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TASMANIA

REPORT

OF THE

SECRETARY FOR MINES

FOR

YEAR ENDING DECEMBER

1905

Including Reports of the Inspectors of Mines, Government Geologist, Mount Cameron Water-Race Board, &c.

Tasmania:
JOHN VAIL, GOVERNMENT PRINTER, HOBART

1906

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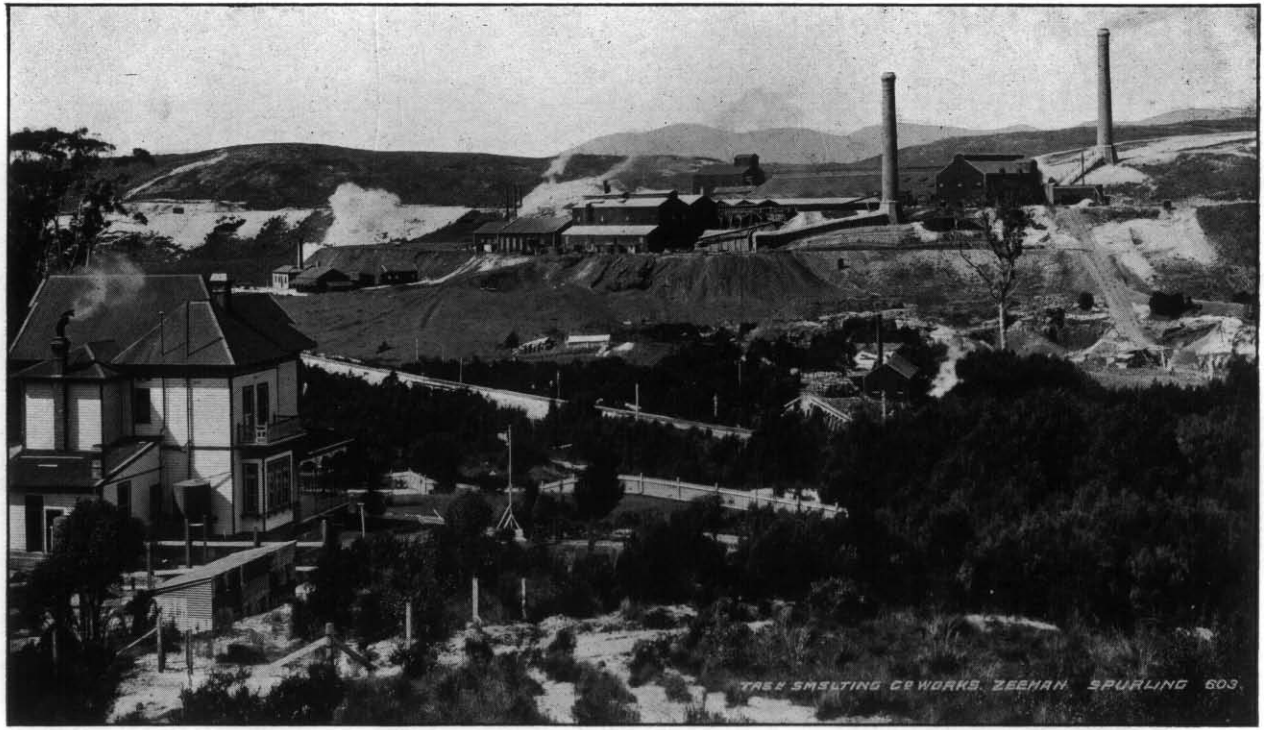

TASMANIAN SMELTING COMPANY'S WORKS, ZEEHAN.

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REPORT OF THE SECRETARY FOR MINES.

Mines Department, Hobart,
27th August, 1906.

SIR,

I HAVE the honour to submit my Report upon the Mines Department, and the progress of the Mining Industry, for the year ending 31st December, 1905.

General Remarks.

The aggregate value of minerals and metals raised in 1905 was £1,729,129, being an increase of £317,937 upon the previous year. The steady rise in the market price of metals has given an impetus to the industry, and there has been an increase in the quantity, as well as the value, of the mineral raised.

The high price of tin has been an incentive to prospectors to search for that mineral, and in many instances new ground has been discovered and prospected with very encouraging results. In the North-Eastern district the tin-mining industry has rapidly advanced, and several dredges have been constructed for the purpose of working the tin-drifts in some of the low-lying flats which cannot be worked to advantage by any other method of mining.

A new Mining Act was passed during last Session of Parliament, which has many advantages over the previous Act, and will doubtless be found to contain many useful

provisions which will be likely to foster and encourage the industry; but until the Act has been in operation some little time, and it has been given a fair working chance, it cannot be said whether all the new measures introduced will be found to give satisfaction.

In my Report for the year 1900-1 I suggested that a monetary reward should be offered by the Government to the discoverer of a new mineral field, such reward not to be paid until the field is on a sound basis, and has supported a stated population for a certain period. I am pleased to be able to state that the suggestion was adopted by the late Minister of Mines, and provision has been made in Part VII. of the new Mining Act for the payment of a reward, upon certain conditions, up to Ten thousand Pounds.

Appendices.

Appended will be found the following Reports:—

Annual Report of the Mount Cameron Water-race Board.
Report of the Government Geologist.
Report of the Chief Inspector of Mines.
Reports of the Inspectors of Mines.
Report of the Registrar of Mines, Waratah.

Gold Mining.

The production of gold for the year was 73,540½ ozs. of fine gold, being an increase of 7619½ ozs. on the previous year.

Beaconsfield.—The yield from this district was 36,450 ozs. of retorted gold, and the number of men employed was 800.

The opening up of the levels of the Tasmania Gold Mine proceeded very satisfactorily during the year, but the recent heavy rains caused the mine to be flooded in the deeper levels, and it will probably be some months before it can

be unwatered. This company has since its commencement obtained 634,356 ozs. of gold, from 582,549 tons of quartz, and has distributed £772,671 15s. in dividends.

The only other mines working in this locality are the North Tasmania and the East Tasmania mines. The former is working in a small way, and the latter is about to put down a bore-hole to a depth of 2000 feet, in the hope of discovering the Tasmania reef.

Lefroy.—The discovery of a small nugget of gold last year again drew attention to this almost abandoned field, and led to surface and shallow prospecting being carried on for a time, but without any satisfactory results being obtained. The quantity of gold obtained from the field was 732½ ozs., of which the New Pinafore Company obtained 442 ozs., and the McIvor Company 97¾ ozs.

The average number of miners employed was 76.

Mount Victoria.—The New Ringarooma Company has taken over part of the Ringarooma Company's leases, and has obtained 240¾ ozs. of gold. The Long Struggle Syndicate and Krushka's Freehold obtained about 160 ozs. between them. Applications for permission to work the tailings from the Ringarooma Mine, under the new Act, have recently been refused, as the Act only applies to leases forfeited since the 1st January, 1906, the date when the Act came into operation.

Mathinna.—The premier gold mine of this field, the New Golden Gate Mine, which has contributed over 262,661 tons of quartz since its inception (yielding over 220,870 ozs. of gold, an average of 16 dwts. 20 grs. per ton, which has realised £840,275 19s. 3d.), and has distributed among the shareholders in dividends £355,200, or £11 2s. per share, has had a reverse of fortune. The gold-shoot appears to have thinned out in going down, and no permanent reef has been discovered, beyond a slide

which cuts it off in the successive levels. A little gold was met with in the 1600-feet level, and a drive north started on the east reef; but the amount of gold obtained has been disappointing. Its neighbour, the Tasmania Consols Mine, has been fortunate enough to find a powerful payable reef, entering its property from the New Golden Gate section, and has been working it remuneratively at 1400 feet from the surface.

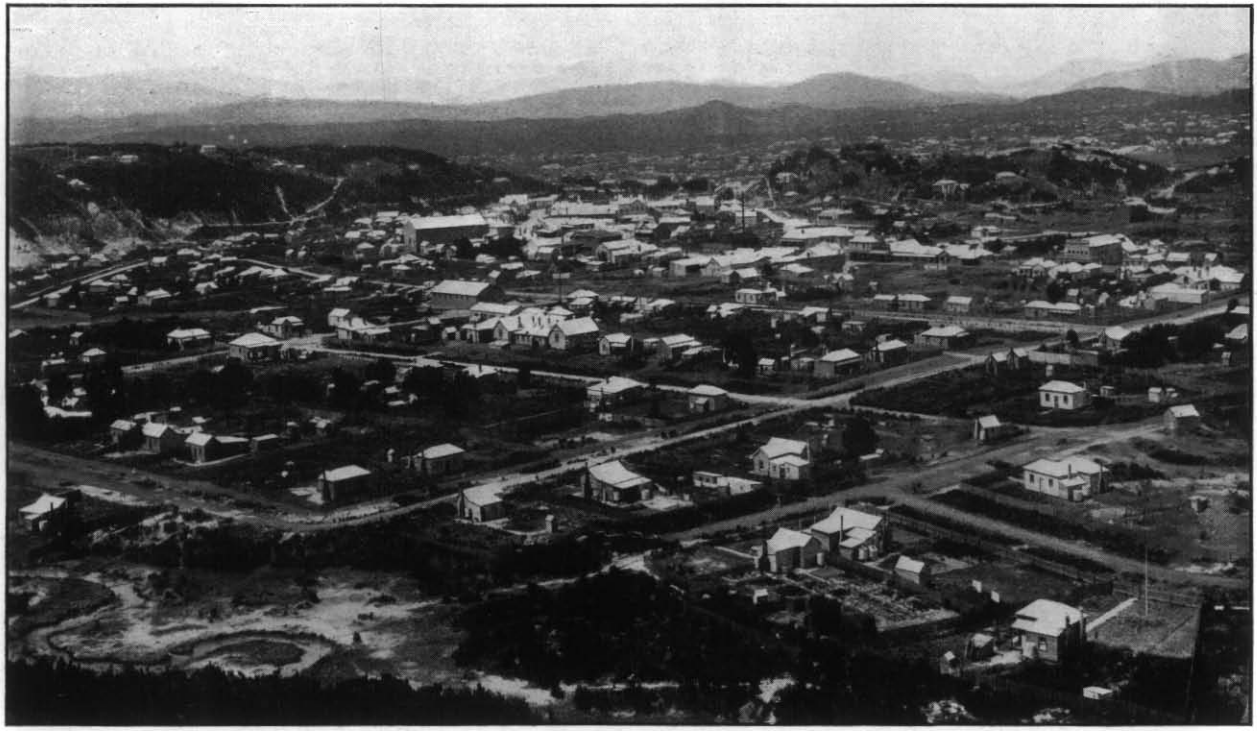
Several other mines in the vicinity are in the prospecting stage, but capital is required to properly and systematically develop them to prove whether gold exists in paying quantities, outside the two principal mines referred to.

Gold-mining on the West Coast has been confined principally to the Woody Hills and May Gold Mines, from which small quantities of gold have been obtained.

Silver Mining.

Zeehan.—The bulk of the silver-lead ore raised during the year has been obtained from the West Coast mines; the total quantity of ore raised being 75,270½ tons, valued at £246,888. The prospects of the West Coast fields are exceedingly good. The principal producing mines are the Mount Zeehan, Montana, Western Mines, and Florence Mines. Outside the Zeehan field the Dundas mines have maintained their productions, and have supplied large quantities of fluxing ores to the Zeehan smelters.

The Hercules Mine has been idle since the strike. The Rosebery Mine, to the north, is sending out large quantities of ore to the Zeehan Smelting Company's works. The company is able to treat the gold, silver, and lead contents successfully, and tributes let on the Primrose and Tasmanian Copper Mines have been worked very profitably in consequence. It is hoped that this field, which has so long remained dormant, will soon assume an important position among our mining centres.



ZEEHAN.

Mount Farrell.—The mines in the district are making steady progress. The North Farrell Mine has opened up for mining a large portion of its lode; and the Murchison River Company has completed the erection of its concentrating plant, and expects shortly to have its underground workings in a condition for handling its ore in an economical way. The Mackintosh Mine is being worked on tribute.

North-Western Division.—A very important development took place during the year in the No. 6 level of the Magnet Mine, the lode being struck 23 feet in width, consisting of about 5 feet of high-class ore and 18 feet of seconds. The lode has been driven on some 240 feet, and, although it continues towards the north, it is not so good as when first struck. The output of the mine has been continued, and the company is increasing its reserves steadily by pushing on the developmental work. The company proposes to bring in the Arthur River with the Magnet Creek, and, after use, to divert both streams into the Magnet bed, and then again into the Arthur River. A dam capable of holding 15,000,000 gallons of water, for use during the summer months, has been surveyed; and it is expected that electric power will be installed at the mine in place of the present compressed-air plant.

Heazlewood.—The Long Tunnel Mine has yielded a fair output of ore, but the work has had to be discontinued owing to the bad condition of the Waratah road.

Copper.

The output of copper and copper ore is valued at £757,226.

The Mount Lyell Mining and Railway Company's output has been steadily maintained. During the year the company smelted 426,854 tons of ore, producing 8610 tons of blister copper, which contained 8506 tons of copper,

valued at £619,071; 732,019 ozs. of silver (fine), valued at £85,216; and 24,567 ozs. of gold (fine), valued at £104,027; a total of £808,314, as compared with £681,938 during the previous year.

The amount paid in dividends was £175,000.

The Lyell Blocks Mine is working its copper-bearing clay deposit, and producing regularly native copper concentrates.

The cupriferous schists on other claims at Lyell have been prospected to some extent, and it is rumoured persistently that several properties which had been temporarily idle are now about to resume work.

Blythe River.—The Copper King Mine has been taken over by an Adelaide syndicate, and exploratory and developmental work is being pushed on with.

Tin Mining.

The high market-price of tin which has ruled during the year has been the means of stimulating great activity in mining for this mineral, especially in the Eastern and North-Eastern districts, and large areas of land have been taken up, and are being prospected and developed with very encouraging results. The quantities raised in the various districts are as follow:—

	Tons	cwts.	qrs.
Northern and Southern Division	23	11	0
North-Eastern Division	1927	3	0
Eastern Division	524	16	0
North-Western Division	1316	3	0
Western Division	100	0	0
TOTAL	3891	13	0

The largest producer has been, as usual, the Mt. Bischoff Tin Mine, raising 1272 tons of ore; bringing the total production of this mine up to 64,774 tons 18 cwts.

2 qrs.; and dividends amounting to a gross total of £2,024,500 have been declared.

The next largest producers were the Briseis and New Brothers' Home No. 1 Companies, 882 tons 15 cwts.; the Pioneer Company, 309½ tons; the Anchor, 198 tons 14 cwts.; Mt. Rex, 95 tons 7 cwts.; Scotia, 24 tons 12 cwts.; Arba, 121 tons 17 cwts.; South Mt. Cameron Company, 62 tons 12 cwts.; Briseis Extended Company, 57 tons 13 cwts.

The Shepherd and Murphy Company's tin, bismuth, and wolfram mine, at Middlesex, which was idle for some considerable time, is now being prospected with English capital, and good results are expected.

At Gladstone great activity prevails, and the once almost deserted township is again flourishing. The established alluvial mines are producing their regular output, and a large area of new ground has been taken up and is being prospected, and in many instances with very encouraging results; and outside capital has been brought in for the purpose of constructing water-races and opening up and developing the mines.

The Gladstone Tin Development Company's dredge commenced operations in the Ringarooma River, and is now dredging at Bell's Flat, and obtaining tin.

Two dredges are to be built by the Dorset Bucket Dredging Company.

New ground has been taken up in the Pioneer, Moorina, Weldborough, Branxholm, and St. Helens districts.

The Swansea and Swan Tin Mining Companies have been formed for the purpose of testing the alluvial tin deposits on Schouten Main, and small parcels of ore have been sent away for smelting.

The tin deposits at Cox's Bight, in the south, which were abandoned some years ago, have been again taken up, and small quantities of tin are being obtained.

The Renison Bell Company's property, on the West Coast, which has remained idle for so long, has again

started operations. The alluvial tin is being sent to market, and underground work is proceeding, with a view of testing the lodes.

At Mount Balfour and Stanley River several mines are at work, but are experiencing great difficulty in getting ore to market owing to the bad state of the roads.

Wolfram.

About 32 tons have been obtained, principally from the Ben Lomond mines and from the Middlesex district, an average of 13 men being employed.

Iron.

The only company raising and exporting ore during the year was the Tasmanian Iron Company, at the Penguin. Six thousand three hundred tons of ore were exported to New South Wales for use in smelting other ores.

Coal.

The quantity raised was 51,993 tons, as against 61,109 tons last year. The principal producers were:—

	Tons.
Mt. Nicholas Mine	24,802
Cornwall Mine	20,478
Mt. Cygnet Mine	2267
Catamaran Mine	1224

A few small mines in the Mersey district have suspended work.

The Sandfly Colliery Company has done a great deal of exploratory work, and has raised about 256 tons of coal. The company's operations have chiefly been confined to erecting a jetty at North-West Bay, and constructing a tramway from the jetty to the mine. This work has been completed since the close of the year, and it is expected that the mine will be a large contributor to the coal output of the State, as it is said the coal is of excel-

lent quality for steam and household purposes, and should command a ready market.

Chinaware.

It is not generally known that the clays in several parts of Tasmania are well adapted for the manufacture of chinaware. Some time ago, Hon. E. Littleton sent a sample from the eastern shore at George's Bay, to the Copeland Pottery, Staffordshire, England, and the result is in every way satisfactory. The cups and saucers of the darker shade were made according to the same formula as the earthenware pottery, and the lighter-coloured samples after the manner of the white English china. The results are pronounced by experts to be remarkable, and prove the existence of valuable commercial clays on the East Coast of Tasmania.

The following Return shows the quantity and value of mineral products for the State of Tasmania during the year ending 31st December, 1905:—

Mineral.	Quantity.	Value.
		£
Gold	73,540½ ozs. (fine)	312,380
Copper & Copper Ore	1150¾ tons	52,939
Copper (Blister)	8610 „	704,287*
Silver-Lead Ore	75,270½ „	246,888
Tin & Tin Ore	3891½ „	362,670
Wolfram	32¼ „	2371
Coal	51,993 „	44,194
Iron Ore	6300 „	2600
Bismuth	3½ „	80
Total Value	...	£1,729,129

* Value of gold contents deducted.

Amount paid in dividends was £307,933.

Geological Branch.

During the year the Government Geologist has prepared reports upon the coal at Mt. Rex, and on the North-West Coast mineral deposits. He has also prepared

quarterly reports on the mining industry of the State, and was also engaged examining the Mathinna Goldfield. The quarterly progress reports of the mineral industry have been issued, as usual. For these, as well as for the special district reports, there is a considerabe demand from abroad, and from visitors arriving in the State. Our publications lying upon the tables of public libraries and institutes throughout the world may be regarded as of distinct service in directing the attention of investors to the mineral resources of Tasmania.

Inspection of Mines.

The three Inspectors have satisfactorily discharged their duties in the districts severally allotted to them. Their reports are appended.

Mining Managers' Examination

The annual examination of candidates for mining managers' certificates was held in March. Two candidates only presented themselves for examination, and succeeded in obtaining sufficient marks to entitle them to receive second-class certificates.

Copies of the papers set at the examination are appended.

Diamond-drills.

The diamond-drills were not in operation during the period under review.

Mt. Cameron Water-race Board.

The report of the Board is appended.

Departmental Staff.

No changes in the Staff have been made during the year.

Revenue.

The net revenue for the year amounted to £20,208 17s., being an increase of £3577 8s. 10d. on the previous year. This amount does not include a sum of £5507 19s. 6d. deposited as survey fees with application for leases.

Conclusion.

The outlook for the present year is a favourable one. The registered value of minerals raised during the first six months of 1906 exceeds that for the corresponding six months of 1905 by £345,422.

Mining is very active all over the State on thoroughly legitimate lines, and the condition of the industry generally may, in the strictest sense of the word, be described as sound.

In conclusion, I desire to thank the officers of the Departmental Staff for the loyal and efficient manner in which they performed the duties allotted to them.

I have the honour to be,

Sir,

Your most obedient Servant,

W. H. WALLACE.

Secretary for Mines.

To the Hon. ALEX. HEAN, Minister for Mines.

DIAMOND-DRILLS.

Statement of ***Work done*** *to* 31*st* ***December***, 1905.

