2 to 6 inches of pretty pure galena, and had cut an approach for a tunnel on the course of the vein. This is mentioned as showing the likelihood of there being on the Dundas as on the Zeehan field, numerous small veins of galena worth the attention of working miners, though not perhaps of sufficient importance for mining on a large scale, or to be worth spending much money on.

Grey Ore.—(3259-87M and 3260-87M.)—No one was at work here either when I visited the ground. A large flume has been built to carry water to a waterwheel which was to drive machinery in a main shaft. A start had been made to sink the pit for the wheel and to prepare for sinking the shaft, the site being at the junction of the Ring River with the Falls Creek (so called on account of a waterfall on it which is visible from considerable distances). On looking about for signs of mining operations, the only things I could see were one or two small shafts sunk in a bed of breccia, containing occasional specks of pyrites. This breccia is a country rock, one of the beds of the sedimentary series, interstratified with the sandstones and slates, and no more likely to carry payable quantities of minerals than the latter. I could not see anything whatever to induce the owners to go to the expense of making the flume and to think of opening a mine. If I am correctly informed, some little gold was found in the breccia where it crops out in the King River, and this was supposed to indicate that the formation was similar to that of the South African "bankets" or conglomerate beds which carry gold, but it seems much more likely that the gold had simply got into the crevices of the superficial portions of the rock from the sands of the river, which are more or less auriferous all along its course up to the Ring River goldfields.

Fahl Ore.—(3212-87M).—In this section a lode has been found crossing the bed of the Ring River several times, its course being slightly west of north, and its underlay about 1 in 10 to the westward. A small prospecting shaft had been sunk at the time of my visit, close to the river, and another larger one was being sunk a little further away from the water's edge. In the prospecting shaft the lode was seen for 2½ feet in thickness, but might be really wider, the lode matter consisting mainly of lode slate, with iron and copper pyrites, arsenical pyrites, and fahl ore in bands and strings through it: a little green carbonate of copper was also sometimes visible. Some very nice solid lumps of fahl ore are obtained, but the bulk of the stuff requires concentration before it would be a marketable product. The ore is often very rich in silver, assays of from 200 to 500 ounces per ton having been obtained. Owing to the proximity of the river it was found that it was impossible to do much sinking without the help of machinery for drainage, and as the claim is in rather an inaccessible place, this was difficult to get on the ground. A flume and race 28 chains long were therefore constructed by which water was brought in from the Ring River, and a 4 feet Pelton wheel was procured. There is 47 feet in vertical height between the wheel and the race, and with the power so gained a small winding plant is worked by which baling and winding are very efficiently performed. The plant is very simple and cheap, and is a very creditable solution of the difficult problem of how to open a wet mine in a place where steam machinery cannot be procured. By going higher up the river for water and making a longer and more expensive race, water power could be obtained sufficient to work a good-sized pump, and open up the mine pretty thoroughly, but it is hoped that the present power will be able to conquer the water sufficiently to enable a good deal of prospecting work to be done.

About 5 chains south of the workings the lode again crosses the Ring River, and passes through into the Rich P.A. section, 1400-91M. A small cutting in the bank of the river shows the lode to be 4½ feet wide, but poor, consisting mostly of lode slate and pyrites. North of the shaft about 6 chains, it once more crosses the serpentine course of the river, and is seen to be from 3 to 4 feet wide, but very poor. It would seem, therefore, that there is a shoot of ore close to the main workings, and it would be advisable to develop this first, and then drive on the course of the lode in search of other shoots. Going north along the lode the ground rises, and a tunnel could be put in on its course, which would have as much as from 500 to 700 feet of backs, according to Mr. Webb, the manager of the mine.

The country rock is mostly hard metamorphic sandstone and slate. The lode is a true fissure lode, and worth prospecting, but I am afraid a good deal of expense will have to be incurred in fluming the river at the places where it crosses the vein so as to keep it out of the mine. The company deserve much credit for the effort they have made in spite of the bad times to work their lode, and it is to be hoped that they will be rewarded by success.

Success and Owen Meredith Mines —(Sections 2922-87M and 2523-87M.)—The lode passing through these sections was originally discovered in the bed of a creek which runs into the Pieman River, and showed itself as three veins of mineral-bearing matter, lying about parallel to each other, and separated by bands of country slate. Galena rich in silver was found in the veins, and the lode looked uncommonly well. The work done later has proved that the three veins soon come together, going both north and south, and that the creek has happened to cut the lode in the very midst of an ore shoot, so that the portion exposed showed it at its best. A large amount of work has been done on the property with rather disappointing results, though there is no reason yet to despair of ultimate success. The lode runs on the whole about N. 27° W., but varies a good deal, and the underlay is about 1 in 1 to the eastward. From the creek a drive has been put in along the lode 470 feet to the southward, but in all this distance it has been rather poor, though there is encouragement in the fact that some shoots of nice ore were passed through, and that these appeared to be getting better going downwards. Above the tunnel level the lode soon becomes oxidised and barren, so it is quite possible that the drive is just a little too high to strike the ore. The walls of the lode are very distinct, and often slickensided and striated, and the lode matter is quartz, galena, siderite, iron and copper pyrites, and occasional stibnite and arsenical pyrites: native silver is not uncommon in the galena. In the north section the lode follows the course of the creek for about 3 chains, and is close alongside of it for some distance further, and two tunnels have been driven across it. In the more southerly of these, which is quite a short crosscut, the lode matter was struck right at the entrance: it consisted of 6 to 8 inches of siliceous galena on the hanging wall, resting on a smooth polished and striated false wall. Under this there was about 6 inches of poorer ore, and then about 2 to 4 feet of broken country, with carbonate of iron and a little ore. The rich vein on the hanging wall dips right under the creek. The false wall on which it rests is strongly slickensided, being very smooth, almost polished in parts, and distinctly striated: the striae are not vertical, but dip southward about 60°. The ore at this point appears to be a different shoot from that on the boundary between the two sections where the lode crosses the creek. The second tunnel is some chains further down the creek, and consists of a short crosscut to the lode, and a drive north along its course some considerable distance, over 100 feet. A lode from 2 to 6 feet wide was followed, but was poor: the distinct hanging wall rib is, however, still visible, though not rich. Throughout these tunnel workings, which have now proved the lode to extend a distance of something like 900 feet, it is a strong fissure, and has every appearance of permanency in depth. The striated walls indicate a certain amount of faulting of the country by it, but I could see nothing that would indicate the amount of displacement.

The tunnels having been unsuccessful in laying bare good ore in any quantity an attempt was made to sink on the lode at the mouth of the southern (Success) tunnel. The water soon proved too heavy for baling by hand, and machinery had to be obtained. As there is nothing but a very bad pack track to the mine it was impossible to get a heavy engine, but after much trouble a small steam pump and boiler were got on to the ground and enabled sinking to be continued. The shaft was sunk 38 feet vertical, at which depth it struck the lode, and was then continued on the underlay for 70 feet, the inclined portion making an angle of about 45 degrees with the horizon. The shoot of ore was followed down in this shaft and was found to pitch somewhat to the southward, but proved to be very short. At the bottom level it seems to have died right out, and been replaced by lode slate. At the 38 feet level a short drive has been made on the lode, but it is poor: on the hanging wall there is about eighteen inches of quartzose ore and then from 2 to 3 feet of broken country and carbonate of iron. In this shoot as in the one further north the hanging wall rib of the lode appears to carry the most of the ore. A little fahlore was found with the galena in these workings in addition to the minerals above mentioned. At the time of my visit the small pump could do no more than keep down the water that was finding its way into the workings, and it was pretty clear that these could not be extended far without a more powerful plant. It is now necessary to drive on the lode to get under the shoot known to exist to the north, and in the south end to see what becomes of the shoots seen in the Success tunnel, and it is a question whether it can be done with the present machinery. The only hope of doing so seems to me to lie in fluming the creek from above the crossing of the lode right down clear of it, and so shutting off one of the sources of the flow of water. As this will have to be done in any case whether more powerful plant is obtained or not, and can be done under present circumstances, I think it would be advisable to try it, and if successful, to go on driving on the lode from the shaft. By the time this is done there may be better means of getting heavy machinery on to the ground. It is quite plain that the best thing to be done, if it were posssible, would be to sink a main shaft and put a good engine upon it, but before this can be effected there must be means of getting the engine on to the property. A tramway will probably have to be made, and its course and location will depend mainly on whether the Zeehan-to-Waratah Railway is gone on with or not.

In spite of the poor success that has hitherto attended the operations of this mine and the difficulties of opening it up, I still think that it well warrants a trial at a depth. The prospects of the property are much improved when we consider that the Success Extended mine has also got good ore on what is probably the same lode.

I do not know exactly how much ore has been sold from this mine but believe that it is over 50 tons: it is very rich stuff, as it would require to be to pay for packing out on horseback. There is a good deal of second-class ore on hand that requires concentrating, and from its nature I think it is probable that good slime-saving appliances will require to be provided.

Success Extended (2912-87M).—This property was in the hands of tributors at the time of my visit. They were working the outcrop of the lode as deep as they could get for water, some 20 feet or so at the most. The lode runs N. 20 degrees to 30 degrees W., and dips easterly 1 in 1, corresponding in these

respects to the Success and Owen Meredith lode. Is is also like the latter in the nature of the ore contained in it, and has the same peculiarity of carrying the best ore in a separate rib on the hanging wall often separated from the poorer portion by a slickensided wall. The good ore is from two inches to two feet in thickness, and the whole lode from two feet to 8 feet. It has been worked at intervals for 7 or 8 chains from the south boundary of the section and has been more or less ore-bearing all the way. Machinery for drainage is urgently required as the shape of the country does not seem to permit of drainage by adits.

The tributors have sent out about 30 tons of galena realising about £8 a ton after paying all expenses but packing, which is done by themselves. A good deal of concentrating ore is lying about the workings, but at present nothing can be done with it. The ore both in this and the last-described mine is very free from blende, though this does at times occur in it.

Bon Accord (2843-87M., 2844-87M).—The lode worked in the Success Extended mine runs across its south boundary into the north-east angle of section 2843-87M., and has been worked for from 2½ to 3 chains in length by shallow shafts and trenches on the outcrop. The lode was from 2 to 4 feet wide and the galena vein up to 10 inches. Some native silver was found in the galena as in the Owen Meredith. Machinery for drainage is here again required. No one was at work on this property, and I have not been able to find out if any ore was sold from it.

Commonwealth (1619-91M. and 2959-87M).—On this property there is a huge outcrop of gossan, and two tunnels have been driven to find out what is in the lode below this. The upper one is 50 feet below the outcrop and has been driven 187 feet. In the mouth of it gossany lode stuff, dipping easterly very flat, was passed through for 25 feet, after which soft slate and sandstone country to 132 feet; then a body of gossan was cut into. The wall of this dips westerly 45 degrees, or even flatter. This lode was penetrated for 55 feet but was not cut right through, and its thickness is unknown. It was mostly oxidised matter, but some soft clay in it was found to carry iron pyrites, and a piece of carbonate of iron carrying iron pyrites was also obtained in the floor of the drive. The gossan is of a rather favorable appearance, full of vughs, and containing a good deal of manganese.

The lower tunnel is being driven from a creek 200 feet below the outcrop, and may be expected to reach the big lode at 650 feet if its underlay is 1 in 1 to the westward as supposed from the upper tunnel. It was in 407 feet at the time I saw it, through hard metamorphic sandstone and slate all the way. About 75 feet from the mouth of the tunnel a lode of quartz and oxide of iron 9 feet wide was passed through, running about N. 10 degrees W., and standing pretty vertical. About 210 feet from the mouth a soft flat-lying lode of iron oxide, running N. 55 degrees W. and dipping S.E. about 45 degrees, was passed through, corresponding very well with the estimated position of the first gossan lode struck in the upper tunnel. (The mouth of the No. I tunnel is about 370 feet west of that of the lower one, and 150 feet higher than it). In the face of the drive veins of quartz containing copper and iron pyrites, blende, and pyrrhotite were being passed through the day I saw it. This has been an expensive tunnel, the ground being very hard, and it is to be hoped that the lode will be valuable when reached, as a recompense to the company.

The two oppositely dipping lodes of gossan seen in the upper tunnel would come together on the top of the hill where the big gossan capping is, and this is probably therefore much wider than the main lode will prove to be below. What the nature of this will be when reached it is hard to say, though the carbonate of iron found in the upper tunnel renders it likely that it will be largely made up of this mineral, if found in an unoxidised condition. Near the centre of the south section however on much the line of the big lode an outcrop of lode matter has been found in the bed of the creek, consisting of quartz, iron pyrites, and pyrrhotite, and it is possible that this may be the main lode, and these minerals constitute its filling. This outcrop in the creek had not been cut into, and it was impossible to determine its course; it was extremely hard and siliceous however, and would not alter to a loose ferruginous gossan, such as is found on the main lode, so I rather doubt their identity.

I have learned from Mr. Harrison, Inspector of Mines, that since my visit two lodes have been found in the south part of section 2959-87M., containing tin ore, and running slightly west of north, a course that would take them under the big gossan outcrop. I shall have more to say about the tin ore found on this property later on, but at present only mention the existence of these lodes, and point out the possibility that the gossan covers a lode of tin instead of one of silver. If this is the case tin ore is probably to be found in the ironstone capping, as in the Brown Face at Mount Bischoff, and thorough search should be made for it. The veins of quartz and pyrites in the main tunnel, and the pyrites lode in the creek rather point to a tin lode than to a silver one, but on the other hand the gossan is not a highly siliceous one to all appearance, but closely resembles the other gossans found further south over the silver lodes.

Other Sections.—A good deal of work has been done on many other properties on the Dundas field besides those mentioned, but most of these had discontinued operations at the time of my visit, and as far as I could learn there were no important developments on any of them. With a revival of faith in the district it is probable that many more will be worked and valuable discoveries made. One other silver mine visited will be described later on when speaking of the Ring River and Mount Reid Goldfield, viz., the Mount Reid S.M. Company's property.