Year.	Locality.	Direction of Bore.	No. of Bores.	Total Distance Bored.	Average cost per foot, inclusive of Labour and Fuel.
	No. 1 Drill.			feet.	£ s. d.
1882-3	Back Creek—For Gold	Vertical	7	1330	0 10 9
1883	Lefroy—For Gold	Ditto	4	1011	0 5 3
1884	Tarleton—For Coal	Ditto	1	401	0 5 6
1886	Longford—For Coal	Ditto	2	1585	0 4 0½
1886-7	Harefield Estate—For Coal	Ditto	1	725	0 6 5
1887	Cardiff Claim, Mount Malcolm—For Coal	Ditto	1	562	0 17 11¼
1888	Killymoon Estate—For Coal	Ditto	1	504	0 4 7¾
1888-9	Seymour—For Coal	Ditto	5	2266	0 7 8½
1889 / 1890	Beaconsfield (Phœnix G.M. Co.)—For Gold	Ditto	1	781	2 0 2
1890	Beaconsfield (East Tasmania G.M. Co.)—For Gold	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
1895-6	Sandfly—For Coal	Ditto	4	2130	0 11 5
1898 / 1900	Blue Tier (Anchor Co.)—For Tin	Ditto	9	876½	0 9 1¾
1901-2	Llandaff—For Coal	Ditto	3	1944	0 7 4
1902	Recherche (Catamaran Co.)—For Coal	Ditto	2	956	0 9 3
1903	Ditto (Moss Glen Co.)—For Coal	Ditto	2	667	0 7 6
	Total	...	54	19,917½	

	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, near 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 (Mount Bischoff Alluvial T.M. Co.) For Tin	Ditto	7	1548	0 6 1½
1887	Waratah (Mount Bischoff T.M. Co.)—For Tin	Ditto	7	841	0 11 8
1887	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 5½
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
1893	Southport—For Coal	Ditto	1	612	0 5 3
1894	Zeehan (Tasmania Crown S.M. Co.)—For Silver ...	Horizontal, underground	2	319	1 0 2½
1902	Eden—For Coal	Vertical	2	566	1 0 7½
1902-3	Farm Cove—For Coal	Ditto	1	571	0 5 6
	Total.....	...	44	12,766	

Aggregate number of bores 98
Total Distance bored .. .. 32,683½ feet.

W. H. WALLACE, *Secretary for Mines.*

No. 1.

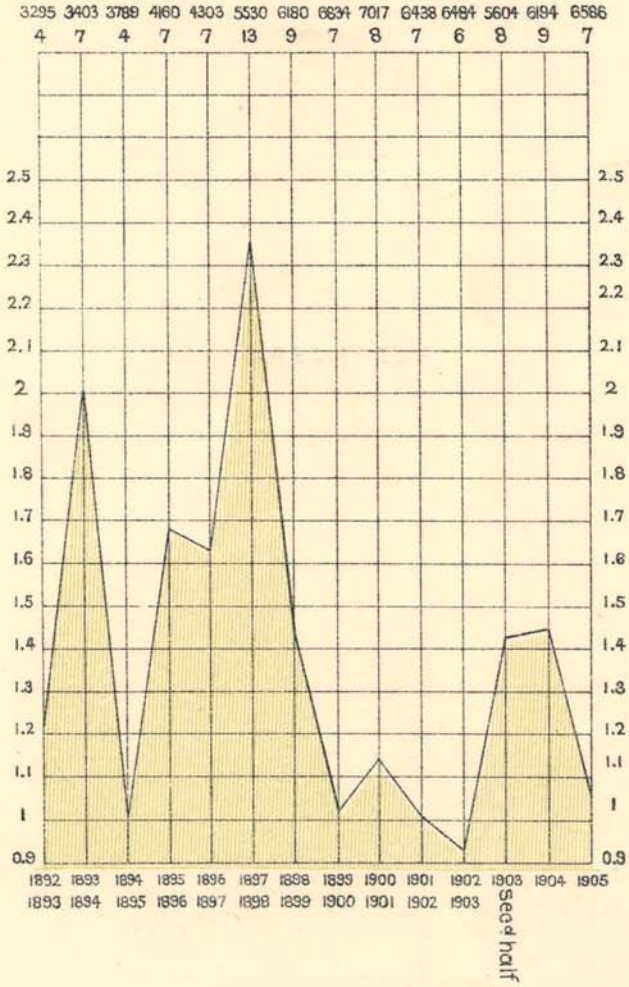
RETURN showing the Quantity and Value of Gold won during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, *and* 1905.

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
1893	37,687	0	141,326
1894	57,873	0	217,024
1895	54,964	0	206,115
1896	62,591	0	237,574
1897	77,131	0	296,660
1898	74,233	0	291,496
1899	83,992	0	327,545
1900	81,175	0	316,220
1901	*69,491	0	295,176
1902	*70,996	0	301,573
1903	*59,891	0	254,403
1904	*65,921	0	280,015
1905	*73,540	10	312,380
	1,405,298	9	5,498,101

* Fine Gold.

Diagram showing the ratio of fatal accidents in mines in Tasmania

Rate per 1000 men employed



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No. 2.

RETURN showing the Quantity and Value of Gold obtained from Quartz during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, *and* 1905.

Year.	Quantity.	Value.
	ounces.	£
1880	34,345	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
1893	30,163	113,111
1894	52,239	195,896
1895	51,628	193,605
1896	59,453	222,948
1897	74,937	288,432
1898	72,080	283,422
1899	81,751	319,141
1900	79,977	311,580
1901	*68,779	292,155
1902	*70,440	299,212
1903	*58,868	250,054
1904	*65,159	276 779
1905	*73,032	310,219
	1,366,850	4,949,216

* Fine Gold.

No. 3.

RETURN showing the Quantity and Value of Coal raised during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, *and* 1905.

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
1893	34,693	27,754
1894	30,499	24,399
1895	32,698	26,159
1896	41,904	33,523
1897	42,196	33,757
1898	47,678	38,256
1899	42,609	38,349
1900	50,633	44,227
1901	45,438	38,451
1902	48,863½	41,533
1903	49,069	41,709
1904	61,109	51,942
1905	51,993	44,194
	880,363½	755,146

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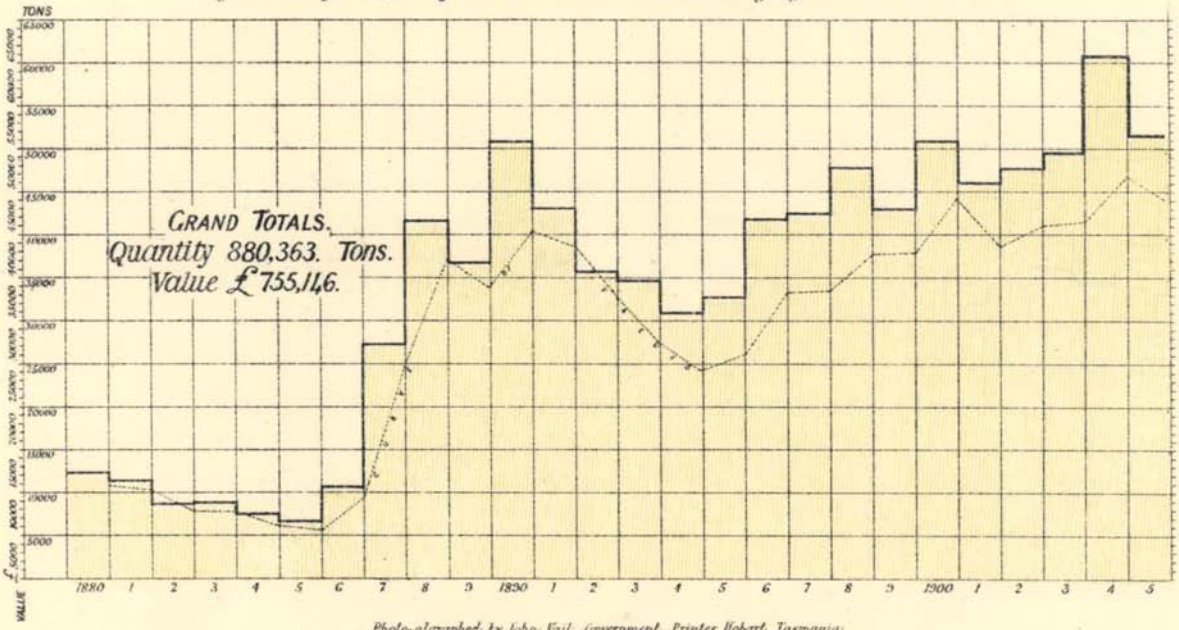
Diagram showing Total Quantity & Value of Coal raised in Tasmania during the years 1880-1905



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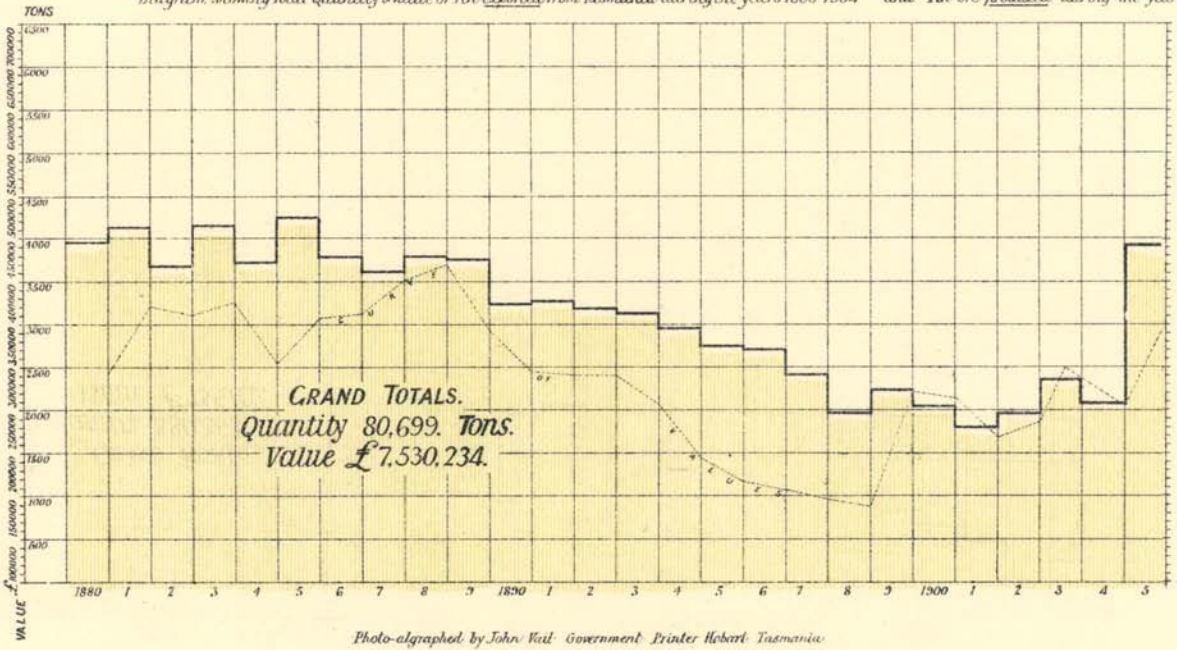
Diagram, showing Total Quantity & Value of Tin exported from Tasmania during the years 1880-1904 and Tin ore produced during the year 1905



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No. 4.

***RETURN** showing the Quantity and Value of Tin exported from Tasmania during the Years* 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, *and* 1904, *compiled from Customs Returns only, and Tin Ore produced during the year* 1905.

Year.	Quantity.	Value.
	Tons.	£
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
1893	3128½	260,219
1894	2934	198,298
1895	2726¾	167,461
1896	2700	159,036
1897	2423½	149,994
1898	1972	142,046
1899	2239¼	278,323
1900	2029	269,833
1901	1789½	212,542
1902	1958¼	237,828
1903	2376$\frac{3}{20}$	300,098
1904	2171½	255,228
1905*	3891½	362,670
	80,699$\frac{18}{20}$	7,530,234

* Tin Ore produced : Customs having ceased to issue Returns.

No. 5.

***RETURN** showing the Quantity and Value of Silver Ore produced during the Years* 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, *and* 1905.

Year.	Quantity.	Value.
	Tons.	£
1888	417	5838
1889	415	7044
1890	2053	26,487
1891	4810	52,284
1892	9326	45,502
1893	14,302	198,610
1894	21,064	293,043
1895	17,980	175,957
1896	21,167	229,660
1897	18,364	200,167
1898	15,320	188,892
1899	31,519½	250,331
1900	26,564	279,372
1901	28,774	207,228
1902	46,480	218,864
1903	42,422	192,492
1904	51,138	203,702
1905	75,270½	246,888
	427,386	3,022,361

No. 6.

RETURN showing the Quantity and Value of Blister Copper produced during the Years 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, *and* 1905.

Year.	Quantity.	Value.
	Tons.	£
1896	41½	1245
1897	4700	322,500
1898	4955½	400,668
1899	8598	735,305
1900	9449	907,288
1901	9981	879,625
1902	7745	*462,151
1903	6684	*478,023
1904	8371	*582,540
1905	8610	*704,287
	69,135	5,473,632

* Value of Gold contained deducted.

No. 7.

RETURN showing Quantity and Value of Copper Matte exported during the Years 1902, 1903, 1904 *and* 1905.

Year.	Quantity.	Value.
	Tons.	£
1902	2500	50,112
1903	3727	83,624
1904	—	—
1905	—	—
	6227	133,736

No. 8.

RETURN showing the Quantity and Value of Copper Ore produced during the Years 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, *and* 1905.

Year.	Quantity.	Value.
	Tons.	£
1896	34	1020
1897	75	2250
1898	394	8128
1899	1695	26,833
1900	4221½	63,589
1901	11,221	130,412
1902	5994	65,270
1903	102	790
1904	104	1640
1905	1150¾	52,939
	24,991¼	352,871

No. 9.

RETURN showing the Quantity and Value of Iron Ore produced during the Years 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, *and* 1905.

Year.	Quantity.	Value.
	Tons.	£
1897	894	812
1898	1598	1598
1899	3577	3474
1900	5375	5995
1901	612	417
1902	2386	1075
1903	5980	2905
1904	6840	2975
1905	6300	2600
	33,582	21,851

5 cm

Diagram showing the Annual Value of Minerals & Metals raised in Tasmania from 1880-1905

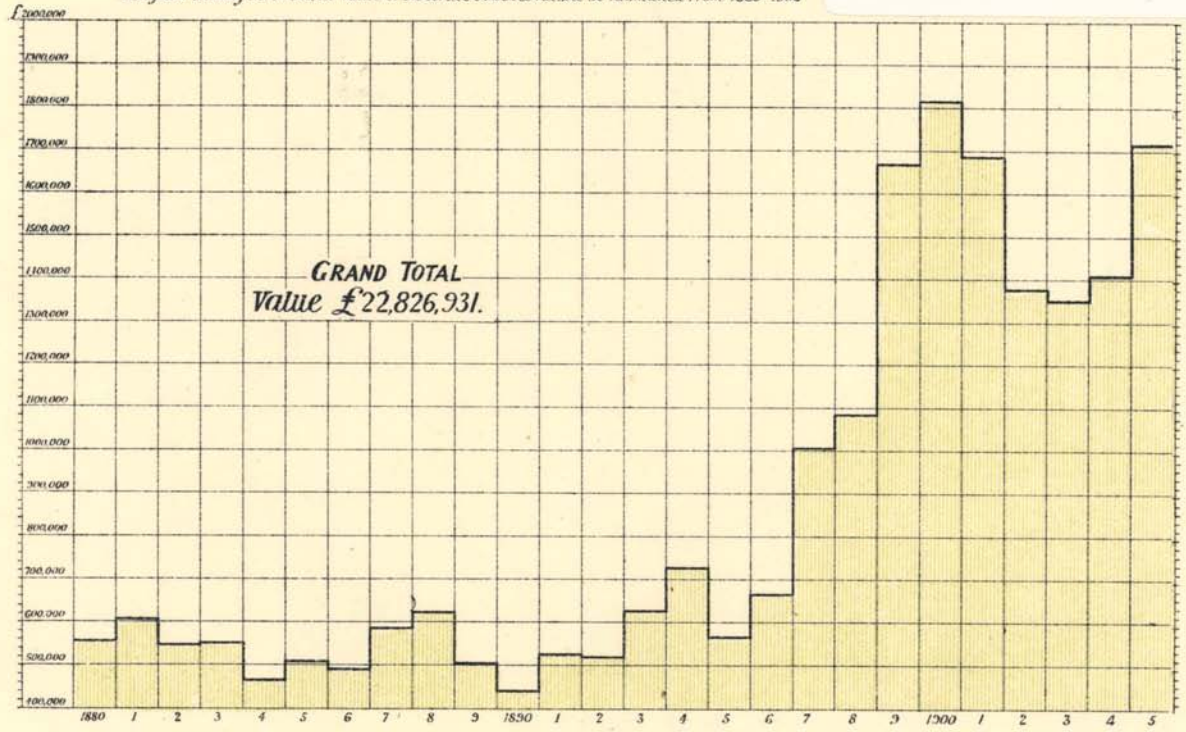


Photo-algraphed by John Vail Government Printer Hobart Tasmania

No. 10.

***RETURN** showing the Quantity and Value of Asbestos produced during the Years* 1899, 1900, 1901, 1902, 1903, 1904, *and* 1905.

Year.	Quantity.	Value.
	Tons.	£
1899	200	363
1900	128	113
1901	46½	45
1902	—	—
1903	—	—
1904	—	—
1905	—	—
	374½	521

No. 11.

***RETURN** showing the Quantity and Value of Wolfram produced during the Years* 1899, 1900, 1901, 1902, 1903, 1904, *and* 1905.

Year.	Quantity.	Value.
	Tons.	£
1899	3½	99
1900	53¾	2058
1901	—	—
1902	—	—
1903	—	—
1904	15½	1147
1905	32¼	2371
	105	5675

No. 12.

RETURN showing the Quantity of Silver Lead and Copper Ore smelted for period 25th June to 31st December, 1896, and 1st January 1897, to 31st December, 1905.

Year.	Ore Smelted.	Products.			Yield.			
		Silver Lead Bull'n.	Blister Copper.	Matte.	Copper.	Silver.	Gold.	Lead.
	Tons.	Tons.	Tons.	Tons.	Tons.	Ozs.	Ozs.	Tons.
1896	26,028 1/20	—	—	2417 6/20	1235 1/20	75,951	4707	—
1897	90,773 1/2	—	3476 12/20	257 16/20	3583 14/20	334,349	16,485	—
1898	170,933	—	4992	—	4783	606,123	24,418	—
1899	275,239	2295	8463	89 8/20	8362	1,089,657	27,615	—
1900	363,113	4817	9449	—	9341	1,215,036	26,255	—
1901	355,528	1839	9982	50	9880	800,317	21,717	—
1902	411,736	6825	7727	2882	8841	1,674,816	24,719	6654
1903	399,032	7560	6683	3413	8094	1,855,158	25,238	7529
1904	433,366	—	8371	—	8265	1,896,134	26,809	7754
1905								

No. 13.

RETURN showing the Average Number of Persons engaged in Mining during the Years 1880 to 1905 inclusive.

Year.	Number.	Year.	Number.
1880	1653	1893	3403
1881	3156	1894	3433
1882	4098	1895	4062
1883	3818	1896	4350
1884	2972	1897	4510
1885	2783	1898	6052
1886	2681	1899	6622
1887	3361	1900	7023
1888	2989	1901	6923
1889	3141	1902	5934
1890	2868	1903	6017
1891	3219	1904	6194
1892	3295	1905	6581

No. 14.

RETURN showing the Number and Area of Leases held under "The Mining Act, 1900," *in force on* 30*th June in years* 1899 *to* 1903 *inclusive, and on* 31*st December*, 1903, 1904, *and* 1905.