Ring River and Mount Reid Goldfield.

All the way from the Pieman River upwards a little gold is said to occur in the Ring River, though only in the upper portions has it been worth working. A dish of stuff from a crevice in the bedrock of the river on the Star of Dundas section, 2568-87M., which I saw washed, gave a good deal of pyromorphite from a lead vein in the crevice, several grains of tin ore, and a good many specks of gold. The stream has been worked from above the Grey Ore section (3259-87M.) up to its junction with a creek known as Scott's Creek, which comes down from Mount Reid; above this point it is said to be poor.

The principal workings are on the Conliffe S.M. Coy.'s section, 3026-87M. The river has yielded a good deal of gold; how much it would be hard to estimate as a good deal has been taken to the mint by the finders without being recorded; and the field has been of the greatest service in giving employment to numbers of men who were unable to find work through the depression at Zeehan. The bed of the stream is shallow and rocky, and was soon pretty well worked out, and work is now principally confined to occasional gravel-banks along the sides of the creek and to some larger deposits which appear to belong to an older river system, constituting what is now known as the "Ring River Deep Lead." This appears to have run from Mount Reid northward towards the Pieman River, across the course of the present Ring River, and the bulk of the gold in the latter has probably been derived from the re-washing of the older gravels. The upper part of the lead is seen in what is called the Alluvial Terrace claim, which lies on a ridge separating two creeks known as Baker's and Booker's respectively, both of which contain some gold. The ridge is a steep one, but right on the top of it is a gravel deposit 10 to 20 feet in depth, consisting of heavy wash of slate, quartz conglomerate, schist, etc., cemented and rusty, and covered with more or less gravelly clay. The workings show the gravel to be deepest in the centre of the ridge, so it appears that the present ridge is right over the gutter of the old stream that laid down the gravel. Gold is got along this spur for about 12 chains, and the ground has been rich enough to give good returns to the owners. If they had a copious water supply they would no doubt do very well out of it, but having but little water, have to break down the gravel by manual labour. Lower down, the lead is cut through by one of the above-mentioned creeks, and is next seen on the other side of its valley in Anderson's claim, at a considerably lower elevation. Here the lead runs northerly, in almost the opposite direction to Scott's Creek, and the bottom of the gutter dips so much that it becomes difficult to follow for water. In the north end of the workings the wash is overlaid by a deposit of clay, which is seen in much greater quantity in the Deep Lead Company's ground, still further north. Anderson's claim is said to have been a very payable one. In the next three claims following the lead the surface of the ground rises while the gutter falls, and shafts up to 50 feet in depth have had to be put down. The unwatering of these has proved difficult with the appliances available. The goldfield is in a very inaccessible place and can only be reached by pack mules with great difficulty, and almost everything has to be carried from the "Pimple," on the top of the Dundas and Reid Range, down on men's backs, a fall of over 1500 feet. It would be a very great help to the miners if the Grey Ore track were extended up the Ring River as far as the claims. The means of access being so bad, the only drainage appliances available are such as can be built on the spot and worked by water power, and unfortunately there is difficulty in getting enough water for this. Several claims have had water-wheels constructed to assist them in pumping out the water from the workings, but at the time I saw them there was no power to work them with. The most elaborate plant that has been erected is that of the Deep Lead Company, who have sunk a shaft 100 feet deep and built a 20 feet water-wheel to work their pump. This claim is the furthest to the north of any working on the lead, and has the deepest shaft. The position of the gutter is not yet accurately known, however, and a good deal of work may have to be done before it is found. The last 5 feet of the shaft are said to be in slate bottom rock, the pitch of the bottom being to the north. The top of the shaft is in the fine clay deposit which is seen covering the wash in the claims further south, but is here seen to the best advantage. It is a fine sandy clay, disposed in thin perfectly horizontal layers, and has clearly been laid down in very still water. It is evident, therefore, that the valley of the stream which laid down the heavy wash found in the gutter of the lead must have in some way become converted into a lake, which became gradually filled up with fine mud. This clay formation is seen for some distance further to the north, and appears to be going towards a saddle which divides the valley of the Ring River from that of another branch of the Pieman River. As it is without doubt an indication of the course of the old valley, in the bottom of which lies the lead, it should be carefully traced out, for it is probable that the lead will again be found emerging from under it. It is not likely to run lower than the bed of the Pieman River, as this seems to be rocky all down its course, and consequently should be found somewhere on the slopes of its valley. The limits of the clay deposit being ascertained, it would be best to bore to find the position of the gutter before sinking for it. In the soft clay boring should be very easily and cheaply done with ordinary boring rods. It would be very important to find the outlet of the lead from under the clay, as it would then very likely be possible to work up it instead of down, and so get natural drainage. The opening of an outlet would also do much to minimise the water difficulty in the higher claims. The amount of gold found in the upper parts of the lead quite warrants us in expecting that the deeper portion will also be payable.

The cause of the lead becoming buried under the clay deposit is not demonstrated, but I think the following explanation of it will agree with the evidence yet obtained. In the country behind Mount Reid there is ample proof of the existence of large glaciers at a comparatively recent period, and the erratic blocks of granite found rather plentifully down the Pieman River Valley point to it also having been largely scooped out by ice action. It is probable that the Pieman Valley was partly eroded before the ice period, and that the river of the Deep Lead ran into it, the configuration of the surface of the country being then considerably different from what it now presents. When the ice came down let us suppose it dammed the Deep Lead and converted its valley into a lake. Mount Reid would probably at this time be covered with sheets of ice, and from under these would rush streams of water, bearing with them the *debris* produced by the grinding action of the glaciers upon the underlying rock. The sand and mud so carried would soon fill up the lake and produce layers of sediment such as we now find. I may say that this explanation was suggested to me not only by the evidences of glacial action to the east of Mount Reid, but also by the strong likeness of the clay layers themselves to some in South Canterbury (New Zealand) lakes, which are now being laid down by streams issuing from under the glaciers of the Southern Alps. It is highly probable if this is the correct explanation of the formation of the Deep Lead, that after the filling of the lake the glaciers themselves descended still lower, and did much of the work of cutting out the present river valleys and so changing the shape of the country that when the ice again retired the drainage of the district was altered from what it had previously been.

The gold in the Ring River field is alloyed with a good deal of silver, and therefore brings a somewhat low price per ounce. There can be little doubt that it has been derived from the lodes on the

Mount Reid range, which yield gold of about the same quality. In this connection I may mention that a large boulder of heavy spar, impregnated with galena, blende, iron and copper pyrites, and a little gold, was found among the wash in the Alluvial Terrace Claim, pointing to the source of the gold being a deposit containing these minerals. Heavy spar (baryte) is one of the most notable minerals in the Mount Lyell mine, and its occurrence here strengthens a belief which I entertain that the Mount Reid lodes are of similar origin to the large deposit of pyrites at Mount Lyell.

On Mount Reid several discoveries of gold have been made, but the only one I visited was that on the Mount Reid Silver Mining Company's section, 3302—87M., which is close to the top of the range. Here a space of about 4 acres has been stripped of surface soil down to the bed-rock, an average depth of 12 to 18 inches, and sluiced, and a good deal of gold has been obtained. The stripping has laid bare an outcrop of a mineral deposit capped by gossan, this gossan being the lode relied on by the Mount Reid S.M. Co. in taking up the section. It contains free gold in parts, and has been worked for this metal by Messrs. Johnstone and Goldie, who have two men's ground, under Miners' Rights, on the outcrop. They had erected a small 2-stamp battery of very light stampers worked by a small water-wheel, and showed me a small cake of 4 ounces of retorted gold, which had been got from a crushing of 26cwts of gossan. The gold from their claim contains from 63 to 65 per cent. of gold, and the remainder is silver, coming thus under the mineralogical variety "electrum." Several trenches and surface holes had been cut in the gossan, and from them I saw some fair prospects of gold washed; some of the gossan also contains carbonate of lead. In some of the trenches pyrites underlying the ironstone was exposed at a very shallow depth, and I have no doubt that the oxidation does not go very deep anywhere. The sulphide ore exposed consisted of pyrites of iron and copper, blende, and a little galena, and some of it appeared almost solid blende. The strike of the deposit is from N. 20° W. to N. 40° W., and it appears to have an underlay of about 1 in 4 to the Eastward at one place, but this may be only local. The country rock is a soft greenish schist, and a rather hard somewhat schistose sandstone. The width of the mineral matter is from 25 feet in Johnstone and Goldie's claim to 70 feet in the workings further south of the Mount Reid S.M. Company, but in the latter it appears to be much split up by bands of country rock. These also appear, but to a less extent, in the first-mentioned portion. The Mount Reid Company were doing some trenching across the line of the deposit at the time of my visit, the work revealing more galena here than before. The veins or layers of sulphides are disposed quite parallel with the lamination of the country rock and themselves partake of it, and it is pretty clear that this is not a lode in the ordinary sense of the word, but either a bedded deposit or one in which the sulphides have been substituted, particle by particle, for the constituents of the original country rock, by "metasomatic" change as it is sometimes called. Common examples of this last feature are seen in the alteration of wood to pyrites and in silicified wood. It is not yet time to definitely decide to which of these classes this deposit should be referred, as it should be much more laid open before a reliable judgment can be formed, but at present I rather favor the theory that it is a bedded deposit, that is, that the sulphides have been laid down as chemical precipitates, or accretions from solutions, at the same period that the enclosing country rock was being deposited as mechanically derived sediments. It is known that at the present day beds of pyrites with copper pyrites and other sulphides in admixture, are forming in certain lagoons and lakes where solutions of sulphates of the metals come in contact with decomposing organic matter, and the great pyrites deposits of the world are very generally held to be so formed also. In cases where large and pure bodies of pyrites are so laid down it is probable that the deposition of the mineral took place in deep water far from the shore, where no quantity of sediment was deposited simultaneously with the sulphides, but nearer the shore the latter would necessarily be much mixed with mud and sand. I take it that it is likely that the Mount Lyell deposit is one which has had its origin in deep clear water, and the Mount Reid one in a place where from time to time layers of mud and sand were dropped on top of the sulphides.

For all mining purposes the deposit may be considered a lode, being a tabular deposit of mineral matter, different from the enclosing wall rock, dipping into the ground at a high angle, but the question of its exact classification as an ore-body is by no means without practical importance. Lodes are liable to vary very much in their value in different parts: deposits formed by metasomatic change are from their very nature apt to be irregular in shape and behaviour, depending as they do on rather obscure chemical re-actions: but bedded deposits are among the most permanent and even in value of any. If the Mount Reid "lode" belongs to this class we may expect to find the ore in lenses throughout the mineralised belt or layer of country, as well as disseminated through portions of the latter, and there is good hope that masses of considerable size and purity will be obtained. What will be the most prevalent ore it is rather hard to say, but it is likely that cupreous iron pyrites will be in much greater quantity than galena or blende. It seems, in my opinion, very probable that this is one of a number of bedded ore-bodies of somewhat similar composition extending from Mount Lyell to the Pieman River, and even further north, on a line running about N.N.W. As this is the general strike of the strata of the country, it is probable that the beds of rock along it were laid down about the same time and under much the same circumstances. We have on this line or close to it, the Mount Lyell deposit of cupreous iron pyrites containing gold and silver, with galena and blende in subordinate quantity, the Lake Dora copper and iron pyrites "lodes," also containing gold and silver, the Mount Reid "lode" with iron and copper pyrites, blende and galena, and gold and silver; and further north, still on about the same line, I believe that another deposit of auriferous copper pyrites has been found near the Pieman River.

The further development of this line of country and of the Mount Reid mine in particular will be of great interest. At the latter place the mine should be opened out with all expedition, but the owners should be prepared to lay out a good deal of money in underground prospecting before they put up machinery for reducing the ore, or expect dividends. The first thing to do is to prove the existence of large quantities of payable ore. While the prospects are decidedly promising, it would be foolish to venture an opinion in the present state of the mine that it would prove payable, and all I can say in its favor just now is that it is well worth trying. It is impossible yet to say whether gold, silver, or copper is likely to be the most important constituent of it from a commercial point of view.

North Dundas Tin-field.—In June 1890, when prospectors were ranging all over the Dundas field, Mr. Ringrose Nicholson discovered tin ore on the Ring River, and took up a section, No. 2568-87M, for alluvial tin, which has since been transferred to the Star of Dundas S.M. Company. No attempt was made to mine for tin ore and the discovery became almost forgotten, until hard times at Zeehan drove numbers of men to the bush to try to make a living by digging. One party prospected the vicinity of Nicholson's discovery, and finding the ground payable kept quiet about it for some months, till several of the sections were forfeited, when they took them up and began to work them. It has now been found that alluvial tin is to be obtained over a very considerable area, and tin-bearing lodes are also being discovered. In February last I made a short visit to the sections and saw the principal discoveries then made, but was not able to give the time required for a thorough examination of the whole locality. There is evidently a considerable mass of granite somewhere in the neighborhood, for stones of it are found in the alluvial wash, but I did not see it *in situ*. I was informed, however, that the high hill on the south of section 1680-91M (formerly 2880-87M) on the watershed between the Ring and Argent Rivers, was all granite. On the track from the North Dundas road to the Commonwealth mine, I noticed a dyke of quartz-porphyry cropping out, and a similar one crosses the Grey Ore track four miles from the North Dundas road. In section 1742-91M (formerly 2907-87M) there is a great deal of a granitic rock, composed mainly of quartz and schorl, and though I did not see this in the solid, I think it must form a very considerable amount of the bed rock in this vicinity. In some respects it is like lode-stuff, and I am not yet clear as to its nature, pending investigation *in situ*, but I expect that it will prove to be a variety of quartz-porphyry, in which there is an unusual amount of tourmaline in needles. Stones of this rock are very common in the wash, and it probably is very closely connected with the source of the tin ore, if it is not itself the rock which sheds it. The occurrence of granite and quartz porphyry dykes bursting through slates and sandstones is quite similar to what is seen at Mount Bischoff, where the great tin deposit seems certainly to owe its origin primarily to the granitic intrusion. It is noticeable that there is a further strong similarity between the ore at North Dundas and at Mount Bischoff, the nuggets of ore in both places being generally composed of aggregated bundles of fine crystals, and therefore presenting a rough hackly crystalline fracture when broken. Some of the larger nuggets that have been got at North Dundas (one of 25lbs. weight has been obtained) are quite indistinguishable in appearance from those that have been so often found in the alluvial portions of the Bischoff deposit. The slates and sandstones round Mount Bischoff are quite like those at North Dundas, and are probably of the same age, and again resemble them in being silver-bearing, as shown by the Silver Cliff mine. In the slate rock at Bischoff, in the North Valley lode, the tin ore is associated with much iron and arsenical pyrites and pyrrhotite; and as mentioned above these same minerals are found in the veins passed through in the Commonwealth tunnel, together with fluorspar, a most constant associate of cassiterite. Mr. Harrison, Inspector of Mines, has lately sent me some specimens from the tin-bearing lodes that have been discovered since I visited the locality, and in these I find rich tin ore with much iron pyrites and some fluorspar: in some other specimens obtained by myself there was tin ore and arsenical pyrites, but the lode had not then been found from which the loose specimens were derived. Mr. Harrison reports that two lodes have been found, one near the south boundary of section 2959-87M, west of Bennett and party's dam (217-91W), and the other at the north-east corner of section 1641-91M. The first "is a large pyrites formation, running so far as one can judge from the little that has been done on it, about 10 degrees W. of N., with easterly underlay: it carries a gossan capping which shows very good tin in places. Mr. Gatenby has cut across the lode from the hanging wall side about 15 feet without striking footwall." As to the second lode Mr. Harrison says, "it seems to run parallel" (to the first) "but there has been hardly anything done on it; there is some splendid stone on footwall in which fine tin can be plainly seen. A quantity of fluorspar is mixed with it." The position and strike of these lodes render it very likely that they are connected with the big gossan lode of the Commonwealth mine. The similarity of the whole occurrence to that at Mount Bischoff should give encouragement to have it very thoroughly prospected. It may be as well here, however, to remind investors that the presence of pyrites in the lodes is a great drawback, as the ore has to be roasted before the clean black tin can be extracted from it. It would therefore be a very important discovery if tin were to be found in payable quantity in one of the large gossan masses, as then roasting would not be necessary.

Most of the alluvial tin so far discovered has been along the course of the creek which runs through the Commonwealth ground into the Ring River. This creek heads from the ridge where the granite is said to crop out, but it is also worth noting that nearly all the discoveries are to the east of the line of the above lodes and below the latter, and therefore there is a possibility that these have been the main sources of the tin. It is yet too soon, however, to build any theory on this fact, and very probably other sources of tin will also be found.

Towards the S.W. portion of section 1742-91M (K. O. Karlson) a great deal of the quartz tourmaline rock is lying on the slopes of the hill, and holes sunk here and there in this part of the ground all yielded more or less tin ore, enough to make me consider that the ground would pay a working party, provided they could get a pretty constant supply of water for washing the dirt. The tin was here mostly crystalline and angular, not waterworn. In section 1668-91M, lower down the same valley, Robb and party were at work, and had got a good deal of tin. They were washing up the bed of the little creek, on slate and sandstone bottom, but the wash contained a good deal of granite and the quartz tourmaline rock. Some heavy nuggets of tin were obtained, together with much finer stuff. The wash was quite shallow, but the ground ought to pay very well. Sixteen chains lower down the creek on section 1641-91M (formerly 2804-87M), Bennett and party were getting some very fair tin when I saw their claim, and had a considerable area to work. About the centre of section 2959-87M, on a small creek which runs into the one on which the above workings are, Hanlon and party were getting some fair ore from very shallow ground. The tin ore in this case was nearly all angular, and often had much quartz attached to it, and from the shape and appearance of many of the larger lumps, I should think that it has been derived from small veins close at hand. In this creek I saw no granite in the wash and no tourmaline rock, so that the tin veins must be in the slate itself. Tin is found all the way down the creek to its junction with the Ring River, and also in another small creek towards the north of Glock's section, 3051-87M. Here, too, the ground is shallow, but yields very good prospects, and will no doubt keep a good many

men at work for some considerable time. Getting down into the valley of the Ring River the wash becomes deeper, and there is difficulty in getting down to bed rock, but from the prospects higher up I have no doubt that there must be a good deal of tin in these portions also; and it may be found worth while to resort to hydraulic sluicing. The creek workings are greatly hampered by dense forest growth, which requires much manual labor for its removal.

On section 3051-87M, and the north part of 1639-91M, there is a pretty high spur between the tin-bearing creek and the Ring River, the top of it being over 200 feet above the latter. This is covered with waterworn gravel, and appears to be more or less entirely composed of alluvial material, and almost anywhere over it prospects of tin are obtainable, especially in the small watercourses where there has been a certain amount of natural sluicing of the stuff. This deposit is comparable with the Alluvial Terrace higher up the Ring River, and is like it probably a relic of an older river system. As there appears to be a large quantity of tin-bearing stuff here, it would be advisable to have it thoroughly prospected by shafts, and if rich enough, it would then be necessary to get a supply of water for hydraulic working. I do not know the country well enough to say whether this could be easily obtained at the required elevation or not, but think it should be possible to bring a race from some miles up the Ring River if the ground warranted the expense. The finding of this high terrace of gravel renders it likely that there will be other similar deposits in the district, and this should be borne in mind by prospectors. Tin is said to have been found still further north, almost to the Pieman River, but I did not go to see these discoveries.

It is evident that the lode and alluvial tin fields in this part of the Dundas district are of very considerable importance, and this winter, when water is plentiful and the track in from the North Dundas road has been completed, I expect that a good deal of tin will be sent out and quite a number of men find employment in raising it.

MOUNT HEEMSKIRK.

In 1875 tin was discovered at Mount Heemskirk by the late Mr. Charles Sprent, and in a short time a great rush took place to the field, and very high expectations were formed of it. Speculation was rife, but quite little true mining work was done, and before long the public lost all faith in the district, and it was all but totally abandoned. Many practical miners who prospected it have nevertheless maintained that valuable tin lodes do exist at Mount Heemskirk, and when times became bad at Zeehan a good many men went out again to it, and are once more bringing the field into notice. Several parties working alluvial ground are making a living, the difficulty in getting food and stores experienced in the old days having greatly disappeared with the better roads and other means of access now provided, but on the whole the alluvial ground is rather shallow and poor, and it is to the lodes that attention must be mainly directed. I am informed, however, that there are deep alluvials gravels in the north part of the Heemskirk field. I have only once visited the mines, and then only for a few hours, riding out from Zeehan and returning the same day, so what is now said is only what could be gathered from a mere flying traverse of the ground. The mines seen were the West Cumberland and New Cumberland lying on the ridge separating the head of Packer's Creek from that of the Cumberland Creek. A good deal of work has been done on both these properties, though, as is unfortunately too often the case, the erection of a battery and construction of a tramway to it have in each instance been gone on with before enough mining work had been performed to ensure regular supplies of ore for crushing. The West Cumberland mine has fallen into the hands of Messrs Fowler and Dunn, who now hold sections 1326-91M., 1327-91M., 1492-91M., and 1325-91M. The battery erected by the old company had fallen into great disrepair, but has been patched up by the present owners and has enabled them to concentrate some of the stuff previously mined: it now consists of 10 heads of stampers and three round buddles, driven by a water-wheel. As a tin-dressing plant it is very imperfect, and is to be substituted by more modern machinery as soon as the owners can provide it. It is situated on a small branch of Packer's Creek near the boundary between 1326-91M and 1327-91M, and is connected with the mine workings in section 1325-91M., which are some 400 feet higher up the hill, by a tramway and self-acting incline. These are now in bad order but could be put right without heavy expense. A small dam has been built behind the battery to give water for the water-wheel, but it is now intended to lay a line of pipes from the large dam on the Cumberland Creek, on section 101-87M., known as the New Cumberland dam, but now reserved by the Government. This is some 570 feet above the West Cumberland battery and quite a short pipeline will bring the water from it round the shoulder of a spur to a point over 400 feet above the machinery site, so that splendid water power to drive the dressing appliances will be easily obtainable.

Two lodes have been worked on section 1325-91M., both being strong veins whose outcrops may be seen plainly from a considerable distance standing out from the hill sides. There is therefore no difficulty in tracing the general course of the lines of lode, though of course the outcrops are not by any means always uninterrupted. On the western lode which runs N.E. and S.W. a tunnel has been driven about 280 feet: the lode is 4 to 6 feet wide with well defined walls, and consists mainly of quartz and tourmaline: numerous leaders come in from the walls and go out from them at intervals, and cross-cutting from time to time will therefore be advisable, as these may contain good ore. In the tunnel a small rise and shallow winze have been made on a shoot of good tin in this lode, but no stoping has been done. All this work was done by the old company, and Mr Dunn informed me that they had got about 11 tons of tin ore from it. I looked carefully over the lode stuff on the tip, but found it very poor, and I saw very little tin in the tunnel either except at the winze. Owing to the long time the workings have been standing however, the walls and roof of the tunnel are very dirty, and in order to fairly test the lode it would be necessary to break down several tons of stuff along the length of the drive, when an average sample might be taken. As far as I could judge, however, this lode was decidedly poor. From its course it should soon run into the next one, going north. On this, now called the main lode, a winze was sunk some 45 feet by the old company, and the present owners have squared up the old workings and extended them 20 or 30 feet each way from the bottom of the winze. They have crushed the stuff raised together with that got by the old company, which was lying at surface, and obtained about 20 tons of tin ore (according to Mr Dunn) reckoned to be about a yield of 6 per cent. from the stone treated. This lode runs N. 12° E., and in these workings consists of soft clayey and talcose stuff

full of little pieces of tourmaline, and containing extremely fine tin, almost slime even without crushing: there are also bands of hard quartz and tourmaline through the soft portion. In the winze the lodestuff was as much as 16 feet wide, but rapidly became narrow, going north and south. On following it however there is much likelihood of it again widening. The wall rock is granite, somewhat coarse-grained, and a good deal softened by decomposition. These workings are some 90 feet above a tunnel which has been driven on this lode a distance of about 150 feet.

Above these tunnels the ground rises going northwards for some chains, and then falls pretty rapidly into the valley of Packer's Creek. The top of the ridge is about 600 feet above the battery. In a gully about a quarter of a mile north of the ridge Mr. Dunn tells me he has got good tin on the line of the main lode.

Going to the north-east along the ridge the ground rises to a height of about 1000 feet above the West Cumberland battery, the highest point being in section 450-87M., and then forms a high narrow ridge between the valleys of Packer's and the Cumberland Creeks. On the top of this ridge in the New Cumberland Company's ground a shaft has been sunk in a large lode of quartz and tourmaline running N.E. and S.W. This lodestuff is quite black with tourmaline and frequently rather pulverulent. Lower down the hill to the N.E., some 65 feet below the shaft, a small crosscut has been driven across this tourmaline lode, a distance of about 30 feet, and then a drive has been put in along the granite wall, which is well defined, for a distance of 50 or 60 feet. In the mouth of the tunnel fine crystalline tin ore shows pretty freely in places. Another tunnel has been started some 50 feet lower down the hill to cut this lode but has been abandoned without reaching it. As it is a large lode and contains some tin at least, it is worth testing thoroughly. A long tunnel, said to be 900 feet in length, has been driven from the south side of the ridge some 300 feet below the top of it: I did not go into this, but was told that it was put in to cut a large quartz lode that is seen on the surface; it would not have to be extended more than some 300 feet before it would also cut the tourmaline lode. There are several outcrops of quartzose matter between the West Cumberland and New Cumberland mines which appear to be of a lode character but have not been opened up. The impression I took away from this hurried visit was that the main lode of the West Cumberland and the black lode of the New Cumberland mines were decidedly worth further prospecting, and that the work of the old companies has rendered this an easy and inexpensive matter.

From the New Cumberland tunnel a tramway still in not bad order, runs to the battery on section 1549-91M but I had not time to visit this to see in what condition the machinery was after its long idleness. It appears to be well housed however and therefore should not have suffered much.

One great advantage possessed by these two mines is their proximity to the New Cumberland Dam. This is quite a small lake and holds a very large quantity of water, the stream being dammed back for probably more than half a mile. A line of pipes used to take the water from this to the New Cumberland Battery, but I noticed that these were much rust-eaten, and very extensive repairs would probably be required. While it is very regrettable that the former owners spent so much money in erecting batteries, tramways, and dams, instead of well proving the lodes by underground work, there is no doubt that their successors will reap a great deal of benefit from their expenditure, and if successful in opening up payable ground will have but little trouble in getting crushing power, and connection with the batteries. The results obtained by Fowler and Dunn's party by actual crushing of a considerable parcel of stone show that there is payable tin in some portions of the lodes, and it seems to me that there is great hope of tin-mining being revived on a legitimate basis at Mount Heemskirk.

I have not been able to ascertain the exact amount of tin ore which has been raised from the Heemskirk District lately: in the Commissioners' reports for July and September, 1892, 24 tons are recorded as having been raised, while in December, 1892, and the first three months of 1893, 50 tons were exported from Strahan. Of this last amount some few tons should be credited to the North Dundas Tin Field, but we shall not be far wrong in saying that during the months mentioned the district produced about £4000 worth of tin ore.