Nature of Lease.	In force on 30th June, 1899.		In force on 30th June, 1900.		In force on 30th June, 1901.		In force on 30th June, 1902.		In force on 30th June, 1903.		In force on 31st December, 1903.		In force on 31st December, 1904.		In force on 31st December, 1905.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.
		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.
For Minerals, Silver, Tin, &c.	1207	64,339	1487	70,500	1388	60,865	1063	45,399	950	40,068	826	33,325	868	33,824	944	34,325
For Coal, Slate, Shale, &c.	39	6002	52	7258	55	7566	52	7819	66	10,767	54	9119	47	7546	45	7185
For Gold	652	6725	647	6623	566	6091	425	4166	310	3117	243	2505	222	2268	195	2087
Dredging Claims	—	—	—	—	—	—	—	—	—	—	15	124	29	469	51	1196
Mining Easements	—	—	—	—	—	—	—	—	—	—	34	225	39	234	45	282
Water Rights Mineral and Gold	200	933 sluice-heads.	225	1004 sluice-heads.	267	1318 sluice-heads.	300	1691 sluice-heads.	299	1514 sluice-heads.	281	1460 sluice-heads.	340	1495 sluice-heads.	251	1477 sluice-heads.

No. 15.

COMPARATIVE Statement of Revenue from Mines, being Rents, Fees, &c. (exclusive of Survey Fees), paid to the Treasury for the Years ending 30th June, from 1880 to 1903, and for Six months ending 31st December, 1903, and for the Years ending 31st December, 1904, and 31st December, 1905.

Year.	Amount.			Year.	Amount.		
	£	*s.*	*d.*		£	*s.*	*d.*
1880	8944	5	11	1894	16,732	7	7
1881	20,936	5	5	1895	15,323	1	9
1882	23,077	1	9	1896	20,901	13	2
1883	15,439	14	5	1897	25,631	0	3
1884	6981	11	10	1898	33,661	13	9
1885	11,070	5	7	1899	24,696	10	5
1886	12,523	10	4	1900	28,380	11	10
1887	14,611	11	5	1901	21,569	5	2
1888	23,502	8	4	1902	19,471	0	1
1889	17,254	9	0	1903	17,776	14	3
1890	26,955	4	9	1903, 1 July to 31 Dec.	14,758	17	1
1891	37,829	16	5	1904, Jan. to Dec.	16,631	8	2
1892	17,568	18	4	1905	20,208	17	0
1893	16,971	9	2				

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

No. 16.

RETURN showing the Total Number and Area of Leases in force on 31st December, 1905.

Minerals.	Number.	Area.
		Acres.
Gold	195	2087
Minerals	109	6199
Silver	158	8157
Copper	37	1857
Tin	611	16,774
Coal	32	5142
Limestone	5	386
Iron	11	529
Slate	1	200
Wolfram	8	387
Asbestos	3	162
Precious Stones	1	80
Lithographic Stone	1	97
Marble	1	317
Shale	4	1040
Phosphate of Lime	1	3
Nickel	6	180
Machinery Sites	19	74
Dredging Claims	51	1196
Mining Easements	45	282
Water Rights	251	1477 sluice-heads, & 710 acres dams

No. 17.

RETURN showing the Average Number of Miners employed during the Year ending 31st December, 1905.

	Europeans.	Chinese.
Northern and Southern Division	920	1
North-Eastern Division	555	100
Eastern-Division	729	61
North-Western Division	432	...
Western Division	3783	...
	6419	162

No. 18.

RETURN showing the Mining Companies registered during the Year ending 31st December, 1905.

Number of Companies.	Capital.
14	£29,436

In addition to the above, 30 Agents for Foreign Companies, and 4 Syndicates, under 60 Vict. No. 51, were registered.

No. 19.

TOTAL Area of Land and Number of Sluice-heads of water applied for during the Year ending 31st December, 1905.

Mineral.	No. of Applications.	No. of Sluice-heads.	Area.
			Acres.
Bismuth	3	...	120
Coal	7	...	990
Copper	20	...	1065
Galena	3	...	54
Gold	81	...	869
Iron	2	...	100
Mineral	81	...	4210
Osmiridium	1	...	20
Silver	24	...	1143
Tin	694	...	19,385
Wolfram	1	...	78
Machinery Sites	6	...	28
Dredging Claims	66	...	1473
Water Rights	211	1233	916
TOTAL	1200	1233	30,451

No. 20.

RETURN showing the total Amount of Rents, Fees, &c., received by the Mines Department during the Year ending 31st December, 1905.

Head of Revenue.	Amount.
	£ s. d.
Rent under "The Mining Act, 1900," for Gold and Minerals	18,404 13 5
Fees, ditto ditto	1804 3 7
Survey Fees	5507 19 6
Rent of Diamond-drills	—
TOTAL	25,716 16 6

No. 21.

RETURN showing the Amounts paid in dividends by Mining Companies during the Year ending 31st December, 1905.

Mines.	Dividends.
	£ s. d.
Copper	195,000 0 0
Gold	1600 0 0
Tin	76,944 0 0
Silver	34,389 0 0
TOTAL	£307,933 0 0

REPORT OF THE MOUNT CAMERON WATER-RACE BOARD FOR THE YEAR ENDING 31ST DECEMBER, 1905.

8th March, 1906.

SIR,

WE have the honour to present the report of the Board for the year ending 31st December, 1905.

Water.—The quantity of water at present available is twenty-five sluice-heads, being an increase of seven heads over this time last year. Most of this increase is derived from the Old Chum Creek, which has been connected with the main race during the year; the rest has been secured by renewing the old fluming across the Old Chum Creek, thus saving the water which was formerly lost by leakage.

Flumings.—There are 24 flumings, 23 of which, by constant care bestowed upon them, have been kept from total collapse. Some bad breaks have occurred during the year, which have taken some time to repair, necessitating the turning off of the water and causing loss of revenue. No. 26 fluming over Old Chum Creek has been replaced by an iron flume.

All the flumings need prompt attention, and the Board respectfully requests the Government to provide at once the sum necessary for their entire replacement, and thus guard against the risk of total collapse, which is imminent if the work is left to the limited resources of the Board.

Syphons.—The number of breaks in the syphon pipes has been less than last year, owing to the constant attention paid to them; but none of the water which leaks from the pipes is now lost, but is stored in a small dam and sold to claim-holders working at a lower level.

Works.—The Government having purchased from Mr. James Ogilvie his water-right on Old Chum Creek for the sum of £75, the Board has now connected the Old Chum Creek with the main race, at a cost of £564 17s. 8d., which will be covered in twelve months' time by the increased revenue from the sale of additional water brought in by this connecting race. The renewal of No. 26 flume has also been carried out, at a cost of £639 9s. 11d. The report of the Engineer on these works is appended.

The statistics for the year are as follows:—

Average per week of claims supplied, 9.

Greatest number supplied in any one week, 15.

Total number of heads supplied:—

Under fixed or cash scale	4246⅜
Under royalty or credit scale...	78⅜
Total	4325¹¹⁄₁₄

Tin ore raised:—Royalty scale, 17 cwts. 3 qrs. 19 lbs.; fixed scale, 74 tons, 15 cwts. 0 qrs. 24 lbs.; total 75 tons 13 cwts. 0 qr. 15 lbs.

Average number of miners employed:—Europeans, 28; Chinese, 1; total, 29.

GLADSTONE TIN DEVELOPMENT COMPANY'S DREDGE.

Total receipts for the year:—Fixed scale, £2553 4s. 7d.; royalty scale, £22 16s. 3d.; sale of wire rope, £5; total, £2581 0s. 10d.

Expenditure: Cost of maintenance and management—

	£	s.	d.
Salary and wages	582	8	0
Repairs to syphon-pipes	168	1	2
Repairs to flumings and race...	21	3	8
Cleaning race-channel	78	6	5
Travelling expenses...	55	12	5
Stationery and printing	4	8	0
Stores, tools, and general repairs ...	13	19	9
Insurance	3	6	0
Old Chum Creek—Connection and deviation of No. 26 flume	1204	7	7
Total	£2131	13	0

Paid to Public Debts Sinking Fund, 1905 (including moiety of rents of mineral land served by the race, £21 17s. 6d.), £978 13s. 6d.

Total amount paid to Public Debts Sinking Fund to 30th June, 1905, £9869 5s. 5d.

Total cost of purchase and construction, £34,281 19s. 0d.

W. H. WALLACE, *Chairman of the Board.*
EDWARD L. HALL,
W. H. TWELVETREES,
JOHN SIMPSON,
S. HAWKES,
} *Members of the Board.*

The Hon. the Minister of Mines, Hobart.

ENGINEER'S REPORT.

Launceston, 16th January, 1906.

SIR,

I HAVE the honour to forward to you my final report on the completion of the work of constructing the race connecting the Old Chum Creek with the Mount Cameron Water-race, and the deviation of No. 26 flume.

These works were commenced on the 24th May, and finished on the 31st October last, at a total cost of £1204 7s. 7d. Of this amount £564 17s. 8d. was expended on the Old Chum connection, and £639 9s. 11d. on the deviation of No. 26 flume. Crediting these works with the plant and material stored (at my valuation), the costs are:—Old Chum, £550 8s. 9½d.; and deviation, £575 0s. 0½d.

Old Chum Connection.—This work cost more than the estimate furnished for it, the reasons being insufficient information for the preparation of estimates, no alignment for race, bad weather, and indifferent labour.

The effects of these causes were as follows:—

Insufficient information.—It was considered desirable to complete as much of the work before the close of the financial year as possible, so that money might be utilised which would otherwise go into the general public revenue. There was not time to thoroughly test the ground by sinking trial-pits, to ascertain its nature, or to take cross-sections. As a conse-

quence, there was a good deal more rock, cement, and drift than was expected, and it was impossible to make proper allowance for the slope of the ground.

The rock on the south side of creek at intake was considered to be sound at surface; but, when preparing to build the weir, I found that it was not so, and I had to take a lot of it out before I got a sound bottom. From the intake to the sluice-gate, where the random rubble wall was to be built, was a heavier work than was expected, as the bottom of the race came into running drift. This, of course, took more stone and cement for the wall; and for the race, the bottom had to be brought up to grade with rammed clay.

There was also a bad drifty bottom at the small creek which was picked up at 17-18 chains, necessitating going much deeper than was anticipated for sound bottom for the clay-hearted bank, and consequently requiring more clay to fill it up.

Alignment of Race.—As there was no time to do this before furnishing the estimate, the quantities were calculated from the line of contour. When the race was constructed, this line had to be departed from, so as to ease bends, and also to avoid weak spots. This meant always keeping on the high side of the contour, and consequently increasing the cutting. The slopes in some places were steep, and not nearly enough allowance was made for these in preparing the estimates.

Bad Weather.—At the start of the work there was about a week of very wet weather, which thoroughly soaked the ground, and brought the creeks up; and though there were considerable stretches of fine weather afterwards, any rain which fell ran from the soaked ground and flooded the works.

As soon as the gullet was opened it used to fill with water, and the men were for weeks over their boot-tops in mud. It was not often practicable to cut an escape for the water, and then bailing had to be resorted to. Besides the discomfort of working in the mud, it was impossible for the men to shift as much material as if it were dry.

When working at the foundations for random rubble wall and clay-hearted bank, I had to keep two men on a Californian pump nearly all the time.

The creeks being high caused considerable trouble whilst putting in the concrete weir and clay-hearted bank.

Indifferent Labour.—This work was in progress when labour is generally scarce in the mining districts. Wet weather is the time when the tin mines are in full swing, and good and experienced pick-and-shovel men find no difficulty in getting employment of a more permanent nature, and in more convenient localities; consequently, I had not nearly such good labour as I might have had if the work had been done in the drier weather. Another reason for the excess of expenditure above the estimate is that the estimate given was for work only, and no provision was made for supervision, so that my salary and the wages of my chainman are altogether extras, as also was cost of plant and tents.

The clearing and felling was a heavier item than was expected. There were a good many large trees which Mr. Harvey and I considered endangered the safety of the race, and thought should come down; so I had them felled.

The random rubble wall, pitching and lining of intake, bank at 17-18 chains, and making up of faulty and weak places used

up a lot of stone, some of which had to be carted over half a mile, at considerable expense, there not being nearly enough at hand. The bank also absorbed a lot of clay, the main part of which had to be carted; that which came out of the works was too wet to ram, besides being of indifferent quality, and there was not nearly enough of it.

Some of the rock at the lower end was very hard, and the heads did not run well for the race. When shot out the channel was very irregular and ragged, and I had to make a good portion up again. Through the whole of the shooting at the lower end precautions had to be taken to prevent flying stones from damaging the old flume. This, among other things, necessitated smaller shots than might often have been used with advantage, and different placing of shots. All these precautions necessarily added to the cost.

There was a great deal of hard cement and decomposed granite met with, much of which was too hard for the pick, and had to be got out with gads.

The cost of the rock-shooting was about 5s. per cubic yard, and of earthwork about 1s. 10¼d. per cubic yard.

I had the work done in a thorough manner. I considered that a race, such as the Mount Cameron, which is required to serve a district, not only for the lives of the mines now working, but for any future developments, should be as sound as it could be made.

Deviation of No. 26 Flume.—The bulk of the first 5 chains of this is through fairly good cutting; but the slope is steep, and therefore the quantity of material to be removed was considerable. About 1 chain was, largely, hard red cement, and there was a nasty little gully to cross, which necessitated a clay-hearted double-stone wall about ¾ of a chain long and about 8 feet high at the deepest part. The stone for this wall had to be carted a considerable distance, none being procurable at the spot. The clay used was taken from the race.

From 9 chains 91 links to 6 chains 98 links is iron fluming on wooden trestle-work, and the remaining 3¼ chains was stone-walling and rock-shooting. The flume was made of No. 14 gauge steel plates, fastened at either end. The flume trestling consists of five spans, the centre one crossing the Old Chum Creek, being about 36 feet in the clear, and trussed. The clearance of this centre-span above the ordinary creek level is about 10 feet.

The rock-shooting on this deviation was mainly through very hard rock, with heads running badly for the race; and being so close to the old flume, great care had to be taken to prevent flying pieces of stone from damaging that. These conditions, of course, added to the cost of the work; but the whole was carried through without causing any loss of water. The earthwork on this part of the work cost about 1s. 5¾d. per cubic yard, and the rock-shooting about 6s.

The flume is 45½ yards long, and cost approximately £290.

Yours obediently,

FRANK SNEYD GROVE,

Engineer in Charge of Works

W. H. Wallace, Esq.,
Chairman Mount Cameron Water-race Board,
Hobart.

MINE MANAGERS' EXAMINATION.

21st March, 1905.

Questions set.

Subject A.—Mining.

1. A mine has been worked to 400 feet deep. The flow of water during the past 12 months has averaged 17,000 gallons per hour. It is proposed to instal a new pump fit to work to 1500 feet deep—
   (*a*) What boiler H.P. is required?
   (*b*) What pump would you recommend?
   (*c*) How would you place that pump in the shaft?
2. State the Regulations under the Mining Act of the year 1900 which refer to winding from shafts, describing the different appliances you would use, and your reasons for preferring them to others used for the same purpose.
3. Describe the use of boring rods in Deep-Lead Mining.
4. Describe the system in which you would open up and stope a lode about 6 feet wide in—
   (*a*) Ground that requires no timber.
   (*b*) Ground with a rotten hanging-wall.
   Give in both cases details of timbering, &c.
5. A tunnel has to be driven 300 feet to connect with a shaft, how would you timber same and ensure ventilation?
6. What precautions would you take to ensure the health of the workmen in a mine employing—say 200 men?
7. State the various conditions to be considered in choosing a site for a shaft to work—
   (*a*) A nearly vertical quartz reef 5 feet wide to a depth of 1000 feet. Show position of shaft and crosscuts, and state generally the method of working you would adopt; or
   (*b*) A thin seam of hard coal, free from faults, and of considerable extent. Give size of shaft-pillars, and generally the method of working you would adopt.
8. Give working sketches, with all dimensions, of an opening set 12 feet high for a shaft 12 feet by 4 feet.
9. Explain, with sketches, the use of false sets and face-boards in a drive through drift. Give details of face-boards and sets.
10. Design an iron sinking-box for a 12 feet by 4 feet shaft through drift sand. Explain method of using it.
11. What do you understand by "Water Gauge," "Equivalent Orifice," "Upcast," "Downcast," "Brattice"? What is the advantage of splitting the air current? How would you calculate the power required to drive a fan to ventilate a mine?
12. Describe generally the "Tail-rope" and "Endless-rope" systems of haulage. How are branches worked by either method?

SUBJECT B.—ORE-DRESSING AND SAMPLING.

1. In deciding on the site for a battery or concentrating plant, what points have to be considered?
2. Describe in detail a concentrating plant that you are conversant with, and what samples you would take and how often.
3. How would you sample a 50-ton parcel of ore in bags, the value, according to sellers, about £22 per ton?
4. Give some principles of separation. What do you understand by "sizing" and "sorting" (hydraulic classification)? Give sketches of appliances suitable for performing each operation. Do you consider that there is any advantage in combining different principles? Give reasons.
5. Describe a Gates or similar rotary crusher.
   A hard ore breaks in large lumps. How would you arrange a plant of such crushers for a large stamp mill?
6. An ore with no free gold consists of equal proportions of pyrrhotite and quartz, and assays 25 dwts. to 30 dwts. How would you treat it?

SUBJECT C.—MINING GEOLOGY.

1. Explain the occurrence of artesian water.
2. Name some metamorphic rocks, and explain the phenomena of metamorphism.
3. Furnish a classification of ore-deposits based upon considerations of origin.
4. Give a descriptive account of how ore-deposits are altered and enriched.
5. Describe the modes of occurrence of (1) tin ore, or (2) gold, and mention the minerals which are characteristically found associated with them.
6. Describe fully the method of recovering a lode which has been heaved by a fault.
7. Distinguish between reef quartz and quartzite; between granite and syenite; and between diorite and basalt.
8. By what tests would you identify the following ores:—galena, cassiterite, chalcopyrite, telluride of gold?
9. Give an account of the more important laws and conditions which affect the occurrence of and richness of metalliferous veins.

SUBJECT D.—MINING SURVEYING.

1. The following traverse connects two shafts; calculate the bearing and distance from one shaft to the other:—

Bearing.	Distance.
N. 53° 30′ W.	254 feet.
N. 36° 15′ E.	236 ,,
S. 23° 58′ E.	201 ,,

2. Describe carefully the adjustments of the surveyor's level.
3. Shew a sample page of a field-book, giving levels along a proposed line of tramway, shewing at least 3 changes of the instrument and 2 intermediate readings from each position of the instrument. Assuming the reduced level of the starting-point to be 100·00, reduce all the levels and check the calculations.

4. Describe how to set out a race by means of a level and staff, the fall being assumed.
5. Two shafts are connected underground through drives, and a short winze of regular underlay. Describe how to connect these shafts by underground survey, and how to connect this underground survey with surface observations.
6. Describe the construction and principle of the aneroid barometer. In what kinds of surveys would you use this instrument? Indicate the method of taking observations and checking them.
7. A chute of pay ore in a quartz reef is found to be 300 feet long at a certain level, and its average horizontal width is 16 feet. At a level 200 feet lower the chute is found to be of the same length, and its average horizontal width to be 12 feet. Assuming that the angle of dip of the reef is 60° with the horizontal, and that the dip of the chute is the same as the dip of the reef, calculate the amount of ore between the levels.

SUBJECT E.—SURFACE WORK.

1. An inclined plane of 1 in 7 is 1400 yards long; what size steel-wire rope would be required to haul 30 tons of coal at an average speed of 4 miles per hour? Assume the other data.
2. What is the effective horse-power of a single-cylinder high-pressure steam-engine: cylinder 16 inches in diameter by 30 inches stroke; number of strokes 60 per minute; average steam pressure throughout the stroke 35 lbs. per square inch?
3. Explain fully the construction of any type of electric coal-cutter you may be familiar with.
4. An engine draws 10 trucks of coal of 10 cwts. each up an incline of 1 in 9, 100 yards long, at an average speed of 5 miles per hour. How many similar trucks will the same engine draw, at the same speed, on the level? Assume the other data.
5. A ventilating fan passes 84,000 cubic feet of air per minute, at a water gauge of 1·5 inches; what horse-power steam-engine would be required to drive it to do this work?
6. Describe the general arrangement of an aerial ropeway for conveying material. Give a brief description of—
   (*a*) Method of hanging buckets from rope.
   (*b*) Terminal station.
   (*c*) Trestles.
7. Give sketches showing all dimensions of a whim and brace for hauling from a shaft of about 100 feet depth, the maximum load of a full bucket being about 7 cwts.
8. Along the course of a proposed race the following country occurs:—Loose soil and decomposed rock, vertical cliffs, solid impervious rock without much side slope. Indicate briefly but clearly in what manner, and of what material, the race should be constructed in each case, and give sketches of cross-sections.
9. What will be the discharge in gallons per minute of a pipe 10 inches in diameter, the length of pipe being 3000 yards, and the head 40 feet?