Conclusion.—In concluding this report I have to express my conviction that the West Coast Fields have made real and permanent progress, and are rapidly coming to a self-supporting position. The generally good results that have followed legitimate mining work are very encouraging, and may almost be held to demonstrate already that the district is sure to become a very important producer of mineral wealth. Besides the silver-lead mines, we have auriferous and argentiferous copper on the east side of the field, and bismuth has also been found there; alluvial gold and tin at North Dundas, and lodes of tin ore at the latter place and Mount Heemskirk, as well as the alluvial deposits. Now that the country is being opened up, and is connected by rail with a seaport, it is beginning to be seen that it has many advantages of position over mineral districts remote from the seaboard, and as time goes on its really very good position as a smelting centre will become more and more recognised. At the risk of reiteration, I would remark that local smelting works and improved concentrating machinery are now the great desiderata, and I would once more draw attention to the great service that might be rendered in prospecting in depth by diamond drill boring, especially in the case of the large gossan lodes.

I have the honor to be,

Sir,

Your obedient servant,

A. MONTGOMERY, M.A.,

Geological Surveyor.

APPENDIX No. 1.

Estimated total Production of Ore Exported or Smelted locally, from mines of the Zeehan-Dundas Silver Field up to 31st March, 1893.

N.B.—This does not profess to be a strictly accurate return, but rather is an estimate for the purpose of showing the approximate production from the field and the relative position of the mines as producers.

Silver Queen...	3725 Tons.
Maestrie's Broken Hill...	3590 „
Western	1418 „
Oceana	1000 „
New Tasmanian	957 „
Mount Zeehan S.L. Mining Company	650 „
Mount Zeehan (Tasmania) Silver Lead Mines	605 „
Grubb's	587 „
Comstock	298 „
Adelaide Proprietary	252 „
Silver Bell	250 „
Mount Dundas Prospecting Company	110 „
Oonah	92 „
Success	50 „
New Silver Stream	46 „
Sylvester	38 „
Sunrise	35½ „
Success Extended	30 „
Junction	25 „
Tasmanian Crown	12 „
Comet	10 „
Sylvester, Despatch, and other tributes, say	10 „
Nubeena	8 „
Montana	7 „
Sacramento	1½ „
Total	13,807 Tons.

REPORT ON THE COUNTRY BETWEEN MOLE CREEK AND THE MOUNT DUNDAS SILVER FIELD, AND ON THE DISCOVERY OF COAL AT BARN BLUFF.

Geological Surveyor's Office, Launceston, 13th June, 1893.

SIR,

I HAVE the honour to forward to you a fuller account than was contained in my *interim* report of 11th April last, of the country lying between the terminus of the Chudleigh branch of the Western Railway at Mole Creek and the Dundas Silver-field, and more especially of the discoveries of coal and other minerals near Barn Bluff and East Mount Pelion. In going from Mole Creek to Dundas my route did not at all closely follow that of the proposed Mole Creek to Zeehan Railway, but was near enough to the latter to enable me to form some idea of the probable nature of the country traversed by it with respect to containing useful minerals.

The railway route has been surveyed more or less completely from Mole Creek to a point on the north side of Mount Pelion, and from the other end, from Zeehan to a point near Mount Tyndall: between these terminals it has only been very cursorily explored. From Mole Creek to Liena it traverses much the same line of country as the existing road does, but crosses the Mersey considerably higher up, just below the junction of the Fisher River. It then follows the west side of the Mersey Valley to a saddle near Lake Ayr, where it crosses the watershed and comes into the head of the Forth River Valley, round which it runs to Mount Pelion.

Round Chudleigh and Mole Creek there is much limestone, belonging to the Silurian or even an older system, which continues through Circular Ponds to Liena. The Barren Tier, on the divide between the Mole Creek Valley and that of the Mersey, seems to be largely made up of ancient sandstones and conglomerates, probably of the same age as the limestone: the close resemblance of the rocks of this district to those of the Beaconsfield goldfield impressed me very considerably, and I regard it as very likely to be found mineral-bearing. I was informed that a little gold and tin ore had been found in the Mersey River, but was not able to ascertain by whom or when. At Liena I observed numerous stones of granite, schist, and quartzite in the gravels of the river bed, together with much diabase greenstone and vesicular basalt. The granite is seen *in situ* on the top of Gad's Hill less than half a mile from the point where the track up its steep northern face comes out on the plateau, and I was informed that it could be traced westward across the Forth to Middlesex. In close proximity to the granite on the top of Gad's Hill there is also a belt of old metamorphic sandstone, and as useful minerals are very commonly found along the contacts of granite with old sedimentary rocks, I should recommend this line of country to the close attention of prospectors. My route from Liena did not follow the railway track, but went over Gad's Hill and the flat-topped range lying between the Mersey and Forth Valleys, crossing the Emu, Hermit, and Mackenzie Plains. For about 10 miles south of Gad's Hill the plateau is mainly composed of scoriaceous basalt, often containing zeolites (especially chabazite), forming a layer of no great depth in all probability. I noticed fragments of limestone and diabase greenstone enclosed in some of the pieces of basalt, indicating that these older rocks occur in the vicinity below the latter. On the plateau the covering of basalt has been in parts entirely removed, and accordingly we come upon patches of quartzite and metamorphic sandstone, and some diabase greenstone: in one place I noticed some much waterworn quartz and quartzite gravel, and in another a rather nice-looking piece of lode quartz. These all serve to show that the basalt has covered a patch of rather likely mineral country, and it is possible that prospecting along the edges of the Forth and Mersey Valleys would discover the outlets of old watercourses that have been covered by the basalt, and these might contain gold and tin. The Forth Valley, as far as can be seen from the plateau, appears to be all composed in this neighborhood of old quartzites, schists, sandstones, and slates, country which is always likely for minerals. The southern part of the plateau is pretty free from the tertiary basalt, but is mainly composed of the older diabase greenstone, an old, probably mesozoic, basalt. This seems to form a thick layer lying upon the old quartzites and schists, which are seen below it in the valley of the Forth, and also occur, I was informed, in the Mersey Valley. The plateau terminates to the south in Mounts Pillinger and Oakley, both steep escarpments of columnar greenstone. By coming over the top of the range as I did, one does not traverse the parts of the district most likely for minerals, which lie in the river valleys below the cappings of volcanic rocks.

Descending from the plateau to Lake Ayr, we come upon rocks of the coal measures series, mostly sandstones, conglomerates, and fossiliferous shales and mudstones. These are first seen about 250 feet below the plateau, and the capping of greenstone is probably quite this thickness as a rule. There appears to be a quite extensive development of the coal measures from here west and south, for they are seen on the lower slopes of East Mount Pelion, Mount Oakley, the north end of the Du Cane Range, Mount Pelion, Mount Ossa, and the Eldon Range, and Mr. T. B. Moore has also found traces of them as far west as Mount Sedgwick. Messrs. Gould and J. R. Scott's maps also show them to be found on the south side of the Eldon Range, and eastward nearly to Lake St. Clair. At Coal Hill, about six miles west of Lake St. Clair, a seam of coal was discovered many years ago, but I have not been able to learn any particulars of its size or quality. It may be mentioned also that coal measures are found along the north face of the Western Tiers: in fact the great central greenstone plateau in the middle of the island of Tasmania may be said to be almost everywhere fringed with coal measures strata. Two explanations of this are possible, viz., that the sandstones were deposited against the faces of cliffs of older greenstone rock, and secondly that they have been covered by immense flows of igneous matter. In my reports on the Oyster Bay coal-field, and on the Ben Lomond District, I have already discussed the question of the relation of the greenstones to the coal measures at some length, and have only now to say that the evidence presented by the splendid sections at the head of the River Forth, is to my mind conclusive as to the greater antiquity of the latter. The tops of Barn Bluff, Mount Pelion. and East Mount Pelion, all consist of masses of columnar greenstone resting on horizontal, undisturbed, marine beds, and all round the head of the Forth Valley, on every mountain side we can see the horizontal coal measures strata up to a fairly uniform level, above which is the greenstone covering. It is perfectly clear that the volcanic rock has been one continuous sheet, and that the present mountains have been carved from it by erosive agencies. This is a very important conclusion, for it means that in all probability the coal measures extend right under the Eldon and Du Cane Ranges, and under the Central Plateau, and that this wild and barren district may be the great coal-field of the colony. My interpretation of this much disputed chapter of Tasmanian geology, shortly stated, is this: During the permo-carboniferous and early mesozoic periods, the central and south-eastern portions of what is now our colony were gradually covered to a very considerable thickness with strata of sand, mud, and carbonaceous matter, that now constitute our coal measures. Then came a period of very violent volcanic activity, during which the strata were fractured, faulted to various elevations, pierced by very numerous intrusive dykes, and finally overwhelmed beneath immense doleritic outflows. Erosive agencies have since cut deeply into the great covering sheet revealing the underlying strata, the older granitic and Silurian formations, the coal measures, and the dykes and pipes by which the molten matter issued, the latter being the roots as it were of the great lava capping. On the Central Plateau, Ben Lomond, and the Fingal Tier, we probably have still remnants of this once general covering, under which lie the older rocks; if we could lift off the crust of lava we should find these beneath, but doubtless much broken by greenstone dykes, Should valuable coal seams be found therefore in the Eldon and Du Cane Ranges it is probable that they could be followed right underneath the mountains.

Besides the old discovery at Coal Hill above mentioned, coal has also been found at Barn Bluff and East Mount Pelion, and no doubt other discoveries will be made when the country is further prospected. There is some reason to think that it will be more profitable to search for coal in the Eldon and Du Cane Ranges than further north, for the coal basin appears to be deepening going to the south and south-east, and it is usually in the deepest parts of the basin that the coal is purest and in the largest seams. The southerly dip of the basin is well seen on the west side of the Oakley Range, the quartzite bottom rising more and more going northwards, and the layer of coal measures strata between it and the overlying greenstone getting thinner and thinner until it disappears. Cradle Mountain, too, seems to be all quartzite and old rocks, the coal measures strata dying out in this direction. Between Cradle Mountain and Mount Pelion there are large beds of quartzite conglomerate, composed of much waterworn pebbles, lying upon the bedrock of strata of quartzite on edge, but going southward these are gradually replaced by shales, sandstones, mudstones, and shell deposits, such as would naturally occur further away from the shore. On the spur between Barn Bluff and Cradle Mountain a seam of coal has been found lying almost directly on the conglomerate, at a height of probably not more than 100 feet above the quartzite bedrock, but on East Mount Pelion, ten miles further south-east, the coal lies 750 to 800 feet above the older formation. It may prove that these two seams do not belong to the same horizon, but if they do, as is most likely, this fact would show a decided deepening of the coal basin going southwards. Unfortunately through a misunderstanding as to the date of my reaching East Pelion, Mr. Will, the leader of the prospecting party that discovered the coal, did not meet me there as arranged, and I was therefore unable to see this seam. He tells me that it is a bituminous coal, 20 inches thick, but of poor quality. It corresponds almost exactly in elevation with the seams at Barn Bluff, viz.:— about 3400 feet above sea level. Round the lower slopes of East Pelion and Mount Pelion, the strata are of marine origin, sandstones, conglomerates, mudstones, shales, and limestones, full of characteristic permo-carboniferous fossils; *Fenestellae*, *Spiriferae*, *Producti*, *Aviculopectenes*, and *Stenoporaes*, being most common. At Barn Bluff the coal rests, as has been said, almost directly upon the congomerate, but is overlaid with similar marine strata for about 900 feet in thickness, the altitude of the highest seen in ascending Barn Bluff being 4300 feet above sea level. The thickness of the lava capping on this mountain is close on 700 feet, its summit being 4925 feet above sea level as nearly as I could determine it. The coal seam is enclosed in a band of black micaceous shale, in which I saw fragments of a large *Glossopteris* (probably *Ovata*) and a *Noeggerathiopsis*. This shale and its contained fossils are exactly similar to, and occur under exactly the same conditions as the patch of fossiliferous shale found by me near Mallana Station, on the Strahan to Zeehan Railway line, described in my report on the West Coast Silver Fields of 25th November, 1890, which is likewise overlaid by marine strata. The Barn Bluff coal, therefore, belongs to the lower coal measures of this colony, to which series also belong the Mersey and Don coal field, the Port Adventure coal, and that at Port Cygnet.

In the head of the Forth Valley we find quartzite, schistose quartzite, and mica schists underlying the coal measures, and apparently extending a long way down the Forth River. Cradle Mountain and the country on the north side of the head of the Fury River, as seen from Barn Bluff, also appear to be

formed of quartzite, and this formation is met with all the way to near the east side of Mount Reid, where softer schists come in. Bands of conglomerate, metamorphic sandstone, mica schist, and other varieties of metamorphic sedimentary deposits occur in the quartzite pretty frequently. Mount Murchison, as far as I could judge from a distance, consists of this same rock: a later conglomerate is, however, seen lying on the schists to the south of this mountain, and may compose a good deal of it. At the Granite Tor a large intrusive mass of granite has been thrust through the quartzite formation, and sends off dykes into it: one of these was seen on the divide between the Bluff and Fury Rivers, some miles before reaching the main mass, and doubtless there are many others. Traces of tin ore have been already got in this vicinity, and I have little doubt that here as elsewhere in the colony the granite will be found tin-bearing. This granitic mass, and more especially its contacts with the quartzite formation, are well worth prospecting. Very few minerals have yet been found in the quartzite itself, but there are not wanting indications of its containing metalliferous ores: some veins have been discovered near East Mount Pelion which will be described later on, and on the south-eastern side of Mount Pelion there is a rather nice-looking quartz lode, containing pyrites, but no gold has yet been found in this. One great drawback to prospecting through this region is that there is hardly any alluvial ground in which traces of gold and tin might be concentrated and so lead to the discovery of the parent lodes. The watercourses nearly all run on the bed rock, and have not yet accumulated much gravel in the portions where I saw them. The reason of this is that the shape of the surface is due to the universal presence, in quite recent times, geologically speaking, of large glaciers in all this part of the country. I have discussed this subject in a paper communicated to the Royal Society of Tasmania at some length, describing the evidences of glaciation, and shall therefore now only mention the fact that clear proof of extensive ice action has been obtained, and point out that it is owing to this cause that the bed rock has been swept so bare, and that the expected alluvial deposits have not been formed in the creeks. Prospectors will therefore have to depend mainly on discovering the actual outcrops of the lodes themselves, by traversing the hill slopes, without the assistance of broken away *debris* scattered over the surface. This will no doubt render the progress of discovery of lodes slower than it would be under more favorable conditions, but I have little doubt that mineral discoveries will in time be made throughout all this region.

The proposed route of the Chudleigh to Zeehan Railway, after leaving Mount Pelion, skirts the slopes of the Du Cane Range, Mount Ossa, and the Eldon Range, so as to avoid as much as possible the deep and impracticable ravines in which run the Canning and Murchison Rivers and their tributaries, and then runs along the watershed between the King and Murchison Rivers, and round the north end of Mount Tyndall and south side of Mount Dundas. The country to be passed through is very rugged, and it seems to me very doubtful if a practicable route can be got at all: it would certainly be a long and expensive line. If payable coal seams are found in these ranges, however, it would be in the best possible position for tapping the fields, as it would run just along or below the base of the coal measures. Should important mineral discoveries be made in the quartzite formation and round Granite Tor, however, the proposed line would be most likely both a long way from them and high above them, and long tramways with uphill traction would require to be made to connect with it. Another route suggested itself to me when passing through the country, which seems to be quite as practicable as the proposed one, and considerably shorter; also at a much lower level, an important consideration in this often snow-clad part of the country. It would be of next to no service to the coal fields, but would command the quartzite country. This route would be down the valley of the Fury and Mackintosh Rivers to the Murchison Valley, up this, and round the south side of Mount Murchison, whence it might go either north of Mount Reid to join the Waratah-Zeehan line, or south of Mount Dundas as already surveyed. There are several deep gorges running into the Barn Bluff and Cradle Mountain Range, both from the Forth Valley and from that of the Fury, and looking down from Barn Bluff it seemed practicable to get from the one valley into the other with quite a short tunnel at an altitude of not more than 3000 feet. The route would run down the west side of the River Forth, cross it in the low country, and run through the Sheffield district to join the Western line near Railton. I know very little of this latter part of the country personally, but several persons who know it well have assured me that they believe a practicable route could be got. The Fury and Mackintosh Gorge would be, without doubt, rough country, and the crossing of the Sophia River Valley might necessitate a long detour, but I do not think it would be any worse than skirting the interminable spurs of the Eldon Range.

Once a railway line is on the low country east of Mount Reid it does not appear that there would be much difficulty in connecting it with the Waratah to Zeehan line on the north by going through the big valley separating Mount Reid and Mount Murchison, or on the south side with the line surveyed from Zeehan to Mount Tyndall, and with a northward extension of the Mount Lyell railway. The development of what is likely to prove an extensive tract of mineral country will greatly depend on the route taken by the railway, and this should be kept in view in selecting the latter. As the interests of the coal bearing portion conflict with those of the probable metalliferous part, the country ought to be much more thoroughly explored and prospected before any route is decided on.

The coal already found at Barn Bluff could be taken out by any of the proposed routes, or by a line running along the high country between Cradle Mountain and the Waratah Plateau; a line down the west side of the River Forth to Devonport would, however, be by far the shortest way of getting it to market, the distance in a straight line being only 45 miles, or say 80 miles by railway at most. Going to Devonport by way of Mole Creek and the Mersey Valley, it would have to be carried not less than 100 miles, and to Launceston about 114 miles. Should a seam of cannel coal, of the same quality as that at Barn Bluff, but not less than two feet in thickness, be discovered anywhere along the slopes of the Du Cane and Eldon Ranges, the distance it would have to be carried would be by no means prohibitive, and even a seam of good bituminous coal could probably be profitably worked. The best outlet for this coal, however, would most likely be by means of an extension of the Strahan—Mt. Lyell Railway.

This discussion as to railway routes may be thought altogether premature, considering that no very valuable mineral discoveries have yet been made in the country traversed, but in view of the fact that

making the Mole Creek to Zeehan line has been so seriously contemplated that a large sum of money has been spent in making surveys, and further, that there is no inducement to prospect this inaccessible part of the country unless it is shown that there is hope of being able to get any minerals that might be found to market, it seemed to me that it was not out of place.

I shall now describe more fully the discoveries of metalliferous veins near East Mount Pelion, and of coal at Barn Bluff.

Section 1112-91M.—This is situated on the head of the east branch of the River Forth, just below where it is joined by the branch from Lake Ayr. In the centre of the section, a lode varying from three inches to two feet in size has been opened by a surface cutting; it strikes N. 5° E. and dips to the westward; it consists of quartz, brown oxide of iron, magnetic oxide of iron, black and red zinc blende, and copper and iron pyrites, with occasional specks of galena also. Assays are said to have yielded 6 ounces silver per ton. About three chains west from this, a six-inch wide vein of blende and magnetic and other oxides of iron, with quartz and copper and iron pyrites, runs N. 20° E.; this also contains a little galena. A chain or more further west again, are a number of narrow small veins in the joints of the country rock, composed of the same minerals as before. About a chain from the western boundary, another vein of pretty fair copper pyrites three to six inches thick is seen running N. 35° E. and dipping S.E. What may perhaps be a continuation of this is seen again in the steep rocky gully of the river Forth, about five chains from the north boundary, and five chains from the western one; it consists of 18 inches of altered schist, with quartz, copper pyrites, and a little blende, between well-defined walls. Strike N. 20° E., dip S.E. 70°. The outcrop is about 30 feet above the river, and not more than half a chain from it, and the vein could very easily be tested by a short tunnel from the water's edge. Throughout the section, the country rock is a micaceous schist containing occasional slaty bands; the veins run across the bedding of the country strata, not with them. None of them, however, are well defined lodes, and they look rather like joints in the schists in which mineral sulphides have been deposited. The first and last mentioned are the most promising veins, and a little work should be done on them to find if they show any signs of improvement, but none of them as yet give much hope of being valuable. They serve to show that the rock carries metallic minerals, and it is possible that there is a larger lode somewhere in the vicinity. The section is worth further prospecting.

Another section 1113-91M, has been taken up south of the above property, but nothing has yet been found on it.

Sections 1149-91M *and* 1150-91M.—These blocks of 40 acres and 80 acres respectively, have been taken up by the Mole Creek and Zeehan Mineral Prospecting and Exploration Co., Limited, immediately north of Richard How's section 1112-91M just described. The country changes from schist to quartzite going north, and the 80 acre section seems to be almost all on the quartzite. The beds of country rock run about N. 30° W., and are much contorted in dip; beds of schist often occur interstratified with the quartzite. At the centre of section 1150-91M, a hole about 13 feet deep has been sunk on an outcrop six feet wide or more of quartz heavily impregnated with iron, copper, and arsenical pyrites, and blende, the iron pyrites and blende predominating, though there is also a good deal of copper pyrites. The width of the lode was not visible, nor were its strike and underlay definitely ascertainable, as the walls of the excavation also are partly made up of lode stuff; however, the general course appears to be somewhere near north and south, and the underlay to the westward. The sulphides mostly lie on the hanging wall, forming a vein several inches wide, from which blocks of very solid ore have been taken. Some of this stuff is said to have yielded 14 ounces of silver per ton on assay. The outcrop is oxidised to brown iron oxide and shows stains of green arseniate of iron in places. This lode deserves opening up a little more, so that the width and course of it may be better ascertained, when an effort might be made to trace it along the surface in the hope of coming upon better ore-shoots. It is not a well-defined lode and as much as possible should be ascertained about it by surface trenching before going to the expense of sinking a shaft on it. The ore mixture is not a valuable one at all, unless it should be found to contain silver and gold in payable quantities, the large admixture of blende and arsenical pyrites rendering the copper pyrites valueless. All the veins hitherto found in this district contain copper pyrites, and it seems likely that this mineral and gold will form the valuable portions of any other lodes that may be discovered, rather than galena and silver. The finds made up to the present, however, while showing that the district carries mineral veins and is therefore worth prospecting, are none of them very promising. The lode just described is the largest, and the most likely to lead to something of more consequence.

A peculiar feature presented by the outcrop may be mentioned, namely, the occurrence of an irregular band of more or less waterworn gravel traversing the quartz at a depth down to as much as four or five feet below the surface, in such a way as to separate a block of stone of large size slightly from the underlying solid lode. This is no doubt due to the action of ice, the evidences of glaciation being particularly clear on these very sections and westward from them: the ice has detached the surface block and slightly lifted it, and water and gravel have then got into the crevice.

Coal Sections.—(1298-91M and 1296-91M, each of 320 acres.)—On the south side of Barn Bluff lies a plateau which extends to Mount Pelion, forming the top of the ridge between the Forth and the Bluff and Fury Rivers. This plateau consists mainly of horizontal beds of conglomerate resting on the older stratified quartzites, and the surface shows numerous signs of having been cut to its present shape by comparatively recent glacial action. At the foot of a spur running south-east from Barn Bluff two sections have been taken up for coal, numerous fragments of cannel coal having been found in the low ground at the foot of the spur, mingled with fragments of all the adjacent rocks. This *debris* is without doubt part of a ground-moraine, left after the ice-masses had melted away. The fragments of cannel coal, as far as yet known, are confined to the two sections taken up, and are probably derived from somewhere in the immediate vicinity. Several holes have been sunk in the moraine *debris*, in some of

which large fragments of coal were found, while others had none of it. In one a very large flake of coal was struck, and was at first thought to be the seam *in situ*, but on sinking through it fragmentary material was again found underneath, still containing pieces of coal, one large fragment of this standing on its edge immediately beneath the large sheet. The top of the latter was much scored and striated in the characteristic glacial fashion. It has been laid bare for a distance of 35 feet by 20 feet, and has not yet been all uncovered, but is a good deal twisted and fractured. No doubt it has first been laid bare by the ice and then become frozen hard to the latter, after which the slow motion of the glacier has torn it from its bed and carried it away, possibly some considerable distance. The probability is, however, that the parent seam is quite close at hand. With the coal we find numerous fragments of black micaceous shale, containing occasional prints of *Glossopteris* and other Carboniferous ferns, and this same rock is seen in the solid at the foot of a long trench which has been dug up the face of the spur, and in one or two holes near the foot of it. Since my visit I understand that a bore has been made through this shale for a depth of some 40 feet or more without cutting the seam, but there can be little doubt that a few more bores in different places will soon discover it. Seeing that a bed of coal has been found further north in the same black micaceous shale at quite a short distance above the basal conglomerate, and under marine strata, as is the case here also, it is pretty certain that the shale marks the coal horizon, and that bores from the bottom of the marine beds through it to the conglomerate must pass through any seams that exist. On the slopes of the spur the trenching that has been done makes it clear that the seam is not high up, and search should therefore now be confined to the lower ground and be continued principally by boring. The depth of shale passed through in the bore indicates the same deepening of the basin going southwards that has been before referred to, for at the northern outcrop it appears to be much thinner. This outcrop is found on the slopes of a spur connecting Barn Bluff and Cradle Mountain, about two miles N.N.W. of the above workings, and at an elevation between 70 and 80 feet higher. It is nearly 12 inches thick, of bright, brittle, highly bituminous coal, free from bands, and has the black shale for both roof and floor. I am inclined to think that this seam is identical with that yielding the cannel, but it may not be so. As it crops out on the side of a steep slope, a trench deep enough to cut well in to the solid rock down the face of the slope to the conglomerate would give a very valuable section, and would show if there was a second seam.

The large flake of cannel coal and the other fragments obtained show that the seam from which they are derived must be at least from 6 to 12 inches thick, the average thickness of the blocks being about 8 inches. As it is likely that the loose blocks are not the full thickness of the seam there is considerable hope of this proving to be over a foot in thickness, which should be workable, as this sort of coal is much more valuable than ordinary kinds. In appearance it is black, with bright, shining conchoidal fracture, almost like pitch; it is very tough, and burns freely on application of a light. It pretty closely resembles the Joadja shale, or cannel coal, of New South Wales, which is so useful for gas-making purposes, but is brighter and more pitch-like. Like many other cannel coals it contains a good deal of pyrites in thin layers, a detrimental feature for gas-making purposes, which, however, does not by any means prohibit their use.

I have obtained from Mr. Bateman, manager of the Mole Creek and Zeehan Mineral Prospecting and Exploration Company, Limited, who has very kindly put them at my disposal, several analyses and tests of this coal by various analysts, which are now quoted :—

PROXIMATE ANALYSES.

	1.	2.	3.	4.	5.
Water	0·30	0·4	Trace	None	0·2
Ash	2·80	4·2	6·05	4·12	4·3
Volatile Hydro-carbons ...	55·00	51·1	54·20	50·86	52·8
Fixed Carbon	41·90	44·3	39·75	43·69	42·4
Sulphur	Trace	0·8	Not determined	1·33	0·7
Analyst ...	J. Sharpe, Ballarat.	W. F. Ward, Hobart.	J. C. Newbery, Melbourne.	W. A. Dixon, Sydney.	Average Analysis.