10. Give specifications for magazine for storing all the explosives necessary for working a large mine. Assume the nature and amount of explosives.

SUBJECT F.—BOOK-KEEPING AND MINE ACCOUNTS.

1. Explain the difference between capital and revenue expenditure.
2. Give an account of the functions of a Cash-book, Journal, and Ledger respectively, and describe how they are kept.
3. If twelve men earn £109 10s. in equal shares, subject however to a deduction of a sum of £7 10s. 6d. for stores supplied to them, what will be each man's share of the balance remaining?
4. One cwt. of steel hammers costs £1 7s. 4d., and they weigh 7 lbs. each; what is the cost of each hammer?
5. Take 7½ per cent. from £5 18s. 6d. What remains?
6. Describe any method of preparing analyses of costs and summaries of output of labour for a mine of which you might be the manager.
7. If a cubic yard of ore weighs 5600 lbs., what is its specific gravity?

SUBJECT G.—MINING LAW.

1. What is the maximum quantity of gunpowder or other explosive which may be stored in any mine, and what distance should same be stored from any travelling road?
2. At what intervals are platforms required to be provided in ladderways for the descent or ascent of persons in a mine?
3. What quantity of detonators is allowed to be kept in any one level in a mine, and how should same be stored?
4. How often is a mine manager required to inspect ropes, safety appliances, &c.?
5. What constitutes a "Sluice-head" of water under the Mining Regulations?

COLLIERY MANAGERS' EXAMINATION.

24TH MARCH, 1905.

SUBJECT C.—MINING GEOLOGY.

[Subject "A.—Mining," on page xxxii., was also required to be answered.]

1. What is anthracite? How do you account for its formation?
2. Explain reverse and trough faults respectively.
3. What genera of fossil plants and animals are usually found associated with coal?
4. What reasons have been advanced for supposing that coal has accumulated by growth of vegetation *in sitû*?
5. Place the following geological periods in their proper sequence in descending order:—Silurian, Tertiary, Jurassic, Carboniferous (or Permo-Carboniferous).
6. Explain the following terms:—Bituminous coal, dyke, stratified rocks, columnar structure, metamorphism.
7. Describe the natural processes by which river deltas have been formed.
8. What are the characteristics of a good coal for gas-making purposes?

SUBJECT D.—MINING SURVEYING.

1. The following traverse connects two shafts. Calculate the bearing and distance from one shaft to the other:—

Bearing.	Distance.
N. 53° 30′ W.	254 feet.
N. 36° 15′ E.	236 ,,
S. 23° 58′ E.	201 ,,

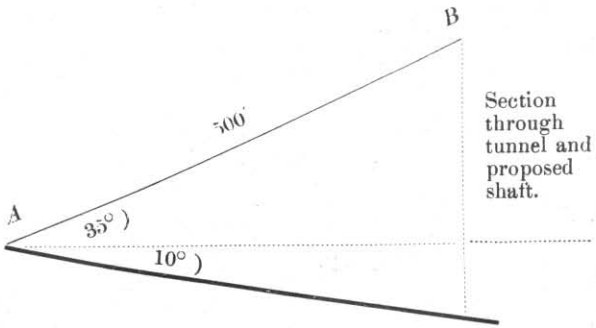
2. Describe carefully the adjustments of the surveyor's level.
3. Show a sample page of a field-book giving levels along a proposed line of tramway, showing at least three changes of the instrument, and two intermediate readings from each position of the instrument. Assuming the reduced level of the starting-point to be 100·00 reduce all the levels and check the calculations.
4. Describe how to set out a race by means of a level and staff, the fall being assumed.
5. Two shafts are connected underground through drives and a short winze of regular underlay. Describe how to connect these shafts by underground survey, and how to connect this underground survey with surface observations.
6. Three bore holes have been put down, and each has cut a seam of coal. The distance apart of the bores is as follows:—

A to *B*	400 feet.
B to *C*	320 ,,
C to *A*	270 ,,

The thicknesses of the seam cut in *A*, *B*, and *C* respectively are 3 feet, 4 ft. 6 in., and 6 feet. Assuming the

seam to be horizontal, calculate the amount of coal contained in the triangle formed by the bores.

7. A tunnel *A* has been driven on a coal seam which dips from the mouth of the tunnel at an angle of 10° with the horizontal. It is proposed to put down a vertical shaft from a point *B*, which is found by observation to be at an angle of elevation of 35° above the mouth of the tunnel, and at a distance of 500 feet from it, measured along the ground.

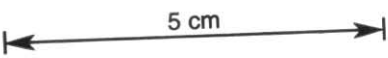


Section through tunnel and proposed shaft.

To what depth must the shaft be sunk to cut the seam?

SUBJECT E.—SURFACE WORK.

1. An inclined plane of 1 in 7 is 1400 yards long: what size steel wire rope would be required to haul 30 tons of coal at an average speed of 4 miles per hour?
   Assume the other data.
2. What is the effective horse-power of a single-cylinder high-pressure steam engine; cylinder, 16 inches diameter by 30 inches stroke; number of strokes, 60 per minute; average steam pressure throughout the stroke, 35 lbs. per square inch?
3. Explain fully the construction of any type of electric coal-cutter you may be familiar with.
4. An engine draws 10 trucks of coal, of 10 cwt. each up an incline of 1 in 9, 100 yards long, at an average speed of 5 miles per hour. How many similar trucks will the same engine draw, at the same speed, on the level?
   Assume the other data.
5. A ventilating fan passes 84,000 cubic feet of air per minute, at a water gauge of 1·5 inches: what horse-power steam engine would be required to drive it to do this work?
6. Describe the general arrangement of an ærial ropeway for conveying material. Give a brief description of—
   (*a*) Method of hanging buckets from rope.
   (*b*) Terminal station.
   (*c*) Trestles.



7. Give the following details of a light tramway:—
   (*a*) Weight and specification of rails.
   (*b*) Size and number of sleepers.
   (*c*) Method of crossing a watercourse, 12 feet wide and 10 feet deep.
8. It is required to excavate in clayey ground a tank to hold about half a million gallons of water. Describe some form of scoop which would expeditiously perform this work.
9. Describe a form of head-gear or pit-frame suitable for working a coal seam through a vertical shaft of moderate depth.
10. Give sketches of a form of travelling-belt for conveying coal from the pit to the sorters. Describe its use and method of working.

SUBJECT F.—BOOK-KEEPING AND MINE ACCOUNTS.

1. How many tons of coal are there in a lease of 320 acres, when the seam is 5 feet 6 inches thick, and the specific gravity of the coal is 1·30?
2. Name and describe the forms of accounts which a colliery manager would be required to furnish regularly to the office of his company.
3. Describe the functions of a Cash-book, Journal, and Ledger respectively, and explain how they are kept.
4. The yearly output of a colliery is 107,467 tons 13 cwts., but only 217 days are worked. What is the average output per day?
5. A colliery raises 12,165 tons 18 cwts. of large coal, and 2994 tons 2 cwts. of small coal. What is the percentage of small coal on the whole output?
6. Explain the difference between capital and revenue expenditure.
7. Divide £71 9s. 1½d. equally between 37 men.

SUBJECT G.—MINING LAW.

1. What quantity of fresh air is required by the Mining Act to be provided in all underground workings for each man and boy employed therein?
2. How many men are required to be employed on a Prospecting Claim of 320 acres for coal, and for how long?
3. How many man-holes or places of refuge are required to be provided in a tunnel half a mile in length which is self-acting or is worked by an engine or windlass?
4. Before commencing to "hole" or undercut a coal seam, what is required to be done to render the same secure?
5. How would you proceed if you were required to mark off and apply for a coal section in heavily timbered or scrub country?

REPORT OF THE GOVERNMENT GEOLOGIST.

Government Geologist's Office,
Launceston, 31st December, 1905.

SIR,

I HAVE the honour to present my Report as Government Geologist for the year ending 31st December instant.

During the year I have prepared the following reports:—

1. On coal at Mt. Rex, 28th April, 1905.
2. On North-West Coast mineral deposits, 26th July, 1905.

The above examinations and reports occupied my time for the first seven months of the year; my field time in the remainder of the year has been spent on the Mathinna goldfield, the inspection of which has not yet been completed.

Mount Rex.

Some coal seams of Mesozoic age have been discovered in the Parish of Malvern, one of which is 12 feet in thickness, and of good quality. It is between 600 and 700 feet above the railway line; and the outlet for the coal would be down the valley of the Buffalo Brook to Hanleth, on the Avoca-Conara railway line. A tramway 7 miles will require to be constructed. The closing down of Mount Rex Tin Mine interrupted negotiations with diamond drill owners for the necessary boring to prove the extension of the seam.

This discovery has extended the Nicholas-Fingal coalfield considerably nearer to Conara, and tends to strengthen the possibility of coal measures existing still further west, and still nearer to the main trunk line of the State. Geologically, however, the coal is identical with that of the Mt. Nicholas group. What is really wanted is an improvement in quality, or a decrease in cost compared with existing collieries, so as to initiate an export trade, as the local demand for coal is not sufficient to keep our present coal mines in full work.

North-West Coast.

This journey included several important districts, viz.:—Rocky Cape, Boat Harbour, Wynyard, Stowport, Blythe, Sulphur Creek, Penguin, Dial Range, and Forth. These are separate fields, and required separate visits. In some cases my inspection of mining work begun by local people saved these from throwing away good money after bad; in other instances I was able to report favourably on the chances of further work. More especially was this the case at Stowport and Blythe, where copper ore lodes were being developed; and in the Dial Range district, where copper and silver ore deposits had for some time received attention from investors.

The Stowport-Blythe mineral field is one of promise. In my report I have stated that the mineral-bearing series of strata are there, and that there are undoubted evidences of lode action; and modest shipments of rich copper ore have been made.

Associated with these copper deposits is the Blythe-Rutherford line of hematite, which is destined in the future to be an

important source of iron. Despite the apparently agricultural character of this part of the Coast, these deposits may be expected to absorb large amounts of capital invested by those interested in mining.

Penguin is another mixed agricultural and mineral field. The rich iron ore quarried on the Penguin Creek is shipped to New South Wales Smelting Works, to be used as flux in the furnaces. The quality is highly suitable for the manufacture of iron; and, in time to come, the deposit will be utilised for that purpose. It may not go down very deep, but the extent to which it can be followed underneath the basalt capping is unknown.

Other iron ore deposits occur in the form of transmuted conglomerate at the summit of the Dial Range. These are not quite so accessible, but no doubt will be worked in due time.

On the east side of the Dial Range is granitic mineral ground, which is being tested for silver and copper. A moderate amount of capital has been expended, and the discoveries are in course of development. It is too soon to expect results, as, in some cases, much deeper work is necessary; but the field is encouraging for prospecting, and I have pointed out in what direction such work should be attempted.

The beach deposits of silver-lead ore at Penguin are not being worked; and I think deeper mining is necessary in order to get below the meshed veins, which have yielded the ore hitherto, to where they possibly unite and form stronger lode-channels lower down. The variable assay returns are suggestive of much leaching having taken place, and it is highly probable that much richer ore will be found in depth.

Near Alma, between the Wilmot and the Forth, some lode action has taken place, which led to copper-mining a quarter of a century ago at the Barrington Mine. Results were not very promising, though a little ore was obtained, and later work has not disclosed anything of value. There is what appears to be a brecciated contact rock zone here, which may carry a mineral deposit, and the country is worth prospecting.

Mathinna Goldfield.

This has not been reported on for the last thirteen years. During this time a good deal of work has been carried out on the field. The New Golden Gate has sunk the deepest shaft in the State (1600 feet from surface). The Tasmanian Consols has deepened its shaft to 1400 feet, and outside capitalists are expected to initiate work in the district. It was felt that a fresh examination of the field would be useful. I am at present engaged in this, and Part I. of the report will be prepared first, and issued at an early date. The adjacent goldfield of Mangana will be examined as soon as Mathinna is finished.

Blue Tier.

In September, in conjunction with Inspector Griffin, I visited this district to inspect the dam-sites which the Government was about to allot to holders of tin ground on the Tier. The Mt. Lyell Company, having amalgamated with various leases, is preparing to test the ground by boring before launching into exploitation on a large scale.

Pottery Clay.

Consequent upon my report in 1904 upon the kaolinic clay near St. Helens, some experiments were made in England with this material, and a few manufactured articles have been received, showing that it is amenable to treatment.

Should the fine pottery industry be established here, these deposits will be of value, as the clay is of suitable quality, and the shipping facilities are excellent.

Progress Reports.

I have prepared during the year four quarterly reports on the mineral industry. I think it may be said that our statistics are comprehensive, and as exact as possible.

A new obligation is imposed by "The Mining Act, 1905," on mine owners and managers, to furnish regularly each quarter the statistics relating to their respective mines, and they are earnestly requested to supply these promptly. I shall always be thankful for any information respecting mining work which managers or owners may wish to communicate.

Office.

Two geological and four progress reports were issued in 1905. The correspondence consisted of 2200 letters, &c., in and out. The usual monographs and bulletins issued by the Survey and Mining Departments of various countries, and publications of scientific institutions, have been received and added to the office library. I beg to thankfully acknowledge receipt from the proprietors, of copies of the *Examiner*, *Daily Telegraph*, *Australian Standard*, *Mining and Engineering Journal*, *Mining and Scientific Press*, *Queensland Mining Journal*, and *New Zealand Mines Record* for office use.

A collection of rocks and ores, from Zeehan, was forwarded by request to Dr. Richard Beck, at Freiberg, the well-known writer on ore deposits. Another collection was sent by the commander of the Austrian warship, *Panther*, to the Imperial Museum, Vienna. A collection was also despatched to Prof. Hoefer, the distinguished Director of the Leoben School of Mines, Austria. Individual specimens have been supplied to Professors Rosenbusch, Brogger, Lacroix, and other authorities interested in the minerals of Tasmania.

Mr. F. S. Grove, as usual, has fulfilled the duties devolving upon him with credit and efficiency. During the year he was charged with the work of connecting the Old Chum Creek with the Mount Cameron Water-race, and of deviating the main race where it crossed the Old Chum Creek. This work was carried out in a highly satisfactory manner, and will result in increasing the water supply of the main race by 4 to 6 sluiceheads per 8 hours.

Government Drills.

These have not been used in 1905. Endeavours have been made to sell the alluvial boring plant, but so far a purchaser has not been found.

I have the honour to be,
Sir,
Your obedient Servant,
W. H. TWELVETREES, *Government Geologist.*

W. H. WALLACE, *Esq.*, *Secretary for Mines, Hobart*

REPORT OF THE CHIEF INSPECTOR OF MINES.

Chief Inspector of Mines' Office,
Launceston, 31st December, 1906.

SIR,

I HAVE the honour to submit my Report on the inspection of mines for the year ending 31st December instant.

I beg to submit a diagram and tables of statistics covering accidents which have taken place at the mines during the year just ended, and to append the annual reports of Mr. M. J. Griffin, Inspector of Mines for the Northern and Southern, Eastern, and North-Eastern Divisions; of Mr. Jas. Harrison, Inspector of Mines for the Western and North-Western Divisions; and of Mr. C. H. Curtain, Inspector of Mines for the Lyell District.

The number of persons employed this year in the industry at mines and smelting works was 6586. Seven persons met with their death, and thirty others were seriously injured. The death rate from accidents was 1·06 per thousand, compared with 1·453 per thousand the previous year. The fatal accidents were distributed as follows:—Northern and Southern Division, 3; Western Division, 4. In the Western Division, 3 occurred in the Lyell District, and 1 at Zeehan.

There has been a gratifying decrease this year in the number of serious accidents. The previous year was an altogether exceptional one; and even neglecting the figures of that year, those of the year just closed may be looked upon as giving a low average. They would have been still lower had it not been for the exceptionally heavy work at the Tasmania Mine, which has involved risks out of the ordinary.

It was not found necessary to take legal proceedings in respect of any breaches of The Mining Act this year; nevertheless, the Inspectors have investigated all serious accidents, and have condemned ropes, cages, shafts, &c., where they have found these in an unsafe condition, besides insisting upon numerous underground workings being made safe for men to work in. Men, through constant exposure to the risks of their dangerous calling, become so careless, and employers, especially in the smaller and inadequately-financed mines, are often so negligent, that an onerous task devolves on the Inspectors, the benefits of whose ceaseless watchings and warnings are too often not sufficiently realised.

It gives me pleasure to commend the industry, judgment, and discretion with which our three Inspectors have discharged their duties. There is no doubt that the work of inspection will be greatly facilitated by many of the new provisions of The Mining Act, which comes into force on the 1st January, 1906.

Some of the most important of the changes which have been made in that part of the Act which relates to the working and inspection of mines are as follows:—Authorising the Inspectors of Mines to inspect smelting works, and bringing the latter under the operation of The Mining Act; general rules for such works; provision of two outlets for ingress or egress in the case of collieries; provisions for weighing coal, and

regulations to come into force when check-weighers are appointed; compulsory certificates or permits for all colliery managers; daily inspection of coal mines for gas, &c.; provision for a proportion of jurymen on coroners' inquests to be miners wherever practicable; Inspectors authorised to order the use of safety-cages; to order, under the authority of the Minister, the connection of adjoining mines, where necessary, for ventilation and escape; regulations affecting ventilation and explosives; and sundry other amendments of the General Rules.

So many additions have been made to the old Act that it will take a little time for mine owners and mining managers to familiarise themselves with the new requirements, and the situation for the moment is sometimes difficult; but our Inspectors may be relied upon to act with the necessary discretion and firmness.

When the new Act is in working order, it will certainly be realised as making improved provision for the regulation of mines and the safety of miners.

I have the honour to be,

Sir,

Your obedient Servant,

W. H. TWELVETREES,

Chief Inspector of Mines.

W. H. WALLACE, *Esq.*, *Secretary for Mines, Hobart.*

TABLE showing the Number of Persons Killed and Injured in and about the Mines of Tasmania during the Year 1905.

Place or Cause of Accident.	Inspection Districts.													
	Northern and Southern Division.		North-Eastern Division.		Eastern Division.		North-Western Division.		Western Division.				Total.	
									Zeehan and other Districts.		Lyell District.			
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Underground—														
Falls of Ground	...	3	...	...	...	...	...	...	1	1	1	1	2	5
Shaft Accidents—														
Suffocation by natural gases	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Overwinding	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ropes or chains breaking	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Machinery	1	2	...	...	...	...	...	...	...	...	...	...	1	2
Falling in or into shafts.	1	2	...	...	...	...	...	...	...	...	...	...	1	2
Things falling into shafts	...	1	...	...	...	...	...	...	...	...	...	...	...	1
Explosives	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Miscellaneous	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	2	8	...	...	...	...	...	...	1	1	1	1	4	10

Miscellaneous (underground).														
Explosives	1	1	...	...	...	...	...	...	...	3	...	...	1	4
Suffocation by natural gases	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Haulage—														
On inclined planes	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ropes or chains breaking	...	...	...	...	...	...	...	...	...	...	...	...	...	...
By trams and tubs	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Machinery	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sundries	...	1	...	...	...	...	...	...	...	...	...	1	...	2
Total	1	2	...	...	...	...	...	...	...	3	...	1	1	6
Total underground	3	10	...	...	...	...	...	...	1	4	1	2	5	16
On Surface—														
Electrical	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Smelting Works	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Machinery	...	...	..	...	...	1	...	...	...	1	...	...	...	2
Boiler explosions	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tramways	...	1	...	1	..	...	...	...	...	...	1	1	1	3
Explosives	...	...	...	...	...	...	...	...	...	...	...	1	...	1
Falls of ground	...	...	...	...	...	1	...	...	...	...	1	...	1	1
Miscellaneous	...	2	...	2	...	1	...	...	...	...	...	2	...	7
Total on surface	...	3	...	3	...	3	...	...	...	1	2	4	2	14
Gross Total	3	13	...	3	...	3	...	...	1	5	3	6	7	30
Total during 1904	1	16	2	11	2	10	...	1	2	11	2	16	9	65

TABLE showing Rate per Thousand Killed and Injured in the different Mining Divisions for the Twelve months, 1st January, 1905, to 31st December, 1905.