The analysts' remarks on these analyses give a good deal of information; Mr. Ward, Government Analyst, Hobart, in reporting on sample No. 2 says :—"The sulphur is included in the coke and gases" (being thus counted twice and making the sum total of analysis No. 2 come to 100·8 instead of 100); "the coke is firm and lustrous, and the gas would be of great value for enriching that of poorer coal. The specific gravity of the sample is 1·13." Mr. W. A. Dixon, F.I.C., F.C.S., etc., writing from the Technical College Laboratory, Sydney, says of sample No. 4 :—"Coal of this quality should be of value for gas-making, but it would be of little use for oil-making, as it would yield more tar than oils, which would be difficult to purify. I am satisfied from its appearance and behaviour when subjected to heat, that it would give rather aromatic hydro-carbons (benzene, naphthalene, etc.) than fatty ones (olefines and paraffines). It is not a cannel (from which oils are not made), and not a shale, from which they are. Its colour both in mass and powder, and its fracture in mass, are different from either, and this difference is emphasized by the coke which

it yields on rapid heating, neither cannel nor shale yielding a *true coke.* There seems to be something considerable extracted by chloroform, which is coloured brownish yellow from the powder. I would be inclined to name the mineral Pitch Coal, as being most expressive of its appearance, and of its difference from highly bituminous coal as that of Stockton or Hetton here, which I consider to be *resin coals.*"

Mr. Ward has also made an ultimate analysis of sample No. 2, with the following results:—

Carbon	74·0	per cent.
Hydrogen	7·8	" "
Oxygen and Nitrogen	12.8	" "
Sulphur	0·8	" "
Ash	4·2	" "
Moisture	0·4	" "
	100·0	per cent.

He remarks:—"The ultimate composition is almost identical with that of 'Grahamite' which is described by Dana as 'an oxygenated and inspissated petroleum found in shrinkage fissures in sandstone,' but the physical characters of the two substances are different."

For comparison with other cannel coals the following table of analyses has been compiled from Dana's "Mineralogy," Newbigging's "Handbook for Gas Engineers and Managers," and Liversidge's "Minerals of New South Wales." As moisture is deducted before making these analyses, the figures above given are re-calculated with the water omitted in the case of the Barn Bluff mineral.

Locality.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Sulphur.	Ash.	Sp. Gr.	Coke.	Authority.
Barn Bluff (Tasmania) ...	74·30	7·83	12·85		0·80	4·22	1·13	48·5	W.F. Ward.
Wigan (England)	80·07	5·53	8·10	2·12	1·50	2·70	...	...	E. S. Dana
" "	79.23	6·08	7·24	1·18	1·43	4·84	1·23	60·33	Newbigging.
Derbyshire, do.	74.346	6·285	14·201	0·350	1·318	3·500	1·271	54·75	Do.
Bulwell, Notts., do.	78.680	5·872	9·378	0·700	0·690	4·680	1·269	56·64	Do.
Boghead (Scotland)	63.930	8·858	4·702	0·962	0·320	21·222	1·218	31·70	Do.
Torbane Hill, do.	64.02	8·90	5·66	0·55	0·50	20·32	...	...	E. S. Dana.
Murrurrundi, N.S.W. ...	66.788	9·712	2·774		0·555	20·171	...	26·403	Liversidge.
Hartley, do.	69·484	11·370	6·356			12·790	1·052	17·76	Do.
Greta, do.	65.610	7·507	9. 851		0·924	16·108	1·13	43·816	Do.
Albertite, New Brunswick ...	86·04	8·96	1.97	2·93	Trace	0·10	1·097	...	J. D. Dana.

The next table below given is taken from Liversidge's "Minerals of New South Wales," to compare the Barn Bluff Cannel with others as regards proximate analysis:—

Locality.	Moist're	Volatile Hydro-carbons.	Fixed Carbon.	Ash.	Sulphur.	Specific Gravity.	Analyst.
Joadja Creek, N.S.W....	0·44	83·861	8·035	7·075	0·589	1·054	Liversidge
Hartley Vale, do.	...	82·50	6·50	11·0	...	...	B. Silliman
Joadja Creek, do.	0·04	82·123	7·160	10·340	0·337	1·229	Liversidge
Hartley Vale, do.	...	82·24	4·97	12·79	...	1·052	do.
Joadja Creek, do.	0·41	77·07	12·13	10·27	0·12	1·098	W. A. Dixon
Joadja Creek, do.	1·16	73·364	15·765	9·175	0·536	1·103	Liversidge
Cannel, Mold Flints, England ...	...	72·08	21·91	6·01	...	...	Percy
Murrurundi, N.S.W.	1·165	71·882	6·467	19·936	0·549	...	Liversidge
Torbanite, Scotland	...	71·17	7·65	21·18	...	1·170	How
Cannel Coal, do.	...	69·77	10·45	19·78	...	...	Percy
Torbanite do.	0·720	69·695	9·045	20·540	...	1·316	Liversidge
New Caledonia (Hartley's)	0·55	64·62	8·71	26·12	...	1·238	do.
Greta, N.S.W.	0·48	61·18	25·13	13·21	...	...	do.
Albertite, New Brunswick	...	57·490	42·086	0·424	...	1·105	do.
Greta, N.S.W.	1·475	53·798	27·946	15·870	0·911	1·130	do.
Cannel Coal, Wigan, England ...	1·464	45·900	45·519	7·117	...	1·259	do.
Barn Bluff, Tasmania...	0·2	52·8	42·4	4·3	0·7	1·13	Average of four tests.

These analyses show that our cannel coal is higher in carbon and lower in hydrogen than the very rich ones of Torbane Hill in Scotland, and Joadja Creek in New South Wales, but lower in carbon and higher in hydrogen than many good English cannels. The proximate analysis also shows a similar relation, the volatile portion being higher than that of the Wigan cannel and lower than that of Boghead or Joadja Creek mineral. The practical tests that have been made bear out the position assigned to the coal by analysis, showing it to be better for gas manufacture than the average English cannels, but not quite so good as the best Scotch and New South Wales ones. It has been tested at the Launceston and Melbourne Gas Works and by Mr. Wm. Leggate of East Devonport, with results as follows:—

Mr. T. S. Cleminshaw, A.M.I.C.E., Engineer of the Launceston Gas Company, reports:—"*In re* sample of cannel coal supplied, I have tested it for quantity and quality of gas, with the following results:—

Quantity (average of 4 tests)—11,200 cubic feet per ton

Quality (average of 3 tests)—50·40 candles, corrected for barometer and thermometer.

The test was made with Sugg's No. 2 cannel burner, as the gas was far too rich to burn in ordinary one. The residue was non-coking and valueless for fuel purposes, being similar to cannel coke of the richer sorts of cannel,—volume, 55·5 per cent. The sample when broken exhibited signs of being an outcrop specimen, and water was visible internally. The tarry vapours, from their appearance, indicate the presence of oil. There was a distinct smell of sulphur in the hot coke."

Mr Leggate's test was a comparatively rough one, but agrees fairly well with Mr. Cleminshaw's, the yield of gas per ton being returned as 12,607 cubic feet of an illuminating power equal to 47 standard candles.

Mr John Wynne, C.E., engineer of the Melbourne Metropolitan Gas Company, reports as the result of a test of half a ton of the cannel, that it gave an average yield of 15,486 cubic feet per ton of an illuminating power equal to 29·44 candles. As Mr Wynne's test was made on a much larger quantity of material than the preceding two, it is likely to be the most correct. The quantity of gas being much greater, and the illuminating power much less than in the Tasmanian tests, it is probable that the retorting was done at a much higher temperature in the Melbourne trial. In order to reduce tests of coal for gas-making purposes to a common standard by means of which their relative value may be estimated, it is usual to calculate what number of pounds of sperm would give the same illuminating effect as one ton of coal. The standard sperm candle burns at the rate of 120 grains an hour, while the standard gas-burner consumes 5 cubic feet of gas per hour. Calculating from these data we find that one ton of Barn Bluff cannel gives a yield of gas equivalent in illuminating power to 2031·53lbs. of sperm, according to Mr. Leggate, 1935·36lbs. according to Mr. Cleminshaw, and 1563·11lbs. according to Mr Wynne; the mean result being 1,843·33lbs. of sperm Even the lowest of these is a very good result, for I find in Newbigging's Handbook for Gas Engineers and Managers, that out of 140 determinations there recorded of various cannels there are only two whose value is over 2,000lbs. of sperm, and only 11 between 2,000 and 1,500lbs., while there are 43 whose values lie between 1,500 and 1,000lbs., and 84 under 1,000lbs. of sperm. Taking the mean result (1 ton = 1,843·33lbs. sperm) of the above three trials of Barn Bluff cannel, it would stand third in Newbigging's list, being only exceeded by the New South Wales cannel (=2,126lbs. of sperm) and by the Boghead cannel of Scotland (=2,073lbs. of sperm). Taking Mr. Wynne's result, it would stand ninth in the list. The following table gives particulars of some of the richest known cannels; the first three being taken from Liversidge's Minerals of New South Wales, and the remainder from Newbigging's Handbook, the local results being also added for comparison:—

Locality, etc.	Gas per ton Cubic feet.	Coke per ton Lbs.	Ash in Coke Per cent.	Illuminating Power Standard Candles.	Value of Gas per ton of Coal in pounds of Sperm.
Grahamite, W. Virginia ...	15,000	1056	4·6	28·70	1476
Albertite, Nova-Scotia ...	14,784	806	0·95	49·55	2511·6
Hartley Cannel, N.S.W. ...	13,716	424	62·86	131·00	6160·4
Cannel, N.S. Wales ...	15,300	818	71·0	38·43	2126·
Boghead, Scotland ...	15,750	817	68·21	38·39	2073·
Wigan 4ft., England ...	17,300	920	7·77	30·07	1783·56
Dykehead, Scotland ...	13,126	1109	15·50	38·71	1742·08
Chapleside, Scotland ...	13,265	973	18·89	35·86	1630·22
Kirkness ,, ...	13,825	1034	24·90	32·13	1522·96
Inchgall ,, ...	13,520	1026	25·80	32·72	1518·42
Lesmahago ,, ...	12,420	1060	13·20	34·26	1458·88
Bromley, England ...	15,865	913	29·73	28·66	1559·83
Barn Bluff, Tasmania (Cleminshaw) ...	11,200	—	—	50·40	1935·36
,, ,, ,, (Leggate) ...	12,607	1030·4	21·65	47·00	2031·53
,, ,, ,, (Wynne) ...	15,486	—	—	29·44	1563·11

The results therefore show that the Barn Bluff mineral is one of the very best known cannel coals for gas-making purposes in the whole world, and when we consider that the pieces tested have been lying on the surface of the ground exposed to the weather for centuries, or buried not more than eight feet deep in loose soil, there is reason to expect that even better results will be got when the seam is mined from solid country, as nearly all kinds of coal suffer deterioration by exposure to the weather.

With regard to Mr. Dixon's contention that this coal is not a true "cannel," it may simply be said, that this is a trade name rather than a scientific one, and from a gas-maker's point of view covers grahamite, albertite, torbanite, and other varieties, which differ very much from one another in composition and origin, but agree in yielding much rich gas. His observation that aromatic hydrocarbons are given off

rather than paraffins and olefines is important, as it indicates that the bye-products of the distillation are likely to be very valuable for the manufacture of aniline colours and other coal-tar derivatives, which are made from the hydrocarbons of the aromatic series, not from the fatty ones. Mr. W. F. Ward has made a test of the quantity of oil that can be got from the coal, and reports :—"Crude oil and tar 92 gallons per ton; this result was obtained by very slow distillation, and is unusually large." No investigation has yet been made, however, by any specialist in the manufacture of coal oils and tar-derivatives, without which the commercial value of the stuff in this respect cannot be estimated.

If used for gas-making alone, without any consideration as to bye-products, the following calculation, which Mr. Cleminshaw has been good enough to send me, shows its approximate market value in Launceston :—"Reckoning the Joadja Creek shale (N.S.W.) as producing 15,000 cubic feet of 50 candle gas (a very low estimate, as results approaching 18,000 feet have been obtained), and costing here 75s. per ton, this gives $\frac{15{,}000 \times 50}{75} = 10{,}000$ candle feet for every shilling of value. Barn Bluff cannel (Tasmanian) producing 11,000ft of 50 candle gas (a high estimate, on a small parcel only) would cost on same lines as above $\frac{11{,}000 \times 50}{10{,}000 \text{ per shilling}} = 55\text{s. per ton.}$ I need scarcely remind you that tests on a small scale should be discounted for a practical result, and should therefore feel inclined to say that the Barn Bluff Cannel might be worth 50s. per ton in Works" (*i.e.* Launceston Gas Works).

Should the seam prove to be one foot or more in thickness, and to extend over any large area of ground it ought to pay for working at this price after access by railway had been established. The following table gives the quantities of coal per acre for seams of different thicknesses, the specific gravity being taken at 1·13 :—

Thickness in Inches.	Cubic Feet per Square Yard.	Weight per Sq. Yd., in lbs.	Tons per Acre.
1	$\frac{3}{4}$	52·9	114·3
—	1	70·54	152·4
6	$4\frac{1}{2}$	317·4	685·9
8	6	423·2	914·5
10	$7\frac{1}{2}$	529·1	1143·1
12	9	634·9	1371·8
15	$11\frac{1}{4}$	793·6	1714·7
18	$13\frac{1}{2}$	952·3	2057·6
21	$15\frac{3}{4}$	1111·0	2400·6
24	18	1269·7	2743·5

Immediately round and under Barn Bluff I estimate the area of probable coal-bearing ground at about 1800 acres, which at 900 tons per acre (taking the seam at eight inches thick) would contain 1,620,000 tons of coal. Round Mount Pelion and the Du Cane and Eldon Ranges there would be a very large field, supposing the coal to exist there, as is probable, but even in the immediate vicinity of the cannel discovery the quantity likely to be present is so considerable as to make it well worthy of serious consideration whether it could be mined and brought to market at a profit. At the present stage, with the seam actually not yet found in the solid, and with its thickness unknown, we have not the data required to decide this question, but in my opinion there is such reasonable probability of success that further prospecting can be recommended without hesitation. It is now necessary, before going further, to ascertain by borings and trenches the extent of the seam of cannel, its thickness, and its average quality, the latter especially, because the cannel might gradually merge into an ordinary bituminous coal. The ground, except where covered by glacial drift, is easy to prospect, and by boring, and cutting a series of trenches from the top of the conglomerate beds upwards to the marine measures all round the mountain, it is not likely that much difficulty will be experienced in getting the required information. Should the seam be thus discovered, the working facilities are very good, the strata lying nearly horizontal, and there being every opportunity to get natural drainage by adits. There is plenty of timber for mining purposes in the adjacent ravines, and along the route of the railway.

While prospecting is in progress it would be desirable to have the cannel tested very thoroughly on a working scale by some European manufacturer whose speciality is the treatment of coal-tar products, a quantity of not less than 50 tons being sent him for the purpose. We should on receipt of his report be enabled to tell whether it would be possible to get a better price for the stuff in the colonies or in England, it being quite possible that the bye-products of distillation would in Europe more than make up for the lower price for gas-making purposes. It would also show us whether it would be worth saving the tar and oils in local gas-works and exporting them, more or less roughly purified. None of

the great industries which in older and more populous countries are founded on coal-tar have yet taken root in the Australian colonies to any considerable extent, but as time goes on no doubt they will be established. It may here be mentioned, in passing, that we have at Mount Lyell an enormous quantity of pyrites of good quality for the manufacture of sulphuric acid, which is largely used in refining coal-tar, and is indeed next to coal and steam the most indispensable material used in all chemical works.

In concluding this report I have to record my thanks to Mr. Bateman for analyses and papers, and to Mr. T. S. Cleminshaw for much information with respect to Cannel coals.

I have the honour to be,

Sir,

Your obedient Servant,

A. MONTGOMERY, M.A.,

Geological Surveyor.

The Secretary of Mines,

Hobart.

REPORT ON THE SILVER-BEARING LODES OF THE SCAMANDER RIVER DISTRICT.

Geological Surveyor's Office, Launceston, June 22nd, 1893.

SIR,

I HAVE the honor to forward to you a few observations upon the silver lodes of the Scamander River district, a locality to which I made a short visit in October last. Owing to pressure of other work I have not been able to forward a report sooner.

Lodes carrying silver have been found in the district in two principal localities, near the mouth of the Scamander River, and on the watershed between it and Constable's Creek, which is a small stream running into George's Bay. There is a strong similarity between the two places, the lodes being found in each instance close to the contact between slates and metamorphic sandstones of Silurian or pre-Silurian age and intrusive porphyritic granite, and further resembling one another in their mineral composition, containing quartz and arsenical pyrites, with also more or less blende, galena, and magnetic pyrites: silver and a little gold are also contained. The old slates and sandstones probably belong to the same formation as those of the Mathinna and Mount Victoria goldfields, and the granite is part of the great mass which forms Mount Cameron and the Blue Tier. In both places where the silver lodes are found a tongue of granite extends southwards into the sedimentary formation from a larger mass of granite, these main masses being seen in the Golden Fleece Rivulet and George's River, and along the road between the Scamander Bridge and St. Helen's. The veins are sometimes in the granite and sometimes in the slate, but never, so far as my observation went, very far from the contact of the two sorts of country.

Very little mining has yet been done in the district, the workings of the old Scamander River Silver Mining Company being the most extensive. This mine is situated on the south bank of the Scamander River, about 30 chains up the stream from the bridge, on the main road from St. Mary's to George's Bay: it is on freehold property. (Lot 126, A. F. Kemp, pur. 640 ac.) In April, 1886, it was reported on by Mr. G. Thureau, F.G.S., whose report and maps of the locality give much information, and have been printed for public use, and should be referred to as well as the present one by those interested in the district. In one matter I differ, however, from Mr. Thureau entirely: he regards the matrix of the lodes as a quartz porphyry dyke of more recent age than the main granite mass and intrusive through it, but it seems to me that there is no evidence of such a later intrusion, and that the so-called quartz-porphyry is simply a somewhat fine-grained variety of the main granite, the fineness of the crystals being doubtless due to the narrowness of the dyke on the south side of the river, and consequent more rapid cooling of the intruded igneous matter than at places where there was a large body of it. The rock thrown up from the shafts shows plainly that the dyke is substantially identical in mineral constitution with the common country granite, though the weathered superficial portions often closely resemble quartz-porphyry. On the north side of the river, the granite is coarse-grained, and with large porphyritic crystals of felspar exactly similar to the common rock of the Blue Tier, and I did not come across anything that could be taken for quartz-porphyry.

I have not been able to get authentic information as to the underground workings of the Scamander River mine, and as the shafts are full of water it is now impossible to see anything but the outcrop of the lode, its appearance in a small adit that has been driven, and the heaps of stuff that have been raised and piled on the surface. The main shaft is said to have been 132 feet deep, and an underlay shaft 123 feet: the mouth of the main shaft is, however, considerably higher on the slope of the hill than that of the latter, and both are said to have gone down to about the same level in the lode. The mine being situated close to the edge of the estuary of the Scamander, and the lodes running under the river bed, there was naturally a great deal of water to contend with, and I believe this had much to do with the abandonment of the enterprise. The outcrop is a good deal broken, and one cannot well estimate the width of the lode from it: it consists of quartz, stained with oxide and arseniate of iron mostly. The adit has been driven from a small gully N. 70° W. about 90 feet, then S. 60° W. some 33 feet: the granite at this level is much weathered, and contains numerous small veins of quartz, so that we cannot tell exactly where the main lode begins and where it ends. A wall which looks like the footwall is met with about 63 feet from the entrance, running N. 70° E. and dipping N.W. about 45°, and on this we find about 9 feet of quartzose lode stuff, much broken. This has been followed about 14 feet to the south-west, and a winze has been sunk which is said to communicate with the workings from the underlay shaft. Before coming to the footwall the granite country contained several quartz veins dipping towards the lode. On the hanging wall a "horse" of slate is found about 9 feet in thickness, and after passing through this, decomposed granite with occasional quartz veins is met with up to the end of the drive, where black slate is encountered, evidently the western wall of the granite dyke. One of the small quartz veins in this latter part of the adit is said to have assayed 122oz. of silver per ton, my informant being Mr. Robert French, who held the mine at the time of my visit, and had been for some months assaying the ore and experimenting with processes of extracting the silver from it by lixiviation. He also got very good returns of silver from several other veins, and from the ore at grass from the lower levels. The latter is of two sorts, quartz with but little of mineral sulphides, and assaying, according to Mr. French, from 80 to 122oz. of silver, and a dense heavy mixture of arsenical pyrites, pyrrhotite, copper pyrites, iron pyrites, blende, and galena, with but little quartz, and said to assay not less than 35 ounces of silver per ton. I took a handful of pieces of the sulphide ore in small fragments from all over the heap, and knocked off a large number of chips from the blocks of quartzose ore, so as to get a rough average sample of both sorts, and sent these to Hobart to be assayed by the Government Analyst. His returns from the quartz ore, however, fall very far short of those obtained by Mr. French, and probably give a much more correct valuation of the stuff. To make a really satisfactory test it

would be necessary to sample the heaps by cutting right through them in several places, and taking a parcel for assay in the regular ore-buyers' fashion, which I had neither time nor authority to do. Mr. Ward's assays gave :—

Quartz.	Gold.	Minute trace.
	Silver.	3oz. 18dwt. 10gr. per ton.
	Lead.	None.
Sulphide.	Gold.	Distinct traces.
	Silver.	41oz. 13dwt. 18gr. per ton.
	Lead.	6 per cent.

It is worthy of note that the sulphide ore carries a good percentage of silver, though quite poor in lead, which agrees with what Mr. French told me, namely that the galena did not appear to carry much more silver than the other sulphides. According to Mr. Thureau's report assays made from the stuff near the surface ranged from 20 ounces of silver, and 8dwt. 9gr. of gold to 198oz. of silver and 9dwt. of gold per ton. In Martin Sholl's Handbook of Tasmanian Mines it is stated that "Three tests of ores from the mine, tested in Tasmania and Adelaide, gave an average of 33 ounces to the ton, 50 tons having been treated," and the following extract from the first half-yearly report of the company is given :—"From some 10 feet from the surface to its present depth, this shaft has carried down with it a silver bearing formation over 3 feet in depth" (*sic*, width no doubt is meant), "from which metal assaying from 89oz. to 281oz. of silver per ton has been obtained. It is calculated that the main shaft will strike the No. 1 lode at a depth of 160 feet; it is also expected to cut some of the other lodes which were exposed in the adit previous to the company's formation. In order to be in a position to be able to treat the metal soon after the main shaft is down the required distance, your directors have found it necessary to erect suitable machinery. After making thorough inquiries, they found the best course to adopt is to erect a reverberatory furnace, which will reduce the metal into mattes, which mattes will be sent away and sold, thus saving the cost of refining the silver." In this extract the shaft first mentioned is evidently the underlay shaft: it is also easily seen that where "metal" is spoken of the mixed sulphide ore is referred to.

I do not know what were the reasons for ceasing work: one was, I believe, the large quantity of water to be pumped out, and another the great difficulty in getting a sale for the highly refractory ore from this mine, but whether there was any falling off in the size or value of the lode I am unable to say. The ore seen at surface is decidedly a difficult one for metallurgical treatment, being on the average both highly silicious and containing much arsenic. It is too silicious (as far as can be judged by mere inspection) for direct smelting for matte in reverberatory furnaces, unless only the sulphide portion were so treated, and on the other hand the quartzose portion contains compounds of silver which cannot well be saved by concentration. A combination of processes would probably be required as follows :—The ore having been freed from lumps of fairly pure sulphide by hand-picking, should be crushed and concentrated, the tailings freed as much as possible from sulphides, being then treated by pan amalgamation. The concentrates and picked sulphide ore should then be roasted and smelted for matte. The arsenic present would be troublesome, and so also might be the zinc blende and galena, but so far as I saw the ore does not contain enough of these latter minerals to greatly affect the treatment. Should this method of dealing with the stuff not succeed it would probably be necessary to grind up all the ore; roast it first without salt, and later on with a large addition of this so as to chloridise all silver compounds, and then treat by pan amalgamation or by lixiviation, the latter for choice. Before any process should be decided on, the ore should be tried on a working scale by several different methods, parcels of not less than 10 tons being sent for treatment to various works where these methods were in use.

Without knowing the state of the lode in the lower levels of the mine, I cannot express any opinion as to the likelihood of its becoming a paying concern, but if it could be proved that the value has not fallen off, and that difficulties of drainage and of treating the ore were the only obstacles to success, I should think that the mine would deserve another trial, as these troubles are by no means insuperable. It is evident that there is good silver ore in the lode, and this seems to be a fairly strong one, so there is considerable encouragement to give it a working trial. It appears to me that a good deal could be learned by driving on the course of the lode from close to the water's edge, so as to prove its strike and to see if it goes any distance into the slate country. This could be done without great expense, and as the surface rises pretty rapidly to the southward, it might turn out that considerable quantities of free milling ore could be stoped from above the water-level. While another trial of this mine cannot be recommended as a promising venture, it is by no means one to be altogether condemned, and it is quite probable that it might be successful.

On the north side of the Scamander several sections have been taken up on Crown Land on Mineral Leases during the last two years, but most of these have lately been forfeited. The most important discovery was made on section 1582-91M (formerly 803-91M), near the middle of which a small lode has been found which has yielded assays of from 100 to 900 ounces of silver to the ton, chloride of silver being occasionally seen in it. The vein is from 2 to 7 inches wide, of ferruginous quartz, and runs from N. 15° E. to N. 20° E., underlaying to the eastward about 7 feet in 6. A shaft has been sunk 40 feet on this, and a short drive some 36 feet or a little more, driven northward along its course. The vein has also been cut on surface in some more small shafts and trenches, but is in all cases quite small. The country traversed is soft weathered granite, which will no doubt get quite hard below the water-level. About 3 chains west of this lode, the slate and sandstone country is met with, and close to the contact another vein 2 to 3 inches wide, parallel to the first and like it dipping eastward has been found: this is said to have given an assay of 136 ounces of silver to the ton. Neither of these veins is large enough to work on a large scale, but a working party could probably make a living from them in the soft ground above the water-level, and in working might come upon larger bodies of ore. As a prospecting measure it would be well to costean across the line of these lodes for some distance, as there may be also larger parallel ones. The rich ore found in the known lodes makes it probable that if larger bodies occur they will be payable, and therefore offer inducement for further prospecting.

On section 1583-91M (formerly 870-91M) in the stratified country, a lode 4 to 5 feet wide of quartz, angular fragments of country rock, and oxide of iron, running N. 15° E. has been found about the centre of the block, and slightly cut into by one or two shallow trenches: I did not hear of any silver having been found in this.

On section 948-91M (now forfeited) two shafts some 60 and 30 feet deep were sunk some years ago in granite country, apparently on a small vein of quartz and oxide of iron. In the stuff thrown out from these shafts hard boulders of undecomposed granite are seen, showing that they were getting down through the weathered portion of the rock, and would soon have come upon the hard solid granite.

On section 3293-87M (now forfeited) in the slate country on the east side af the granite dyke a lode of quartz carrying much arsenical pyrites has been found, striking N. 30° W. In a cutting close to a small creek it is seen to be from 6 to 10 inches wide, but in an old shaft it is said to have been 3 feet wide. Mr. G. Worker, who has been a long time in the district and knows the mines well, told me that he had seen gold in this quartz at times. The course of the vein would bring it near the Scamander mine workings if it continued so far. It seems worth doing some more work upon.

The Upper Scamander silver discoveries are at the head of a large branch of the river, but not the main stream, about 6½ miles N.W. from the above sections, and several of them are on the north side of the water shed on the head waters of Constable's Creek. They are near the southern extremity of a long tongue of granite, protruding southward into the slate country from the main mass seen in the tin workings on the Golden Fleece Rivulet. Very little work has yet been done, though the lodes seem to be pretty numerous and strong. I noticed one which ran nearly north and south, but all the others which I saw ran approximately east and west.