Division.	Average number of men employed.	Number of Accidents.	Number of Persons.		Total number Killed & Injured.	Average per 1000 Killed and Injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
Northern and Southern	921·75	13	3	11	14	15·19	3·25	11·93
North-Western	432·5	—	—	—	—	—	—	—
North-Eastern	654·25	3	—	3	3	4·58	—	4·58
Eastern	795·5	5	—	5	5	6·28	—	6·28
Western	3782·5	13	4	11	15	3·97	1·06	2·91
Totals	6586·5	34	7	30	37	5·62	1·06	4·55

Analysis of Statistics for the Western Division.

Division.	Average number of men employed.	Number of Accidents.	Number of Persons.		Total Killed & Injured.	Average per 1000 Killed and Injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
Mount Lyell	2325·75	8	3	6	9	3·87	1·29	2·58
Zeehan, &c.	1456·75	5	1	5	6	4·11	0·68	3·43
Totals	3782·5	13	4	11	15	3·97	1·06	2·91

Diagram showing Total Quantity & Value of Gold won in Tasmania during the years 1880-1905

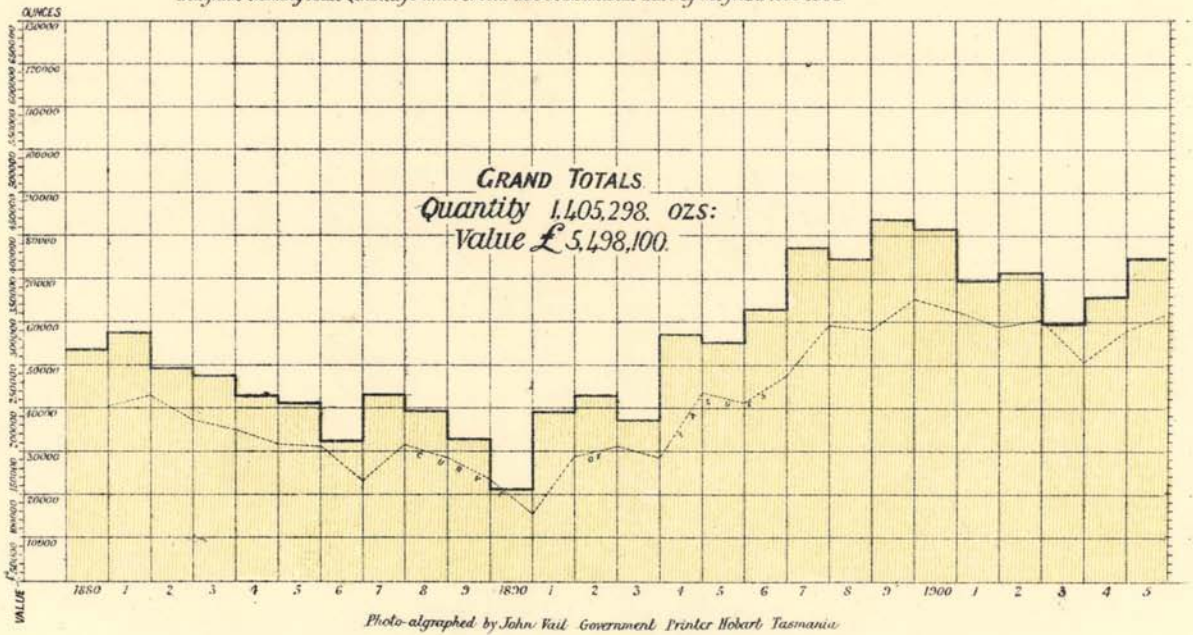


Photo-algraphed by John Vail Government Printer Hobart Tasmania

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COMPARATIVE Table of Statistics of Accidents in and about the Mines of Tasmania from 1st July, 1892, to 31st December, 1905.

Period.	Number of Miners employed.	Number of Accidents.	Number of Persons.		Total killed and injured.	Average per 1000 killed and injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
1 July, 1892, to 30 June, 1893	3295	28	4	25	29	8·8001	1·214	7·586
„ 1893 „ 1894	3403	25	7	20	27	7·934	2·057	5·877
„ 1894 „ 1895	3789	26	4	24	28	7·390	1·058	6·332
„ 1895 „ 1896	4160	22	7	16	23	5·529	1·682	3·847
„ 1896 „ 1897	4303	36	7	31	38	8·831	1·627	7·204
„ 1897 „ 1898	5530	36	13	33	46	8·318	2·351	5·967
„ 1898 „ 1899	6180	35	9	34	43	6·957	1·456	5·501
„ 1899 „ 1900	6834	19	7	16	23	3·365	1·024	2·341
„ 1900 „ 1901	7017	29	8	23	31	4·417	1·140	3·278
„ 1901 „ 1902	6438	38	7	35	42	6·524	1·088	5·437
„ 1902 „ 1903	6484	44	6	43	49	7·557	0·925	6·632
„ 1903, to 31 Dec., 1903	5604	27	8	20	28	4·977	1·428	3·569
1 Jan., 1904, to 31 Dec., 1904	6192	73	9	65	74	11·951	1·454	10·497
„ 1905 „ 1905	6586	34	7	30	37	5·618	1·063	4·555

REPORTS OF INSPECTORS OF MINES.

Mr. Inspector Griffin (stationed at Launceston) reports:—

I have the honour to present my report of mines inspected in the Divisions under my charge, viz., Northern and Southern, North-Eastern and Eastern, for the year ending 31st December, 1905.

Accidents.—I am glad to report that the number of these is much less than for the preceding year. Out of twenty-two accidents reported and registered for the year, three were fatal, the remaining nineteen of serious nature, such as injuries to or fracture of limbs, concussions of spine or of brain, dislocations, enforced absence from work for fourteen days, &c., all of which come under the heading of "Serious injury to any person." In addition to these, a number of trivial accidents have been reported, which, not being of sufficient importance to register as accidents, are merely recorded by the Inspector, but not reported to the Head Office.

Fatal Accidents.—All of these—three in number—occurred at the Tasmania Gold Mine, Beaconsfield.

Robert Rasmussen, a surface hand, engaged trucking timber to the brace at Hart's Shaft, was assisting the braceman, Goldsworthy, and another man to put a piece of timber 9 in. by 12 in. by 8 ft. into a cage, when the stage on which two of them were standing suddenly gave way. Rasmussen fell 300 feet, and was instantly killed. His body was found lying, or hanging, across the piece of timber that fell away with him, which, in its descent, knocked large pieces out of the timbers, and at last lodged on the frames right across the compartment. This accident was the subject of an action against the company for damages, brought by the relatives of the deceased man, who alleged defective construction of the stage on which the men were standing when the accident took place. A lot of evidence—expert and otherwise—was taken, and the jury returned a verdict for the defendant company. The very large new pumping plant had, a short time before, been installed at this shaft. Alterations and enlargements had to be made to receive the larger plant, and in doing this it was found necessary to encroach even farther on the already narrow cage-compartment, which was provided for and was to be used exclusively by the "pitmen" in the future, and after all necessary alterations, re-skidding, &c., had been made to the main cage-compartments of the shaft. For the time being, however, this narrow cage was in use as a means by which men could descend and ascend into that portion of the mine, and as it could not be brought right up to the surface brace owing to the large sweep-rod overhanging some 8 or 9 inches, a staging had to be fixed 7 feet down, and from this the men going below entered the cage. I inspected the mine less than a week before the accident happened, and concluded my notes in the mine record book by drawing attention to the close proximity of the sweep-rod to the cage-compartment, and to the care necessary to be exercised by enginedrivers and bracemen, as in any case of over-winding with men a serious acci-

dent might occur, the cage coming into contact with the sweep-rod. With the staging I had no fault to find. It was well and securely constructed, and quite capable of sustaining, with perfect safety, the combined weight of a dozen men, could they find room to stand upon it. I was not aware at the time that short, and even fairly long, pieces of timber were at times sent down by this small cage. Inspection immediately after the accident happened, and the hearing of the evidence adduced at the coroner's inquest, did not appear to me to give any sufficient reason why that staging should give way if properly used, and with only the weight of one man and a piece of timber weighing less than 4 cwts. It was only on the following day that the discovery was made that this particular piece of timber bore on its end marks indicating that when uprighted on the stage it must have come into contact with the sweep-rod of the pump working at the time. The signs were unmistakable, viz., a mark on the sweep-rod corresponding with a partial indent on the end of the timber, the latter having paint from the former ingrained in its wood. Thus was the whole thing explained: the unfortunate man, Rasmussen, uprighted the piece of timber that was leaning against the wall of the shaft, and in doing so it must have got too near to the side of the small staging, and was caught by the down-stroke of the sweep-rod. Everything considered, and in view of the verdict obtained by the company in the action for damages, this accident may fairly be classed under the heading of "Unavoidable." The question was asked by His Honour, Mr. Justice Clark, before whom the case was heard, "Could not a shield have been erected to keep things which were being moved on the stage from coming into contact with the sweep-rod"? Such a shield could have been erected; but under the circumstances, and taking into consideration the already cramped space for getting into the cage, it would have been unwise to erect it. A low wall on the side next the pump guarded against men falling down there. Some allowance must be made for mine owners who are carrying out extensive alterations and construction works as in the case of the Tasmania Mine, and where pumping and other machinery must be kept going the whole time.

The occurrence of all mining accidents may be said to be attributable to, or at least come under the following headings:—(1) Negligence or want of reasonable precautions on the part of owners or managers; (2) carelessness or want of skill on the part of the men employed; (3) unavoidable, or that could not be foreseen or guarded against. As an Inspector, I consider it my duty to give in this report reasonably full particulars with reference to the serious and fatal accidents that occur, in order that it may be seen under which of the foregoing headings they may be classed. This must be my excuse for writing at length on the subject.

Second fatal accident: Peter Brown, employed in the sinking of Grubb's Shaft at the Tasmania Gold Mine, disregarded the warning call, "Look out for the cage," of the signalman, and deliberately stepped beneath the descending cage, and was instantly killed. I was at Hobart when this accident occurred. There was no occasion to return. The verdict of the coroner's jury was to the effect that no blame whatever was attachable to any one for this accident, and the fact that they (the

jury) did not consider it necessary to view the place where the accident happened, was in itself significant enough.

Third fatal accident: Edward Mullins, employed as shift boss or foreman of a number of men at work sinking Grubb's Shaft at the Tasmania Gold Mine, met his death through a blasting accident. The shaft is a large one, 30 feet by 8 feet in the clear, about 18 men being at work in it at one time. Two safety-cages worked in their respective compartments on either side of the central, which is a ladder compartment. Sixteen holes were bored in the bottom of the shaft, and to charge and fire these Mullins retained the help of James Thos. Levings, Herbert Kerrison, and Thomas Wellington, sending the other men up to the 500-feet level, about 70 feet above the bottom. The usual practice in spitting a fuse is to prepare it by inserting a small piece of gelignite in the end to be fired, and thus ensure its spitting readily when a lighted torch or candle is applied. Mullins, who was a man of long experience in blasting and shaft-sinking, and who was also said to be a most careful man, had used the above-described method of preparing the fuse for lighting on all previous occasions when shots were fired under his direction in that shaft. On the day of the accident, however, he departed from his usual practice, and spit the fuses with lighted candles without gelignite. Some little time before charging the holes he asked one of the men if the fumes made his head ache when spitting, and getting a reply in the negative, said, "Well, it made my head ache, and I mean to spit them to-day with the candles and no gelignite." When ready for firing, Levings and Kerrison fired or spit the fuse in 8 holes on one side, Mullins and Wellington attending to the other 8. Levings finished first, and went to the cage. Some little delay was caused through Mullins going back to one fuse which he overlooked, remarking as he did so, "that they had plenty of time." The other men did not think so, and got into the cage at once. Mullins was about to enter a few seconds later, and after asking the others if they were all right, reached out his hand to pull the knocker-line. Just as he did so, the first charge exploded, all lights being extinguished. He (Mullins) called to the others, "Climb the cage," after which he was not heard to speak. Kerrison managed, with great difficulty, to climb to the top of the cage (14 feet), and after calling several times, made himself heard by the men in the chamber above, who at once signalled to heave up the cage, and on its reaching the chamber, where it was stopped, a dreadful sight met the gaze of those waiting there. Poor Mullins' body was half suspended on the inside of the cage, one arm being jammed tightly between the iron "long shoe" and the wooden skid, which latter had to be cut through before he could be released. By the time this was done life was quite extinct. The injuries to the head, side of face and upper part of body were of a very severe nature. Levings and Wellington were huddled together in the bottom of the cage. Kerrison had climbed to the top; both he and Wellington escaped with only slight injuries; Levings, however, was severely injured, and suffered much from cuts, bruises, and shock. The safety-cage in use at the time was the "long shoe" sinking type, more than twice the height of the ordinary cage, and being skeletal or open at the sides for two-thirds of its height, afforded but little protection

from the flying fragments of stone. It is surmised that Mullins was not much injured from the effects of the first explosion that put the lights out, and that being unable to get hold of the knocker-line in the darkness, he by some chance got into the cage and attempted to climb up, when he was struck and fatally injured by the force of the second explosion. The fact of his arm being thrust through the bars of the cage and his body almost suspended, points to this conclusion. Levings, too, must have received most of his injuries in a similar manner, but having dropped right down to the floor of the cage where Wellington was crouching, escaped further injury. The whole of the 16 charges had exploded before the cage with the injured men could be got away from the bottom. The coroner's jury returned a verdict to the effect that Mullins met his death accidentally, and that no person was to blame for the accident.

With reference to the safest and most expeditious way to spit or light safety-fuse in blasting operations, there are different ways of doing it. The most common practice since gelatine dynamite has come so much into use, is to slit the end of the fuse diagonally into the powder core, insert a small wedge of gelatine or gelignite, which burns freely and spits the fuse almost instantaneously when a light is applied to it. Snuffing the fuse, *i.e.*, placing a candle-snuff beneath the fuse a little way back from the end, which, when lighted, takes some considerable time to burn through the fuse-envelope before reaching the powder-core, and thus gives plenty of time for men to get away, is perhaps the safest way; but miss-fires may sometimes occur through the fuse curling away from the flame before the powder-core is ignited, or it may be blown aside by the wind if in a draughty place. Electric firing, where a number of shots are required to be ignited simultaneously, is the safest method of any, as there cannot possibly be a miss-fire. The objection to this is that simultaneous firing in most cases is a disadvantage, and that the re-arranging of wires and making connections after each batch would take too much time were it required to fire a number of shots in groups; there would also be the cost of the apparatus and electric fuse connections. To insure quick and sure ignition without electricity, I do not know of any better way than the firstmentioned, viz., to slit the fuse and insert a small wedge of gelignite, assuming, of course, that good fuse is used, and not a defective kind that would run and cause the charge to explode before a man had time to get to a place of safety. It has been suggested that, for the safety of men employed in shaft-sinking, electric firing should be insisted upon, and no other method allowed. I do not agree with this; much better, I think, to let experienced miners follow the practice they have been accustomed to, always taking care to see that the best explosives and fuse, carefully stored and in good order, are used; also, that the men are provided with a speedy and safe means of getting away after lighting the fuse. In the case of the unfortunate man, Mullins, a miscalculation of time was the sole cause of the accident: it was only a matter of a few seconds, for had he got hold of the knocker-line, the accident would not have happened.

Non-fatal Accidents.—Thomas Bewes, in attempting to land timbers for the second brace being constructed at Grubb's

Shaft, Tasmania Gold Mine, missed his footing and fell to the surface brace, sustaining severe injuries—a broken thigh, dislocation of wrist, and slight concussion of the brain. He was in a very critical condition for a time, but finally recovered after several weeks' enforced absence from work.

Edward Pryde was struck on the back by a small piece of stone falling from the face at the Anchor Tin Mine, sustaining injury to the shoulder-blade, that caused him to be off work for fifteen days.

James Jeffray jumped off a truck when running out of the Briseis open-cut face, and sprained his ankle; also fractured small bone of his leg. Was off work for over fourteen days.

John Annear was timbering up drive in the Tasmania Gold Mine, which was left too long without being secured, when he was caught by a fall from the footwall, sustaining shock and concussion of the spine, that incapacitated him for over fourteen days.

James Scott was working in a level of the Tasmania Gold Mine, when a piece of stone fell from the roof and jammed one of his fingers badly. He was off work for fifteen days.

Joseph Miller, employed as lander at the pit-bank of the Catamaran Coal Mine, carelessly walked backwards and fell down the pit 30 feet, dragging the bucket-landing trolly with him. He sustained shock and a few cuts, that necessitated his being sent to the Hobart Hospital. He had only himself to blame for the accident. Was off work over fourteen days.

Charles Walker was lifting a large stone on to a truck at the Briseis Mine, when it slipped and injured his leg, which caused enforced absence from work for eighteen days.

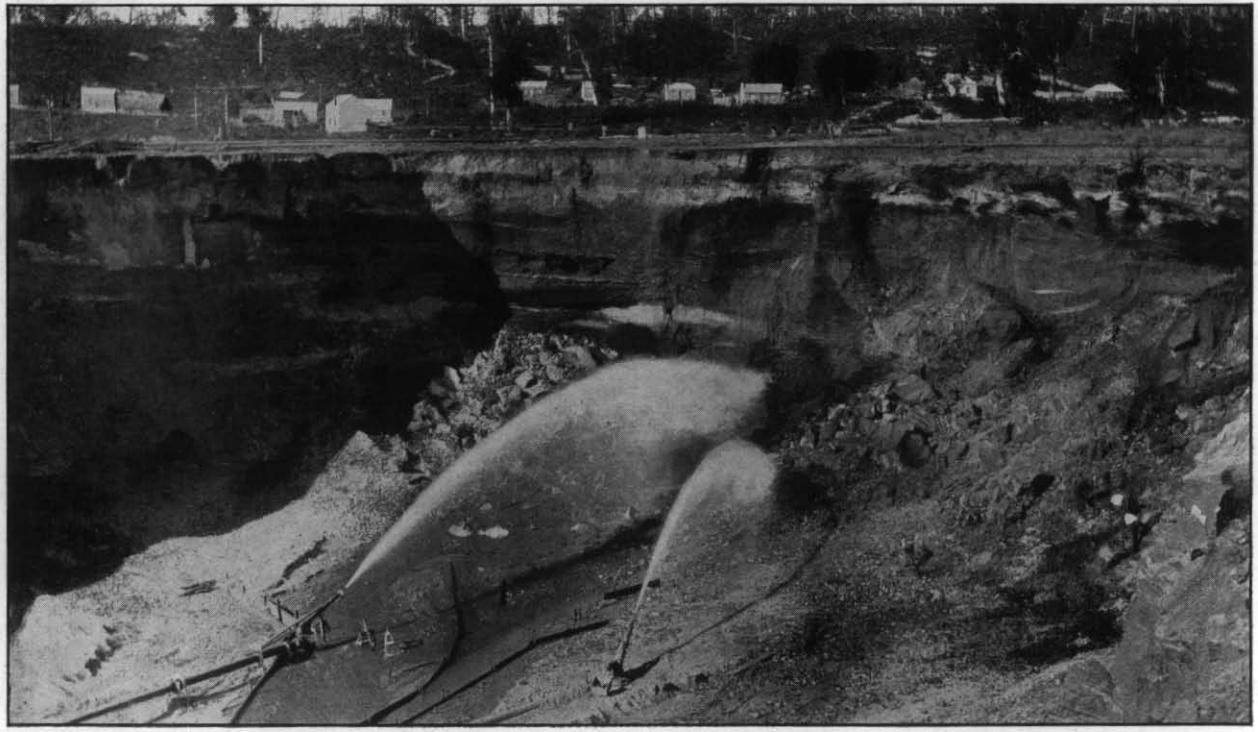
William Webb, shift boss at the New Golden Gate Mine, was down a winze some few feet, when dirt, accidentally tipped from a passing truck, fell on him. He sustained cuts and bruises about the head and shoulders, also injury to a finger, and was off work for seventeen days.

Charles Maizey was lowering timber into a winze at the Tasmania Gold Mine. It lodged near the bottom, and then slipping lower, jerked the windlass-rope in such a way as to bring his hand against the post with such force as to break two or three of the small bones. He was nearly six weeks off work through this accident.

Donald Lyons, while endeavouring to lift a truck on the line at the Tasmania Gold Mine, got a portion of one of his fingers jammed off, a second finger being badly bruised. He was off work for over fourteen days.

Benjamin Cowie was assisting to lift a cap-piece into position in a stope at the Tasmania Gold Mine, when he was struck on the chin by a piece of wood, the injury causing him to remain away from work for fifteen days.

Josiah Trounce was knocked off a stage in Grubb's Shaft, Tasmania Mine, by a descending bucket, and sustained cuts and bruises, but not of a very serious nature. The cause of this accident was thoroughly investigated. A new hand had been put on to relieve the signalman, whose duty it was to watch the working of the cages and buckets from below, signal for hoisting or lowering, and give warning to the men employed when a bucket or cage was coming down. Some blame was attachable on both sides—to the foreman for putting an inexperienced man to look after the signals with-



PIONEER TIN MINE, BRADSHAW'S CREEK.

out giving him definite instructions how to act, and to the signalman for doing other work, attending to the men, &c., when he should have been watching for the descending bucket.

Edward Paul, a trucker, was descending a winze at the Tasmania Consols Gold Mine, Mathinna, when he fell from the ladder to the bottom, 35 feet, got a severe shaking, also cuts and bruises, but no bones were broken, and he was able to resume work within fifteen days from the time of the accident. In this case, blame attached to the manager, as the ladder from which Paul fell was placed or fixed in a vertical, and in one part almost overhanging position, contrary to Gen. Rule XXIV. Very long timbers had at times to be lowered in this winze, and as much room as possible was required to be given. Inclining the ladders would perhaps interfere with this.

James Thomas Levings was very seriously injured in the blasting accident that caused the death of Edward Mullins in Grubb's Shaft at the Tasmania Gold Mine, and which has already been described under "Fatal Accidents" in this report. His injuries—cuts, bruises, shock, &c.—were so great as to cause an enforced absence from work for fifteen weeks.

Thomas Kimp was attending to diamond-drilling machinery at Mount Rex Tin Mine, when he got a finger of one hand badly crushed in the wheel-gearing. He went to the Launceston Hospital, where he remained a few days for treatment. This accident comes under the heading of "Serious," and is therefore recorded.

Joseph Martin Brent, caretaker on the Briseis Tin Mines' water-race, was struck by the branches of a falling tree, and sustained a fracture of the small bone of his arm, also bruised ankle, which caused an enforced absence from work for fifteen days.

Donald McDonald was assisting in taking off a swing-cage at the New Golden Gate Mine, when he got his arm jammed between the cage and the king-post of the shaft. No bones were broken, but he lost nineteen days off work through the injuries received.

Thomas Johnstone was working forward to make ready for timbering in a stope at the Tasmania Gold Mine, when he was struck by quartz falling from the roof and sustained injuries—shock and bruises—that necessitated treatment at the hospital for sixteen days, after which, it is understood, he was all right.

Samuel Knowells was cleaning the end of the pump sweep-rod at Hart's Shaft, Tasmania Mine, when he slipped and fell into the bob-pit, sustaining a broken leg, and enforced absence from work for a considerable time.

Inspection Generally.—The principal mining centres have been visited and mines inspected as frequently as the time at my disposal would permit, sometimes bi-monthly, but more often after a lapse of three, or even four, months were inspections made. The coal mines in the southern part of the State, Colebrook, Sandfly, Mt. Cygnet, and Catamaran were inspected in April, and again in October, of the past year, 1905. The new coal find at Preolenna, south of Wynyard, was visited in February. Mount Cameron Water-race business, visit with the Minister, making survey, designing new

work, &c., occupied a good deal of my time. I had also a good deal to do apart from actual inspection of mines. Roads and tracks had to be reported on, sometimes entailing a special visit to a locality. A couple of weeks were spent in visiting, with Mr. Twelvetrees, Government Geologist, the Blue Tier, and preparing a report for the information of the Hon. the Premier, having reference to various matters in connection with dam-sites, storage areas, catchments, value of tin deposits, and water supply generally; also, advisability of granting certain dam-sites applied for. The drafting of the new Mining Act and Regulations also made a call on my time, as I was frequently required by the Parliamentary Draftsman and Mr. Twelvetrees, Government Geologist, to assist in framing the part relating to Inspection of Mines.

Ventilation.—The ventilation of the metalliferous mines in the Divisions under my inspection is generally good. The Tasmania, at Beaconsfield, has been ever a most difficult mine to ventilate, owing to the large quantity of natural gas in the strata. Much has been done under the new management, and fairly good average results produced. Shaft-connections have helped a lot, but until thoroughly equipped with a powerful exhaust-fan it is useless to look for uniform and adequate ventilation. The Root's blower now in use, and which has been converted into an exhaust, is of very little use when it is most wanted; that is, when some sudden atmospheric change takes place, and natural ventilation can no longer be depended upon. I have taken measurements and velocities of air-currents in this mine at times, and found everything most satisfactory; yet, within twenty-four hours, and after a change had taken place in the direction of the wind, generally from south to north or north-west, the latter being a particularly bad quarter, the men had to be taken out of nearly every part of the mine east of the main cross-cuts. So much has been going on in the way of erecting new buildings, poppet-heads, winding machinery, and the installation of the first of three very powerful Cornish plunger-pumps (two more to be put in at Grubb's Shaft when it is sunk to the required depth) during the year, that very much attention could not reasonably be expected to be given to the question of ventilation; a good deal has, however, been done in the way of connecting the old Lefroy Shaft with the workings. Grubb's Shaft will soon be down to the 1000-feet level, and when the sinking of this is finished and a powerful exhaust-fan put into use at the former, or Lefroy Shaft, good ventilation for the whole should be made easy. Second only to coping with the water, is the question of good ventilation for a big mine like the Tasmania, and this must come, for apart from what is required under the Act and Regulations, the successful working of the mine will in a great measure depend upon it. Shifting men about from place to place, or finding work for them to do elsewhere, when the ventilation of certain parts, very often most parts, of the mine is unfit for them to work in, as was the case a few years ago in this mine, will not do under the present progressive management.

The North Tasmania is another of the Beaconsfield mines where natural gas is very troublesome. Recently this mine

has been equipped with a steam-winding plant, to take the place of the horse-whim formerly in use. A small blower was also provided to help ventilation, but was not of much use. I found it necessary, when visiting the mine the first time after this machinery was installed, to call the men (only 4 or 5) employed out of the mine, as the ventilation was not good enough. Some attempt was to be made to connect the 300-feet level with an old shaft further south, but this has not been done, so far.

At the New Golden Gate Gold Mine, Mathinna, the ventilation has been fairly good. No alteration, however, has been attempted to reverse the air-currents. The main shaft is still up-cast, the cold air entering the mine from the surface connecting airway at the south stopes. The objection to this made in my last annual report still holds good, viz., that in the event of a fire occurring in the mine, the smoke and fumes would pass to and up the main shaft, which is the only way by which men could escape in a cage from the mine. Recently (19th December) a fire occurred at the 1400-feet plat at this main shaft. Happily, there were only a few men in the mine at the time, otherwise serious consequences might have resulted. At 3.30 a.m. the men working at No. 17 (1600-feet level) knocked for the cage, and on coming to the surface reported a fire below, but they did not know at what level. Shift boss Wm. Webb, with the braceman, then went below to investigate. Several levels were examined, but no sign of fire, other than a little smoke hanging about in places, until No. 13 was reached. There the smoke was very dense for 150 feet along the crosscut, beyond which point all was clear—no fire. On attempting to descend to the next level, No. 14, they were met with thick volumes of smoke coming up the shaft, and not daring to go further, they had to return to the surface without locating the fire. The men working at No. 15 (1400-feet level) did not notice any fire on leaving at half-past eleven the night before; but everything pointed to the fire being in that level, probably in a dry timber-stack supporting the roof of west No. 1 reef. Some of the men suggested, or appeared to think, their candle might have lighted the boards of an old magazine about the same place. At 7 a.m. the fire was evidently in full progress down below, sending up smoke and small charred pieces of wood to the surface. Nothing could be done but let it burn itself out, which, to every one's surprise, it did within thirty hours from the time it was first discovered. On going below at 8 o'clock on the morning of the 20th, it was found that the fire took place in east plat, No. 15 (1400-feet level), burning about 5 feet of leg and about 18 inches of cap, and some laths.. The men who were working at that level brought their spiders away with them, but it is surmised that a candle had ignited the wood, and that when bailing was commenced after they left, a spark was fanned into flame. Fortunately, but little damage was done by this fire, nor was the working of the mine delayed for very long. Some miners are careless in handling lighted candles, and require to be frequently reminded of the danger of sticking candles on dry timbers in a mine. I have myself discovered, on one occasion, a leg on fire in this mine, and have strongly urged on the management the necessity for greater care being taken to avert

accident from fire in this way. It is to be hoped that now the risk attendant on careless use of lighted candles in the mine has been brought home to those most concerned, more care will be taken to guard against this danger in future.

Tasmania Consols Mine.—Ventilation in this mine is, as a rule, fairly good, yet there are times when the temperature is rather high. As at the "Gate Mine," they, the Consols, are dependent on natural ventilation, excepting for the exhaust from the rock-drills. The two mines adjoin, the working shafts being not more than 100 yards apart, the boundary-line being a little nearer to the "Consols" than to the New Golden Gate shafts. Connecting drives could be constructed between these two mines without any great cost. Already drives have been extended to the boundary on either side, but there is some difference of level, the bottom level (1400) of the "Consols" mine being some 25 feet lower than the 1400-feet level at the "Gate" mine. Now that the new Act (1905), coming in force from the 1st January, 1906, provides that mines adjoining, and where the works are not more than 300 feet apart, shall, upon the order of an Inspector, be connected by drives at the cost of the owners, &c., an improvement in the ventilation of these two mines could be easily made by such a connection.

Coal Mines.—With regard to the ventilation of these, the smaller ones, and these represent eight-tenths of the whole, are, as a rule, good enough. The workings are not extensive, and are for the most part reached by short tunnels into the hillside. The larger collieries, however, are beginning to experience difficulty. The Cornwall Mine, the workings of which are on the pillar and bord system, has not had good ventilation of late. The bricking-in of the furnace at the up-cast shaft, most necessary to be done, had been put off until at last it was insisted that the work be carried out without further delay, and it was to be put in hand during Christmas holidays. A special visit was made to this colliery in August, when it was found to be in an unsatisfactory condition as far as the ventilation was concerned. The main heading (a tunnel from the surface) is in about three-quarters of a mile, and the seam has been worked pretty extensively on either side of this for nearly the whole way. The back-heading used for a return air-way, and which connects with the up-cast furnace shaft near the entrance to the main tunnel, was found to be in a rather neglected condition; at different places the roof had come down, partly blocking the drive, the sectional area of which was at best rather small for a return air-course. Work was going on at eighteen places, eleven of these being on the west side of the main heading. The temperature ranged from 53° F. at surface entrance to 66° in first part of the main heading, and up to 74°, 76°, and at last, three places coming to the return air-way on the east side, 79°. Here the air was much vitiated, the tallow flare-lamps used by the men burned dimly; candles could not be kept alight. A pure atmosphere could not, of course, be expected at this return, when the air had already circulated through fifteen working-places; but had the return air-drive been kept well open, and with proper furnace accommodation at the up-cast shaft, such a bad state of

affairs could not exist. Preparations are being made for the installation of an electric motor service at this colliery, to take the place of the steam cable-hauling plant now in use. This, no doubt, will save cost in working, but until the mine is properly ventilated, and this must be looked to as speedily as possible, it is of no use for the owners to look for satisfactory results. Already too much time has been lost, and unless steps are now taken by the management to improve the ventilation of this colliery, there will be no option for the Inspector but to recommend that proceedings be taken to enforce compliance with the requirements of the Act and Regulations.

Mount Nicholas Colliery.—On the whole, the working of this colliery has been fairly satisfactory. It is worked under the "Long-wall" system. The ventilation is produced in the same way as at the Cornwall Colliery, that is, natural ventilation assisted by a furnace at the up-cast shaft. The return air-way is now in fairly good order, and with proper attention to the firing at the up-cast good ventilation can be produced. An improvement has been made by extending a drive from the workings east of the main heading to day-light on the south-eastern slope of the hill. This serves to help ventilation, also as an "escape" from that part of the workings. Long-wall is the most expeditious system of working coal-seams up to 5 or 6 feet in thickness. Ventilation is more easily produced in a sweeping current along the continuous face than in pillar and bord; in the latter the air has to be carried into each "bord," generally by means of bratticing. The Cornwall Mine owners would do well to revert to the "Long-wall" system. The wonder is, they have not done so long ago.

Sandfly.—Not much has been done in the way of mine-development during the year, attention being chiefly given to the construction of the tram line to North-West Bay, jetty building, &c. A lot yet remains to be done before this line, which will be some 12 miles in length, is complete. Why such a long line of tramway, on stiff gradients and entailing heavy cost for construction, not to speak of the after-cost of working and maintenance, should be undertaken, when the construction of a self-acting incline line directly down the mountain side for a mile and a half or so, and to connect with an easy gradient line of tram extending in 5 miles or so to the jetty, could be carried out is not easily understood by anyone knowing the country and possessed of even a small amount of engineering knowledge.

With reference to the other coal mines, all small in their way, in the State, there is not much to report. There is, I believe, an all-round improvement in their system of working, as far as safety for the men is concerned. They all work intermittently, and where the facilities for getting the coal to market are good, they manage to do fairly well. A new mine has been opened at Catamaran (Recherche Bay) by the Catamaran Coal Co. A couple of pits have been put down about 150 feet apart, and to a depth of 30 feet. A nice seam, from 4 to 5 feet in thickness, has been worked. The coal is of good quality, rather soft as yet, as the covering of fire-clay and shaly substance is not impervious to surface water. The seam is dipping to the north-west beneath a flat, the

surface of the ground sloping in the same direction for some little distance before the flat proper is reached. The method of working, so far as the pit-head gear and hoisting arrangements are concerned, are most primitive; underground, things are not so bad.

Ropes, Cages, Chains, Shackles, &c.—These have received careful attention, and wherever found defective have been condemned. Spare cages are generally provided to replace defective ones. One cage at the Tasmanian Consols Mine being badly defective, had to be condemned, and as there was none to replace it, the work of shaft-sinking had to be suspended for four or five days until another cage was procured. The management has only itself to blame for the delay, as notice was given three months before to provide a spare cage in case it should be wanted. It would never do to allow a defective cage to be used in a shaft over 1300 feet in depth, and where men were employed sinking. The men themselves demurred somewhat at first, but afterwards acknowledged that the Inspector was right.

Some small ropes, windlass generally, had to be condemned. Engine-hauling ropes receive more care and attention from owners now than heretofore, and as a consequence it is rarely that we hear of a rope breaking in these days; especially so is this the case with regard to big mines. One whim-bucket had to be condemned. It was a wretchedly bad one, and was used in a shaft where men were sinking 500 feet below the surface.

Magazines and Explosives.—The magazines for the most part are fairly well, in some cases very well, kept, both above and below the ground. It is, however, difficult to get some miners to understand that careful storing in dry, well-ventilated places is necessary to insure not only safety, but also the best results being obtained from any kind of explosive.

Gelignite destroyed.—Fifteen cases, 750 lbs., of really bad stuff had to be removed from the Anchor Company's magazines at the mine and at St. Helens, and destroyed. It was over a year on hand, was in a partly-frozen state when first received, and subsequently underwent frequent freezings and thawings. A sample sent to Mr. Ward, Government Analyst, was pronounced to be no longer fit for use, transport, or storage. In destroying this, I had it removed to an out-of-the way place, the plugs taken out of the boxes, laid out in long trains (not more than three plugs abreast), and then fired the trains from the windward end. A number of detonations occurred, blowing a few plugs away and breaking the train, which had to be re-lighted. It was noticeable that these generally took place when the wind sprung up, making the fire burn more fiercely. Hard plugs detonated quite as readily as the soft ones when the heat of the fire increased. This work was carried out as part of my duties as Inspector of Explosives. (Expenses paid by Explosives' Inspection Department.)

General.—The open-cut tin mines on the East and North-East Coast were, I am glad to report, pretty free from accidents, some seven or eight only being reported, and none of these of a very serious nature. The very high price of tin has given a great impetus to mining on the Coast. The first

Briseis dividend is to be declared shortly. Too much praise cannot be given to Mr. Lindesay Chark, general manager of this mine, for the able way in which he has pulled things together, and by engineering skill and good management has placed the mine on the dividend-paying list.

Bucket-dredging.—The Gladstone Tin Development Company started their No. 1 bucket-dredge on the Ringarooma River, near Gladstone, in the early part of August. A series of breakages took place at the commencement, and it was found that the one high-speed engine employed could not be employed to drive the fast-running centrifugal pump and slow-working buckets and trommel successfully. A second engine was obtained for the buckets and trommel. A further delay was caused through having to dredge a way through a clay and slate point before getting into the regular stope of wash-dirt. Progress has since been made, with varying success. The flat was formerly heavily timbered, and now being covered by tailings from 3 to 5 feet in depth, it is most difficult to cope with the stumps, tree-trunks, and branches buried up therein. Some fairly-good weekly returns have been obtained, and I think it may be fairly predicted that bucket-dredging will prove a success on our tinfields. The dredge under review was badly designed to commence with; this, followed by faulty workmanship, has caused much trouble, and has no doubt given rise to an erroneous impression that bucket-dredging is not suitable for tin-getting. I am not of this opinion, and see no reason why bucket-dredging, which I hold is the only means by which the river beds and adjacent flats can be worked, should not be a success on the Ringarooma River.

LIST of Accidents in Inspector Griffin's District for the 12 *months*, 1*st January to* 31*st December*, 1905.

Fatal, 3 ; non-fatal, 19 ; total, 22.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1905.							
7 Jan.	Tasmania G.M.	Beacons-field	Fall from stage	Bews, Thos.	Married	Broken thigh and concussion of brain	Was working on a stage, and whilst pulling some timber slipped and fell about 26 feet.
11 Jan.	Anchor T.M.	Lottah	Falling stone	Pryde, Edwd.	Ditto	Bruised shoulder	Working at No. 2 bench, and was struck by a stone which rolled from No. 1 bench.
10 Feb.	Tasmania G.M.	Beacons-field	Fall of stone	Annear, John	Ditto	Concussion of spine	Working in a stope, when part of the hanging-wall came away and struck him.
4 Feb.	Briseis T.M.	Derby	Fall off truck	Jeffrey, Jas.	Single	Sprained ankle	Was braking a truck down tram-way, and slipped off.
27 Feb.	Tasmania G.M.	Beacons-field	Fall down shaft	Rasmussen, Robert Wm.	Ditto	Fracture of skull, legs and arms broken, &c.	Was helping to place piece of timber in cage at surface ; the stage on which he stood gave way, and he fell down the shaft for about 300 feet. Injuries fatal.
22 Feb.	Ditto	Ditto	Fall of stone	Scott, James	Ditto	Crushed finger	Was working at No. 3 level, when a piece of stone fell and crushed his finger.
6 Mar.	Catamaran Coal	Recher-che	Fall down shaft	Miller, Joseph	Ditto	Shock and cuts	Whilst attending to skip at surface fell down shaft on to a platform about 30 feet below.
8 April	Tasmania G.M.	Beacons-field	Struck by descend-ing cage	Brown, Peter	Married	Broken spine, &c.	Stepped beneath descending cage, and was crushed up.
27 May	Briseis T.M.	Derby	Rolling stone	Walker, Chas.	Ditto	Bruised leg	Was lifting stone into a truck ; his foot slipped, and the stone rolled on to his leg.
27 June	New Golden Gate	Mathinna	Fall of dirt down winze	Webb, Wm.	Ditto	Cuts on head and crushed fingers	Was working in winze. Some loaded trucks, which were crossing the winze, capsized, and some of the material fell on Webb.