Three sections, 1024-91M, 1025-91M, and 1026-91M, are held by the Ironbark Prospecting Association, so-called from the large numbers of fine ironbark trees growing on the property: these would be most useful mining timber if extensive work should be undertaken. Near the S.W. angle of section 1025-91M, are some workings made by the old Nevada P.A. on a quartz reef 4 feet wide, running N.75° E. and underlaying 1 in 7 to the north-west. The country is soft granite. The quartz contains much arsenical pyrites and green arseniate of iron; I do not know whether gold or silver has been found in it. The reef looks a strong and permanent one, and may yet prove to be valuable. Towards the north-east angle of section 1026-91M, a shaft about 15 feet deep has been sunk on a lode 3 to 4 feet wide, running N.70° W., and some few chains higher up the hill (eastward) another small shaft has been sunk on it. The reef is composed of quartz, containing arsenical pyrites, a little copper pyrites, and occasional specks of blende and galena; in parts the sulphides predominate in quantity, but usually the quartz is by far the largest constituent of the lode-stuff. One assay from this lode is reported to have yielded 18 ounces of silver to the ton. About 100 feet north of this reef there is a smaller one about 18 inches wide, showing much oxide of manganese and a good deal of arsenical pyrites. These lodes run into a high hill, and a tunnel driven on the course of the larger one, would open up probably quite 150 feet of "backs." The country is granite, but the slate comes in on the east boundary of the section, and if the lode continues eastward it would run into the slate. In section 1052-91M, another east and west lode of quartz is seen, but has not been opened up. In section 1093-91M (Lake and Smith's), a lode has been traced from near the north-east corner to the centre of the section by several trenches; it is from 2 feet to 4 feet in width, and runs N.70° E. and consists of quartz with much arsenical pyrites, also some copper and iron pyrites, galena, and blende. The outcrop shows a good deal of brown oxide and green arseniate of iron. No one was at work, and I did not learn if any metal of value had been obtained, but the lode looks very promising and deserves a trial; it looks best near the centre of the section close to a creek which runs to the Scamander River.

Besides the above lodes, I have been told of others in the district, carrying the same minerals, and generally near the contact of the slate and the granite country. The constant presence of arsenical pyrites seems to me a good feature, as it is very frequently associated with gold elsewhere. The slate country belongs to the auriferous formation, and it is likely that if the lodes are traced into it they may be richer than in the granite. Nothing appears to have been done except the most desultory sort of prospecting, and more thorough work will have to be done before it is known whether the lodes are valuable or worthless. I would recommend the belt of country along the contact of the granite and the Silurian rocks to the attention of prospectors as it is a very likely place for mineral discoveries. The Scamander finds have proved that rich silver ore exists in these rocks, and it is probable that some day a really payable lode, or several, will be discovered. It may be recalled to mind that the Waterhouse reefs, which were proved to carry arsenical pyrites rich in gold, are situated in a patch of the same Silurian formation, lying between two areas of similar granite, which again gives hope that the common presence of arsenical pyrites in the Scamander district indicates the probability of gold being in the vicinity.

I have the honor to be

Sir,

Your obedient servant,

A. MONTGOMERY, M.A.,

Geological Surveyor.

The Secretary of Mines, Hobart.

REPORT ON THE PANDORA COPPER MINE.

Geological Surveyor's Office, Launceston, 11th July, 1893.

SIR,

IN pursuance of your instructions of the 27th June last, I visited and examined the Pandora Copper Mine on the 30th ultimo, and have now the honour to submit my Report thereon.

The mine is situated in the Parish of Winkleigh, County of Devon, on a small branch of Saxon's Creek, and is about three miles to the north-west from the township of Frankford. It is situated in the north-west angle of Mineral Section No. 1039–87M, held under lease by Mr. Myles Mahony, and I understand that mining rights are also held by the same proprietary over the adjacent 45½ acre freehold block belonging to Mr. F. Robinson. Several other mineral leases were formerly held in the vicinity, but have now become void and forfeited.

The mine is near the southern extremity of a stretch of country composed of older Palæozoic schists, slates, and metamorphic sandstones, which extends N.N.W. to Badger Head, a distance of from 13 to 14 miles, and N.E. to the Beaconsfield goldfield. I cannot say that the old rocks throughout this area all belong to one geological formation, but it seems most probable that they do. Round Frankford the older strata are overlaid by Permo-Carboniferous beds, sandstones, mudstones, and shales containing marine fossils, and these have been much broken by dykes and intrusive masses of diabase greenstone. Traces of Tertiary gravels and soft ferruginous sandstones are also observable at various points in the District.

Several years ago a shaft was sunk near the beach near Badger Head in search of copper, and veins of cupriferous minerals have been found, it is said, in several places throughout the District, but the Pandora Mine appears to have had the best prospects of any, and to have excited most attention. A small streamlet runs north-westerly through Section 1039–87M, and through Robinson's 45½ acre freehold block to the north west of it, and in the bed of this several quartz veins traversing the schists and sandstones have been discovered. I did not see all of these, as the creek has now become very much grown over with dense scrub, but according to information given me none were large or showed any copper ore except the one upon which the principal workings have been made. This is seen in the east bank of the creek almost on the boundary between the two sections named. A drive has been made to the N.E., a distance of about 104 feet, with several branches. At the mouth a flat vein of ferruginous ruggy quartz is seen, but is very irregular, having apparently no defined course or underlay. All along the tunnel and its branches we find similar irregular flat veins, sometimes up to 4 feet in thickness, but generally smaller; they consist of quartz full of cavities filled with oxide of iron and also containing copper pyrites. The cavities are evidently spaces from which copper pyrites have been dissolved out. About 30 feet from the entrance to the tunnel a strong-looking vein of quartz crosses the drive running to the N.N.E., but when this is followed some 13 feet it is found to have become small and flat. At 82 feet in, two drives go off from the adit, one running about S.E., and the other a little south of east: the former is along the best defined vein of ore seen in the mine, which it follows for about 40 feet, when it again becomes small and flat, and dips underfoot. Near the end of this drive a winze has been sunk on the vein, and some good ore is said to have been extracted. The underlay is very flat and to the south west: it is said that some driving was done from the bottom of this winze towards the south-east, but as it was full of water I could not see this. Opposite the winze a drive runs about 18 feet to the N.E. and meets the other branch drive from the main adit, which is then continued eastward some 30 or 40 feet, but this part was inaccessible at the time of my visit. Another winze was sunk close to the end of the connecting drive and some good ore was extracted, but the very irregular character of the veins is evident when I say that though the two winzes mentioned are only some 16 feet apart, the long axis of the second one is almost at right angles to that of the first, and the underlay of the vein is to the north-west. It is quite impossible to say really what is the course of the vein or the direction of its underlay, though the latter appears to be on the whole rather westward than eastward. The country rock throughout the drives appears to be much broken and often contains quartz veins, and we cannot yet decide whether there is only one main flat-lying vein with numerous feeders and droppers and itself much contorted, or whether there is a large broken lode-mass consisting of disturbed country rock, in the crevices of which irregular strings and veins of quartz and ore have been deposited. A small shaft which was sunk less than a chain to the south-east of the tunnel mouth passed through barren rock for some 26 feet before coming on quartz and ore at about the same level as where they are got in the tunnel, which would favour the idea that there is a flat lode, but, on the other hand, the country schist on the west side of the creek seems very solid and undisturbed. If any more work is done on this mine the shaft should be sunk deeper, and cross-cuts driven from it to prove the nature of the lode: if it is a flat vein the shaft will soon pass through it into little disturbed country rock, but if the ore is in strings through a large broken lode-mass the shaft and crosscuts will soon reveal the fact, and give a chance of estimating whether ore is present in payable quantities. If the vein is flat and irregular in its underlay, as in the present workings, I do not think there is any chance of the mine being worked profitably, as the mining costs would necessarily be very heavy, and very much better ore than any yet seen in it would be required to cover them; but, in the other case, it might prove that the quartz veins would form into a more solid lode body, and that mining might be a commercial success.

Most of the ore that has been extracted from the drives is still on the ground, though the very best of it has been picked out and sent away. What is left is mostly quartz with yellow copper pyrites, and vughs containing oxide of iron, resulting from the oxidation of pyrites. In the lowest parts of the mine the ore is said to have been more solid and less oxidised. It is clear that the cavities so common in the quartz have been formerly filled with pyrites, and it is therefore reasonable to think that the vesicular ore above the

water-level is not of so high an average value as will be found at greater depth, where there has been less chemical action. Nevertheless it appeared to me that there was not enough copper in the ore on an average to make it worth working unless there were a very large and easily mined mass of it. I did not take any bulk samples, being satisfied from ocular inspection that the ore was of low grade, but I should be much surprised if a fair bulk sample of the lode were to yield more than 3 or 4 per cent. of copper at the very most. Five tons of the best ore were sent in May, 1890, to the E. & A. Copper Company, Limited, at Port Adelaide, whose assay return was 7¾ per cent. of metallic copper. If this is all that was yielded by the picked ore, it is not to be expected that the bulk of the stuff from the mine will contain even half as much. Almost all the ore would have to be concentrated to get rid of the great excess of quartz, and the concentrates would have to be shipped to smelting works, as it would not be profitable for the owners to smelt on the spot unless the output of the mine were a great deal larger than there is any present warrant for hoping for. Now, if we take the cost of mining and concentrating at 30*s.* per ton of ore mined, and of freights to smelting works, smelting charges, smelting losses, agency, and all other charges at £4 a ton, both of which estimates are more favourable than could probably be obtained, and supposing the copper in the ore to be 5 per cent., and the concentrates to amount to 20 per cent. of the ore mined, we should find the expenses to exceed the value of the copper, thus :—

100 tons ore contain 5 tons copper, gross value at £44..... = £220.
Mining and concentrating 100 tons ore, at 30*s.*..... = £150 } Total expenses,
Freights, smelting charges, and losses, 20 tons concentrates, at £4 = £80 } £230

In actual practice, I believe the loss on 5 per cent. ore would be even greater than that shown.

The future of the mine therefore depends on finding very much better average ore than any now in sight, so long as copper continues at or about its present value. Should the price of copper rise it might pay to work, but the tendency of improvements in copper smelting is towards lowering the value of the metal, and at present there seems no likelihood of a substantial rise in price for a long time to come.

There seems to me to be only one possible opening for the disposal of this ore at a profit, namely, selling it to the Mt. Lyell Co. for flux when their smelting works are in operation. The Mt. Lyell ore is very free from silica, and siliceous ores will be in request for mixing with it in order to get a good slag, and the Mt. Lyell works will therefore be able to smelt siliceous ores at a much lower cost than is usual. The freight on the ore from Port Sorell to Strahan should not be very considerable. The proprietors should keep this chance in mind if they decide to do anything more with the mine, and ascertain how cheaply they could get the ore landed at the smelting works, and on what terms they could get it treated. The concentration of the ore at the mine need not then be nearly so thorough as if silica were detrimental, but still it would have to be carried to a certain degree.

Should it turn out that the ore could be dealt with in this way, and should larger and better ore-bodies be found on opening up the mine, it would be necessary to construct a tramway from the mine to deep water at Port Sorell. There should be no engineering difficulties in doing so, as the mine is only about 750 feet above sea level, and the fall of the country is towards the port. The distance in a direct line is about eight miles, so the tramway would probably have to be from 10 to 12 miles long. There is good timber round the mine for mining purposes and construction of the tramway, and some revenue might be obtained from the latter for timber and agricultural products carried to the shipping-place. There would be some difficulty, I think, in getting enough water to supply power for driving concentrating machinery near the mine itself, but by going two or three miles towards Port Sorell for a mill-site it is probable that good water-power could be obtained from the Franklin River and its branches. This and the construction of the tramway should, however, receive detailed consideration before going to much expense over them, my judgment being simply formed on general grounds, from the lay of the country and the size of the streams seen.

For a copper mine to be payable nowadays it is necessary either that it should contain considerable quantities of very rich ore, or else, if the ore is of low grade, that it should yield large quantities of it, and have very good facilities for cheap mining and concentrating. The Pandora mine is neither rich nor on a large deposit of ore so far as yet seen, nor has it more than ordinary facilities for cheap handling of the stuff mined, while the flatness and irregularity of the veins are decidedly detrimental to cheap working ; so, though there is of course the chance that further developments will show a much more favourable aspect of the case, I do not think there is much likelihood that it can be made to pay. There is certainly a good deal of copper about it, but I am very much afraid that there is only enough to keep people spending money on it without return.

I have the honour to be,
Sir,
Your obedient Servant,
A. MONTGOMERY, *M.A.*, *Geological Surveyor.*

P.S.—13*th July*, 1893. Since writing the above I have received the result of the examination by the Government Analyst (Mr. W. F. Ward) of a small sample of the best ore I could pick from the ore-heaps at the Pandora mine, the object being to determine, not the average value of the ore, but the percentage of copper in the clean ore, as this mineral (copper pyrites) is liable at times to contain much iron pyrites, which lowers its metallic value. It was also desired to know if there was any gold or silver in the ore. The analysis showed traces of gold and silver, 23·5 per cent. of copper, and 16·4 per cent. of silica and matter insoluble in acids. The percentage of copper corresponds to 67·9 per cent. of chalcopyrite of typical composition in the ore, which, with 16·4 per cent. silica accounts for all but 15·7 per cent. of its weight, which was probably made up of oxide of iron and other constituents not determined by the analyst. The test shows that the ore is a very pure chalcopyrite, and that when freed from the quartz gangue by concentration it might be expected to assay about 30 per cent. of metallic copper. The presence of traces of gold and silver points to a possibility that the precious metals may be found in payable quantities when the lode is further developed ; being in a known gold-bearing formation increases this chance.

The Secretary of Mines, Hobart. A. MONTGOMERY.