7 July	Tasmania G.M.	Beacons-field	Windlass rope jerk-ing	Maizey, Chas.	Ditto	Left hand broken	Was lowering timber down winze by means of a windlass. Think-ing timber had bottomed he jerked the rope; the timber lowered another foot, and the rope pulled his hand against the windlass-frame.
19 July	Ditto	Ditto	Lifting truck	Lyons, Donald	Single	Loss of finger	Was trucking at surface, and in trying to lift a truck on to the line had the second finger of his left hand jammed off, and the third badly bruised.
27 Aug.	Ditto	Ditto	Descending bucket	Trounce, Josiah	Ditto	Cuts and bruises	Was struck by descending bucket and knocked off a stage to the bottom of the shaft, about 8 feet, sustaining several cuts and bruises.
28 July	Ditto	Ditto	Struck by cap-piece	Cowie, Ben-jamin	Married	Cut chin	Was lifting a cap-piece on to the legs, and it struck him on the chin, causing a cut which re-quired stitching up.
5 Sept.	Tasmanian Consols	Mathinna	Fall down winze	Paul, Edw.	Single	Cut head and bruises	Going down ladder in winze; he slipped and fell to the bottom, a depth of about 35 feet.
13 Sept.	Tasmania G.M.	Beacons-field	Explosion of gelig-nite	Mullins, Edw.	Married	Fractured skull, broken arm and thigh	Was helping to fire a round of 16 holes in Grubb's shaft, and miscalculated the time of the fuse. Injuries fatal.
13 Sept.	Ditto	Ditto	Ditto	Levings, Jas. Thomas	Ditto	Cuts and bruises	Was helping Mullins to fire the round as above.
10 Oct.	Mount Rex T.M.	Avoca	Drilling-machine	Kimp, Thos.	Single	Crushed finger	Was assisting with diamond-drill, and had little finger of left hand crushed by the cog-wheels.
23 Oct.	Briseis T.M.	Derby	Falling tree	Brent, Jos. Martin	Married	Broken arm, &c.	Caretaker of water-race. Was knocked down by falling tree.
15 Nov.	New Golden Gate	Mathinna	Swinging cage	McDonald, Donald	Ditto	Bruised arm	Assisting to take cage off for re-pairs; it swung round and jam-med his arm against king post.
19 Dec.	Tasmania G.M.	Beacons-field	Fall of quartz	Johnstone, Thos.	Ditto	Bruises and shock	Was making ready for erection of a set, when some quartz fell on him.
29 Dec.	Ditto	Ditto	Fall into pit	Nowells, Samuel	Ditto	Broken leg	Cleaning end of sweep-rod of pump, and fell into bob-pit.

Mr. Inspector Harrison (stationed at Zeehan) reports:—

In submitting to you my annual report, I am pleased to be able to state that the accident-list is considerably less than for the previous year, being as follows:—Fatal 1, serious 5; as against fatal 3, non-fatal 11, in 1904.

Ropes and Cages.

Ropes and cages have been tested as required; several of the former have been put out of use.

Ventilation.

The ventilation of the various mines is as good as circumstances will permit. There has been no complaint in this respect.

Magazines.

There are a large number of magazines in the district; most of them are connected with the various mines. During the last quarter of the year the larger ones, used by merchants for storing large quantities of explosives, have been removed outside the town boundary, to the reserve laid off for that purpose.

Legal Proceedings.

It has not been found necessary to take any legal proceedings with respect to the working of the mines during the year.

The results obtained during the year have fully borne out my expressed opinion in my last report, while the continued good price obtained for the various minerals won from the district, and the energetic manner in which mining is being pushed ahead, leads me to anticipate that the output for the present year will far exceed both in quantity and value that of 1905. Following is a short report on some of the principal mines of the district:—

Zeehan.—Mount Zeehan (Tas.).—This property is looking very well. The deeper levels show abundance of high-grade ore. The manager has laid off a new main shaft, and is now busy erecting powerful pumping and winding machinery on the site. Mr. T. Vincent, general manager, sends the following report on the work done during the past year:—

Spray Mine.—Drives on lodes, 824 feet; rises, 300 feet; and winzes, 120 feet. Of the latter, 110 feet were sunk below the bottom working-level, where the lode is 10 feet wide, composed of antimonial galena, worth, per ton, £7. At 105 feet we have started drives both north and south, which are worth, per lineal foot, £38. This shows we have a rich body of ore at the deepest point, and when we take into consideration that the upper level is driven 520 feet through pay-ore, it does not require an expert opinion to tell one that our prospects for 1906 are as good as one could wish for. It has also given the company a sufficient guarantee to provide the funds necessary to equip and sink a new main shaft, which work is now in progress. Some thousands of yards of mullock have been removed, to clear a site, and when the powerful machinery which is being made by Salisbury's Foundry Co. is installed, sinking will be carried on rapidly. By carrying out

the new work, it shows the company has every confidence in the future success of the property. The output of marketable ore for 1905 was 5018 tons, and value £42,557. For 1906 we have every reason to expect a greater output and value.

No. 2 Shaft.—Drives on lodes, 549 feet; crosscuts, 110 feet. At this mine the ground is very hard, hence development is slow and expensive; nevertheless, on No. 30 lode, out of 156 feet driven, the last 56 feet are in pay-ore, the face showing a fairly good lode. On Nos. 10 and 15 lodes we have driven a considerable distance through barren ground, which has been very much disturbed. It is our intention to keep these drives going, as we feel sure that eventually we shall be repaid the outlay.

During 1906 we purpose sinking the shaft another 100 feet, and thus open up pay-ore known to exist below the present working-level. Our prospects for the future are decidedly good. The output for 1905 was 1288 tons, and value £21,099. The class of ore raised from this mine is of a high grade, hence the cost of development is not felt to the extent it would be if the ore were of poor quality.

Zeehan-Montana.—No. 1 shaft: This mine never looked better than at present. Large bodies of ore are available in the various levels, while the manager has the progressive work well ahead of the ground that is being mined. No. 2 shaft has been sunk to a depth of 400 feet. A drive is being put in to strike No. 1 lode (so favourably worked in the past). A few more days should see this work accomplished.

Zeehan-Western.—This company is giving employment to a large number of tributors, with remunerative results; while the deeper levels are showing better and more encouraging prospects.

Florence.—Manager has put down a winze in the bottom main level on a shoot of good ore. It is more than probable that arrangements will be made to sink the main shaft.

Watt & McAuliffe.—This mine, which has been very successfully worked by a party of working men, has changed hands. It has been taken over by a Victorian company, and is now called the Austral Valley. The manager is busy erecting pumping and winding plant in a new main shaft. He should be in a position to win ore by the end of March. The prospects of the mine are good.

Victorian-Zeehan.—This company has a good plant, and has started two prospecting drives at the 100-feet level. On the old Maxim property, pumping and winding machinery is in the course of erection.

New Mt. Zeehan.—A few tributors at work. The same applies to the Oonah, Silver King, and a number of other mines.

Comstock and Heemskirk.—At Comstock several mines are at work. The South Comstock is still turning out good ore, while several others are obtaining parcels of zinc-blende under favourable circumstances.

Mayne's Tin Mine is still turning out tin in payable quantities, last quarter's return being valued at £1100 net.

There have also been several new discoveries on the slopes of the Mount. On McIvor's some very rich tin has been found. The property is under offer to a Victorian syndicate. The Public Works Department has cut several tracks up the Mount, for the benefit of the prospector, and in every instance the result has warranted the outlay.

Dundas.—The Comet Mine is still being worked satisfactorily on the tribute system. No. 3 level is being unwatered. Large consignments of fluxing-ores go from this mine to the local smelters.

South Comet.—This mine is worked principally for fluxing-ores. Four thousand tons were sent out during the last quarter.

Red Lead is another mine worked for the same purpose.

North-East Dundas and Mt. Read.—Renison Bell T.M. Co. is being prospected by a syndicate who have the mine under offer. They are working the alluvial with profitable results. There are a number of small parties at work in the same locality.

Fahl Ore Mine, or *Ring Valley*, on the Ring River, is still sending consignments to the Mt. Lyell Smelters.

Mount Read Company's main adit is being pushed ahead with all possible speed.

Hercules.—I regret to state this valuable property is still idle.

Rosebery and Mt. Farrell.—The *Primrose* and *Tas. Copper* companies are sending out large quantities of ore for the local smelters; they are also sending ore to the Blinman, South Australia.

North Farrell Mine is keeping up its output, and has large reserves of ore in sight.

At the *Murchison*, the erection of the new dressing-mill is nearing completion. Manager has several thousands of tons of ore at grass, ready for treatment, and a strong lode to work on.

The *Mackintosh* and several other mines are at work.

Waratah, Whyte River, and Mt. Stewart.—At Waratah we have the Mt. Bischoff, Bischoff Extended, Weir's Surprise, Wombat, Badger, and several others busy tin-mining.

At the Heazlewood there are the Victorian Magnet, the Washington Hay, and others.

At Mt. Stewart the Long Tunnel is sending out ore for the Zeehan smelters.

The Magnet Mine is turning out large quantities of galena and fluxing ores. Several new developments have taken place during the last few months in this mine.

South of Zeehan.—A tram line over 5 miles long is being constructed from Eden Station to a mine best known as McKimmie's, near the Henty River. The mine has been taken up by a private gentleman, and he has a large quantity of ore on hand to send to the smelters directly the tram is completed.

Red Hills.—At the Red Hills prospectors are again at work, in the interests of the Mt. Lyell Co.

Stanley River.—The alluvial flats on the Stanley have been taken over by a strong syndicate, and active operations started. The ground is known to contain rich tin, but it will depend on the results of boring, nature of bottom, &c., what system will be adopted to work the mine, whether it will be hydraulic-lifter or bucket-dredge. I feel sure that this somewhat neglected field only requires a little more energy put into it to place it on the list of the remunerative tinfields of the State.

During the last quarter of the year it was found necessary to close down the Zeehan-Queen for a time. Against this we have the starting of the Victorian Zeehan, Maxim, and the Austral Valley, all equipped with good pumping and winding plants.

LIST of Accidents in Inspector Harrison's District for the 12 *months,* 1*st January to* 31*st December*, 1905.

Fatal, 1 ; non-fatal, 5 ; total 6.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1905. 27 Mar.	Zeehan-Montana	Zeehan	Explosion	Meredith, John	Married	Scalp wounds, broken limbs, &c.	Meredith and his mate, Wroe, returned to the face immediately after firing two shots, for the purpose of firing another charged hole ; just as they reached the face this third charge exploded. Meredith sustained severe scalp wounds, loss of one eye, left arm and right leg broken, and numerous wounds on face and body.
27 Mar.	Ditto	Ditto	Ditto	Wroe, Herbert	Ditto	Cut lip and bruises	Was with Meredith as above ; severe cut in upper lip, and bruises.
4 July	West Comet P.A.	Dundas	Detonator exploded	Miller, Harry	Ditto	Loss of two fingers and lacerated hand	Knocked sawdust out of primer, and was looking to see if it was clean, when it went off, shattering his hand.
18 July	Florence S.M.	Zeehan	Machinery in motion	Carey, John	Single	Left arm broken	Was attending one of the jigs, and got on top of it to clear a shoot. The seam of his coat caught a key in the shafting.
31 Aug.	Ditto	Ditto	Fall of stone	Loveridge, Jas. E.	Married	Injury to leg	Was going into stope, when some stone fell from wall and struck him on the leg, causing a wound and slight splintering of bone.
3 Sept.	West Comet P.A.	Dundas	Fall of timber and mullock	Chatters, Henry	Single	Crushed to death	Was repairing a stope, when some mullock and timber fell and crushed him.

Mr. Inspector Curtain (stationed at Queenstown) reports:—

A summary of the casualties in the Lyell Division of the Western Mining District for the past year is as follows:—Fatal, 3; serious, 7; not serious, 7. They were confined to the mines hereinunder mentioned; viz.:—

Mount Lyell Mining and Railway Company, Limited.—Alfred Ernest Walsh, single, age 24 years, engaged as miner in the North Lyell Mine, was killed instantaneously by a fall of schist in the "B" stope. The cause was attributed to Walsh knocking out a piece of timber that had been placed as a sole-piece to take the flooring of a mullock-chute—taking weight as a "tom"—which, when liberated, permitted the ground to fall, and occasioned the accident.

William John Kelly, single, aged 26, an ore-filler, was decapitated after jumping off an uncontrolled balance-rake of loaded trucks on the mine side of the main haulage.

Ernest Frederick Rdzberg, married, aged 58 years, a line-repairer, had his skull fractured in the preceding accident, ankle dislocated, and body severely bruised and shaken.

A line-ganger was with Kelly and Rdzberg, and gave the alarm when the trucks parted from the rope. Beyond a severe shaking, he sustained no other ill-effects, and resumed duty after the enquiry.

The particulars relative to this casualty are, that without any warning the rope broke from the curved or turned-back (shod) wires at its extremity, and drawing through the metal permitted the load (12 tons with men) soon after its departure from the top to get away on a steep—1 in 3—gradient. The men were riding on loaded trucks, and at the enquiry the jury added a rider recommending amendment of the company's rule, to the effect that no person should be permitted to ride on loaded trucks in the future. Rdyberg was idle for some time, but is again working for the company. The rope was 4 inches in circumference, 6-strand, 7 wires per strand, and made of best ploughed steel, and therefore possessed a more than marginal factor of safety.

In mounting these end couplings, the custom is to "thread" the rope longitudinally through the shoe, serve, and unreeve about a foot of the wires, half of which are cut off, and the balance turned back in 6 and 9-inch lengths. The shoe being cone-shaped, is then "swedged" over the latter, until the longer lengths approach its leading collar, when the interstices are filled with a specially-prepared white-metal. This method was inaugurated at the haulage, and without any alteration continues to the present.

Richard Dillon Ross, single, age 41 years, a quarryman, working in "No. 2" bench of the lime-quarry, met his death under somewhat peculiar circumstances. His particular duty at the time was watching the movement of an expected transverse fall of permanently battered ground, in order to warn his mates. This he did, and as the mass began to finally settle and come away, he began running, and had reached a distance of 144 feet from the base of the face, when the major portion of the fall overtook and buried him to such an extent that before relief could reach him he was smothered.

Donald McLean, single, aged 41 years, a slag-wheeler at the reduction works, had his right leg broken by the fall of a cast-iron launder which he was removing from "No. 8" furnace. Other complications following, keep him under medical attention.

Henry Charles Frost, married, aged 39 years, a repairer, working in the "No. 2" sub-stopes at the 600-feet level of the North Lyell Mine, was, with others, engaged withdrawing timbers for the purpose of making room for an ore-chute, when, chiefly from side-pressure, the section collapsed, and causing Frost to fall to the level below, broke his right leg between the ankle and knee, from which he is still suffering. Had the off-side timbers been "tommed" as the front timbers were relieved, this accident could not have happened.

John Patrick Keating, widower, aged 36 years, a leverman at the "No. 6" hydraulic stand of the converters, was somewhat severely burnt about the arms, elbows, and throat by an overflow of matte from the vessel which he was regulating. Realising the danger his action occasioned, he stuck to his post, recovered his vessel, and thereby averted what might have proved a matter of more serious consequences. He is about, and making a recovery.

Lyell Blocks Mining Company, No Liability.—Charles Powell, single, aged 28 years, a general hand, was engaged "lathing up" a pass in the "No. 1" level stopes of the balance shaft, when a quantity of earth fell on him from the adjoining set and caused serious injuries to his back and legs. Powell left the Queenstown Hospital in the middle of last March for his home in Daylesford, Victoria, and late advice from there states that he is still suffering.

A close investigation was made into this accident, and I came to the conclusion that Powell, by his own actions, did not contribute to his injury.

Lake Jukes Mining Company, No Liability.—Luke Richards, married, aged 58 years, a labourer, working in the wheel-pit, struck an unexploded piece of gelignite with a pick, that going off caused serious injuries to his head and eyesight. One eye was destroyed.

The circumstances are, that a round (7) of holes was fired and their explosions accounted for, but the full charge of one evidently failed to detonate until struck by Richards. Fortunately, the direct force passed over the man's shoulder, otherwise the result must have been more serious, if not fatal. He subsequently resumed work as a battery-feeder, but his eyes proving troublesome necessitated his recently seeking further medical advice.

The following were non-serious cases, but are mentioned here as requiring comment on account of the attendant circumstances:—

Henry Rowlands, single, aged 24 years, a shoveller on the floor of the office tunnel, was seated in Block "F2" having crib when a quantity of "side-ground" came away, and falling on his legs and back necessitated a week's idleness to recover. The selection of the set was most injudicious, and an order followed that no sets should be left before being properly secured.

James Cumming, married, aged 31 years, a riseman, working in a connection between "No. 1" level of the "balance" shaft and the "office" adit, sustained a scalp-wound that incapacitated him for a week. He had "spit" three holes, and while endeavouring to close a trap-door lost his light. In all probability he remained longer than he believed or intended, and a shot going off before he reached safety in the level, broke a staging-board that, with a portion of the overburden, fell upon him.

George Brooks, aged 25 years, a faceman, working in Block "3" stopes of the balance shaft, received slight bruises to his legs by a fall of clay from the face he was working, jamming him against the timber of the set below. He had only taken up the position for a moment, in order to clear the spoil that was accumulating and blocking his "rill," otherwise the injury could not have happened. He returned to work within a week.

Thomas Dillon, single, aged 28 years, was engaged on a windlass lowering timber from a crosscut in the "office" adit, when he sustained a slight fracture of the skull by being struck with the handle that he lost control of. He resumed work within a week. An investigation elicited the fact that the timber (a leg) caught, and then slipping away jerked the handle out of Dillon's hands, an occurrence that is most prevalent in this class of work, and that can only be guarded against by making it compulsory to have all windlasses mounted with pawls and ratchets.

Richard Lonsdale, single, aged 26 years, a shaft-sinker in the North Lyell Mine, was struck in the fleshy or back part of the right thigh while being pulled away from a round (7) of shots he and his mate had "spit" in the bottom of the main shaft. Three of the latter, according to the men's statement, exploded prematurely. Whether this was the case or not, fortunately needs no comment, beyond demonstrating the necessity of all precautions being taken in this branch of mining, particularly in the selection and use of fuse, which for shaft-sinking purposes should be specially prepared and its qualities guaranteed by its makers. Electricity is becoming so general that it will be well when, by regulation, its service is applied to shaft-sinking, and even now there is no valid reason why these mines that are installed should not extend its use for the purpose stated.

May Gold Mining Company, No Liability.—Thomas Hardman, a battery-feeder, single, aged 19 years, had the fingers of his right hand jammed between a revolving cam and a stamp-shank he was cleaning. The injuries were slight, but might have been otherwise, and demonstrates that unless required under exceptional circumstances, no dangerous part of any machinery should be cleaned while it is in motion.

The foregoing constitute the number of casualties that have come to my knowledge; others, such as bruises to hands and feet, chiefly fingers and toes, burns, and shocks, have taken place, but were not reported. With the operation of the new Mining Act, however, some of these will henceforth be included; while others that are now enumerated, unless attended with circumstances calling for remark, may be omitted.

In reviewing the whole of these accidents, it is satisfactory to note that apart from the flux-quarry fatality, no other serious accident has happened in the open-cut faces, which, considering the number of men employed and the quantities of material removed, is worth noticing; while an analysis of the fatal accidents demonstrates that if not all, certainly two, of them should not have happened: (1) Walch's action in knocking out the piece of taut timber in order to give more freedom to the shots he was about to fire, cost him his life; (2) where Ross was overcome would have assured most men of safety, but it was only after running some distance that he gained this spot. He warned others, and evidently only thought of his own safety when the mass was collapsing; (3) Kelly, in pursuing a custom that had become somewhat general with the haulage hands, contributed to his death by riding on loaded trucks, that was contrary to the company's regulations. Hence, had thoughtfulness on one hand and discipline on the other prevailed, those men might have been living still, and their untimely ends should be an object-lesson to all, and especially to young men, who are engaged in dangerous callings, to remember *that the greatest responsibility for their own welfare and safety rests with themselves.*

Magazines and Explosives.—Five are locally in use. Three belong to the Mount Lyell Company, and each carry an average stock of 10 tons of mechanical and chemical compounds. The monthly consumption of explosives on the field is between 5 and 6 tons. A grievous mistake is made in permitting any deleterious stuff to come into the State, and those responsible for its distribution should be subject to a severe penalty.

Shafts and Ladder-ways.—Those in daily use for "life" purposes are in good order. The balance shaft at the Blocks Mine became, for cage work, unworkable, but prior to this men were not permitted to ride through it. The main shaft of the same mine occasions attention, but beyond intermittent repairs and bailing, it is not used, and even for these purposes its use will in all probability cease when the main or "Consols" adit connects it.

Ropes and Cages.—In addition to periodical tests, close observation has been kept on those in use, and with one exception they can be returned as being all in first-class order. Miller's Tasmanian cage predominates, and were it mounted with a hand-lever, whereby it might be serviceably controlled by those riding in it, I have little hesitation in stating that it would come within the nearest approach of its intended purpose. Competent and careful enginedrivers, with nothing but the best ropes, governed by "life" limits, are, however, the best margin of safety to rely on.

Ventilation.—With the year just terminated, this has been good, but as depth is attained, and waiting connections with the preceding levels, it must necessarily require increased attention, and for that purpose, apart from anemometer readings, provision will have to be made whereby, in addition to quantity, the purity of the air may be ascertained. The recently-connected higher or stope workings with the "Con-

sols" adit in the Blocks Mine have much improved these workings.

Inspections.—Inspections and other duties pertaining to this office have been attended to, as follows:—

Iron Blow, open-cut, surface, 41; underground, 5.
North Lyell, open-cut, surface, 41; underground, 39.
Lyell-Tharsis, open-cut, surface, 37; underground, 15.
Lyell Blocks, open-cut, surface, 40; underground, 44.
Flux Quarries, open-cut, surface, 27; underground, 0.
Fire-clay Face, open-cut, surface, 12; underground, 0.
Brick Kiln Face, open-cut, surface, 8; underground, 0.
Crown Lyell Mine, surface, 0; underground 5.
Tasman-Comstock Mine, surface, 0; underground, 2.
Tasman and Crown Lyell Extended, surface, 0; underground, 4.
Lake Jukes, surface, 0; underground, 3.
Coronation Gold Mine, surface, 0; underground, 5.
May Gold Mine, surface, 0; underground, 10.
Woody Hills Gold Mine, surface, 0; underground, 5.
Copper Mines, West Lyell, surface, 0; underground, 3.
Hyde's Show, surface, 1; underground, 0.
King River P.A., surface, 1; underground, 0.
Reduction Works, Smelters, 15.
Reduction Works, Concentrators, 8.
Reduction Works, Batteries, 7.
Ropes tested, underground, 12.
Cages tested, underground, 12.
Ropes examined, surface, 88; cages, 15.

Enquiries, 22; interviews, 11; Lands and Works Office, 5; magazines, 13; conference, 1; inquests, 3.

Conclusion.—The various mines that form the Mount Lyell group promise a continuance of advancement and prosperity during the ensuing year (1906). Prospecting continues on the South Contact from the "No. 8" level of the parent mine, also at the North Crown; while similar and developmental work is kept well ahead of the stopes and producing-faces at the Tharsis and North Lyell mines. The main shaft at the latter is some 480 feet below the lowest adit or 300-feet level. The odd feet are credited to the last "sink," that has passed through a continuance of high-grade copper ore. The Lyell Blocks Mine have advanced their main or "Consols" adit to a total of 1500 feet, and about this point connected with their higher workings 100 feet above. They are confronted with a difficulty in the shape of a surface-movement that, though slow, is ever increasing, and must prove menacing during the "life" or extraction of their more shallow workings. The value of this mine is centred in a clay channel, ranging from 20 to 100 feet in width, that assays up to 2 per cent. in the form of glance (Cu_2S) and native copper. It readily yields to puddling, and the residues are the chief sources of production. The latter is now about 87 tons of fine copper per month, with a promise of increasing.

Crown Lyell Mine.—One hundred feet were completed in the main shaft and the western "green" schists penetrated, but beyond maintaining the general characteristics of this belt of rock, nothing of importance was elicited.

Tasman and Crown Lyell Extended.—The winze on the large "sulphide" deposit was sunk 30 feet, but sufficient work was not done whereby its value could be ascertained, when the mine shut down pending a scheme of reconstruction that is still under way in Victoria.

Tasman-Comstock Consolidated.—Beyond prospecting on the western fall of Mt. Lyell, and a close scrutiny and sampling for purchasing purposes, no work has been done on this property for some time.

Copper Mines of the Mount Lyell West.—Prospecting has somewhat intermittently been carried on in the Razor-back tunnel, but without meeting with any success.

Lake Jukes Mining Company.—In an iron formation (principally hematite and magnetite), through the felsite, small bands and strings of glance and bornite, together with quartz, carry gold. To treat this a 5-head battery and water-wheel has been erected. The proposition, however, was hardly an amalgamation one, consequently, beyond establishing the presence of gold over a width of 16 feet, present appliances proved of little use as a final treatment of the ore, which will have to be subjected to more appropriate methods of extraction. For this, and the purpose of obtaining depth, increased capital is being solicited in the home market, from whence recent advice to the manager, Mr. H. S. Muir, is of an assuring character.

Coronation Gold Mine, Lynchford.—After persistent efforts in the "70-feet" level, operations ceased, and the plant is now being disposed of. An alluvial digger came across two large pieces of green-tinged stone that valued over 5 ozs. to the ton, but like similar loose boulders in the past, their source has evidently never been located.

May Gold Mine, Lynchford.—This company removed from Heemskirk and re-erected a five-head battery and water-wheel. They crushed 183 tons of stone for 35 ozs. of smelted gold, and are at present preparing another crushing that is expected to be more remunerative.

Woody Hills and Macquarie Mines have been persistently prospected by the Murray Bros. with a number of men, that still continue. The last crushing of 30 tons returned 12½ ozs. of retorted gold.

Darwin.—The Thompson P.A., a co-operative syndicate from Gormanston, are prospecting the south-eastern spurs of the mountain, on a section where some heavy gold had been found by their prospector.

Alluvial diggers are also in evidence in this neighbourhood, Flannigan's Flat, Harris' Reward, Queen River Flats, and upper tributaries, but judging by the returns supplied by the banks and storekeepers, none are making fortunes. These grounds provide means of making a living, that there is little doubt will continue indefinitely. Many of these locations present favourable situations for suitable dredges which, according to interstate statistics, should pay handsomely.

Mr. T. B. Moore, the well-known West Coast explorer and prospector, is credited with taking up ground in the vicinity of "Dora" and "Red Hills" for a strong syndicate that is likely to test these properties.

Now that communication is made so much easier than in the early days, it is to be regretted that more attention is not

given to the equipment of prospecting parties under the lead of capable and reliable men, who have better opportunities of rendering a good account of themselves than those who preceded them when the West Coast was practically unknown.

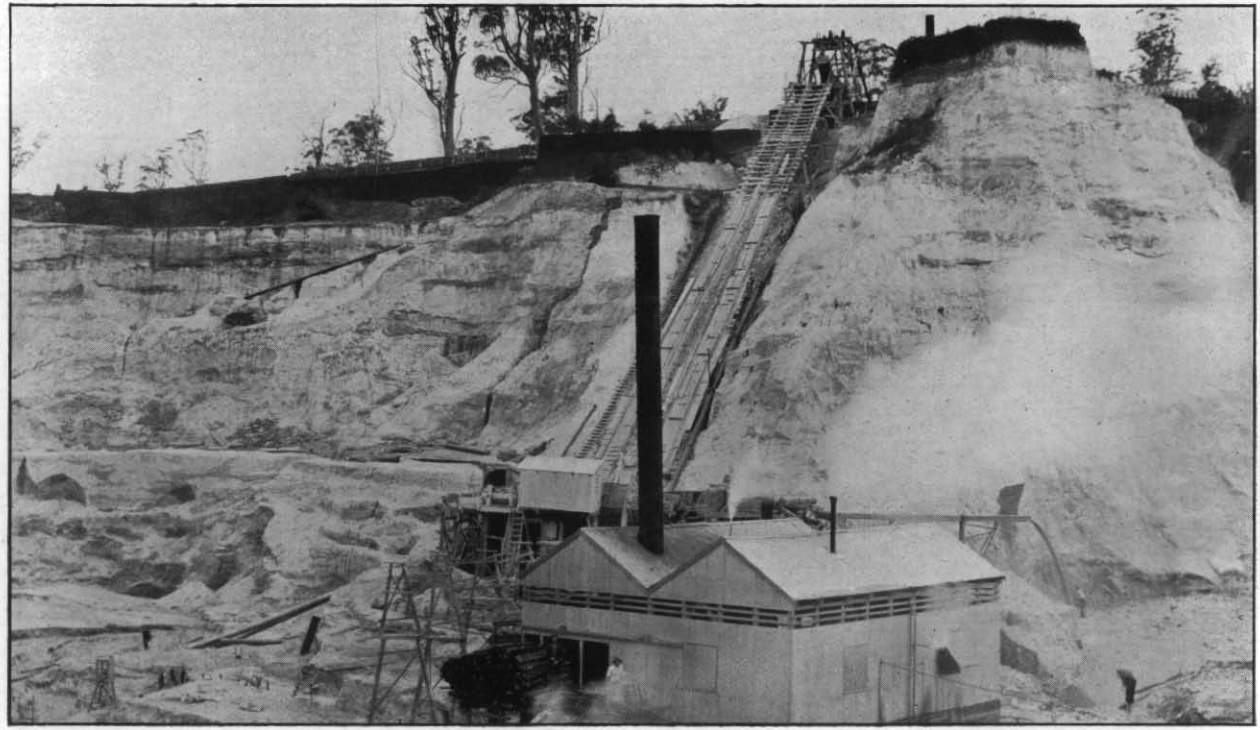
This Lyell District receives such little consideration from the Government in return for what it provides and gives, that I certainly think our Department would be justified in having a fund established whereby another exploring expedition, on lines similar to that of Gould's, could be revived, and its labours devoted to cutting tracks and opening up the country east of the metalliferous belt that continues through the intervening ranges between Darwin, Sorell, and Mount Farrell.

LIST of Accidents in Inspector Curtain's District for the 12 *months,* 1*st January to* 31*st December,* 1905.

Fatal, 3 ; non-fatal, 6 ; total, 9.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1905. 19 Jan.	Mt. Lyell Blocks	Mt. Lyell	Fall of stone	Powell, Chas.	Single	Severe bruises	Was mullocking up second floor of a level, when some stone fell and knocked him down ; another piece then fell and struck him on thighs and groin, bruising him internally and both of his legs.
10 Feb.	Mt. Lyell M. and R.	Ditto	Ditto	Walsh, Alfred E.	Ditto	Fatal internal injuries	Was working in B stope, N. Lyell Mine. He knocked away a prop, and a slab of stone fell on him, killing him instantly.
18 Feb.	Ditto	Ditto	Runaway truck	Kelly, Wm. John	Ditto	Fracture of skull	Riding on truck on haulage line. The truck became detached from rope, and Kelly jumped off. When picked up his skull was found to be smashed in.
18 Feb.	Ditto	Ditto	Ditto	Rdzberg, Ernst Fredk.	Married	Fractured skull, bruises and cuts	Same accident as preceding.
14 June	Lake Jukes Copper	Mt. Jukes	Explosion of gelignite	Richards, Luke	Ditto	Loss of an eye, and cuts on face	Was working some rock after a round of shots had been fired ; his pick struck some unexploded gelignite, and an explosion took place. His eye was injured, and eventually he lost the sight of it.

17 Aug.	Mt. Lyell M. and R.	Mt. Lyell	Slip of earth.	Ross, Rd. Dillon	Single	Suffocation	Working in flux quarries. A fall took place and buried him.
17 Sept.	Ditto	Ditto	Fall of launder	M'Lean, Donald	Ditto	Broken leg	Assisting to take back launders off furnace: the nut on last bolt came off, and the launder fell on him, causing compound fracture of right leg.
16 Dec.	Ditto	Ditto	Fall of timber	Frost, Henry Chas.	Married	Ditto	Withdrawing section of square-set timbers. Four sets had been removed, and the others collapsed, causing a compound fracture of right leg.
27 Dec.	Ditto	Ditto	Molten matte	Keating, Patk. John	Widower	Severe burns	Working as leverman at converters, and got splashed by molten matte.



Arba Tin Mine, Branxholm.

ON COAL AT MOUNT REX.

[One Map.]

Government Geologist's Office,
Launceston, 28th April, 1905.

SIR,

ACTING on your instructions, I proceeded to Mount Rex on the 16th ultimo, in order to examine the recently reported occurrence of coal in that district. A discovery of seams situate in the Parish of Malvern has been made by Mr. James Stevenson, at a distance of about $\frac{3}{4}$ mile south and south-east of the Mount Rex Tin Mine, and 5 miles north-west of Avoca in a direct line. A section of 160 acres, 201-M, has been taken up by Mr. James Stevenson, and mining rights have been acquired on the adjoining freehold of Mr. H. R. Falkiner, 3680 acres. The present way of approach to the field is along a fairly level road from Avoca, on the western side of the Castle Carey Rivulet for three or four miles, and then up the road to Mount Rex for a couple of miles, as far as the Black Pinch, when a turn to the south is taken just west of Mr. McCarthy's farm boundary. The journey can be easily made in one and a half or two hours from Avoca Railway Station. If the seams are developed, and a permanent coal-field springs up here, the outlet will be down the valley of Buffalo Creek to Avoca.

The Avoca township is on Tertiary basalt, and the road for some distance on the west side of the Esk River traverses Tertiary sediments. But further on, the Mesozoic trap-rock or diabase prevails, giving place to Permo-Carboniferous sandstones. The road up Mount Rex is on the western side of a valley which is along the contact of the sandstones and diabase on the west with the granite on the east. At the Black Pinch a diabase (greenstone) hill occurs to the west of the road, and at the southern end of this hill two seams of coal have been discovered in sandstones of Mesozoic age.

In Tasmania it is not practicable to divide Mesozoic strata in the same way as is usual in Europe; but these upper coal measures probably correspond as nearly as

possible with the Jurassic or its equivalent in other parts of the world. In Tasmania they are everywhere pierced by eruptive diabase rock, which at the contact tends to make the coal brittle and hard. Owing to detritus, the actual contact is rarely seen, except where dykes traverse the sandstone, and the present position of the denuded eruptive mass at the crown of the ranges always impresses the casual observer with the idea that the sandstones with their associated coal seams pass beneath it. Without denying the possibility of this in certain cases, it must be said that its occurrence has not yet been demonstrated; while, on the other hand, several instances are known of coal measures being cut off by the trap-rock; and bore-holes in the sandstone have frequently penetrated to the underlying trap.

At the south end of Greenstone Hill a drive has been put north-west into the hill for about 50 feet on a seam of coal said to be 6 or 7 feet thick. The approach has fallen in, and I could not examine the seam. I was told that it was soft at first, but developed into solid coal when further in. At surface loose stones of diabase greenstone are scattered through the soil. These have been derived from the hill higher up. I think it quite possible that in extending this tunnel, say, some 500 or 600 feet further the solid diabase would be met with, unless, of course, the sandstone passes beneath it, as mentioned above. The seam could, however, in any case be followed round the contour of the hill, and would yield a lot of coal, though my fear would be that, as it is apparently so near to where the diabase may be expected, it would never get much weight upon it.

Four or five chains south-west of this, and 90 or 100 feet lower, a 12-feet seam of coal has been discovered. This was the first discovery, and a drive was put in on the upper part of the seam for upwards of a chain; but it has fallen in, and I could not see this particular drive. However, a tunnel has been driven upon the seam a few yards to the west for a distance of 150 feet. This tunnel averages 10 feet in height by 6 feet in width. Its direction is 10° west of north; and the dip of the seam is to the west, at an angle of 10° from the horizontal. The level or drift has been carried horizontally across the dip of the beds, and the whole vertical thickness of the seam has been extracted from sole to roof. The seam is displayed well and continuously all along the drift for an average thickness

of 10 feet. A hole which I had sunk in the floor about 20 feet behind the face showed the seam to within a few inches of 12 feet thick in all. I was told it had been measured to 12 feet. The section near the face and on the east wall of the level was as follows, in descending order:—

	ft.	in.
Coal	3	0
Band of white clay	0	6
Coal ..... 5 inches to	0	6
Clay band	0	2
Coal	1	2
Band ..... ½ inch to	0	1
Coal	1	9
Band, variable	0	0½
Coal	0	7
Thin band, inappreciable		—
Coal	4	0
Total	11	9½

I could not examine the last foot or two of coal in section as the water drained into the hole sunk, but the quality was quite equal to that exposed in the level. In the face the two upper bands are coming together closer, being only 3 or 4 inches apart. On the west side of the level, too, the bands seem to be thinning, and some of the thinner ones have died out altogether. If there is any difference at all in the appearance of different parts of the seam, the lower part is the sounder; but all through the seam consists of solid, marketable coal. Inside the entrance to the level a peculiar occurrence is noticeable. The lower part of the seam is invaded by sandstone, leaving the upper 3 feet and band unaffected. The fact that the upper part is untouched proves that there has been no faulting or other disturbance, and I think the proper interpretation of it is that a roll or even a more decided unevenness or drop of the floor takes place at this point. It occurs at the entrance itself, and does not prejudice the part of the seam in which the level has been driven. Several tons of good quality coal are lying outside the mouth of the tunnel. Some of this heap has been used in the furnace at the Mt. Rex Mine.

The line of contact between the sandstone and diabase ahead of this tunnel is not visible, being concealed by detritus from the eruptive rock, which tends to make the contact seem nearer than it really is; but it is probable

that after further 10 to 20 chains have been driven north the drive would be in the neighbourhood of the junction, and the much debated point of whether the coal measures pass below the diabase or not would be on a fair road to settlement.

About ½ mile further west, and 140 feet lower down, is a shaft which has been sunk on what appears to be the same seam outcropping at surface. Its section, in descending sequence, is:—

	ft.	in.
Coal	3	0
Clay band	0	4
Coal	0	9
Band	0	2
Coal	3	2
Band	0	1
Coal	0	6
Band	0	0½
Coal	3	7
Clay bottom	—	
Total	11	7½

It will be remarked that the main features of the seam correspond fairly well in both the tunnel and this pit, viz., 3 feet of top coal, 3 feet of coal in the middle of the seam, and nearly 4 feet in the bottom part. On the other hand, the seam in the pit is horizontal, while in the tunnel it is dipping at an angle of 10°; the difference may be due to local weighting, or the dip at the eastern end of the field may very well be caused by the strata there being at the edge of the basin where it ends against the granite range.

The first thing to be done in this field is to test the extension of the seam or seams; and having determined them to be continuous and free from faulting, a few tons should be got out and placed for practical trial. Then the matter of connecting the field with the Government railway can be taken in hand.

A sandstone flat occupies the valley between the two diabase-crowned ridges of Christie's Hill and the Greenstone Hill, but between the former and the flat there is a lower ridge of sandstone. The flat ground nowhere exceeds a height of 100 feet above the coal seam at the shaft, and is for the most part less than that, so that testing the seam in the valley even by means of shafts,

would be comparatively easy. It is not likely that much water trouble will be met with, as the underground drainage will follow the coal seam to its outcrop lower down the valley. A couple of shafts on an E-W line would be sufficient on the flat. To test the ground along the north side of the valley up on the southern flank of the hill, between the shaft and the tunnel, it would be best to resort to boring with a core drill; a heavy plant would not be required. The boring will be easy work, but some way of bringing water on the ground will have to be devised. While the drill is on the spot it might be advisable to put down a hole lower down the valley, to ascertain whether other seams do not exist below the present one, and in situations nearer to the Fingal Railway line.

The outlet for this coal-field will be down the valley of Buffalo Brook to Hanleth, on the Avoca-Conara line, and once production here is established there is no doubt that this, and not the Avoca route, will be the egress for Mt. Rex and Ben Lomond traffic. The distance to Hanleth station along a route which would be followed by a tram or railway-line has not been ascertained, but it is thought it will not exceed 7 miles, and most of this is easy grade. The steepest gradient will be shortly after leaving the mine. The height (barometric) of the coal shaft above Hanleth station is about 650 feet.*

From the felspathic nature of the sandstone, the thickness of the seams and quality of the coal, although so far I have seen no fossil plant impressions, I entertain no doubt that the seams belong to the upper coal measures in Tasmania, and indeed to the same great series of coal-bearing strata which flank Mt. Nicholas and other mountains in the eastern part of the island.

I had average samples of coal broken down from the upper and lower parts respectively of the seam in the tunnel; and these, assayed by the Government Analyst, Mr. W. F. Ward, gave the following results:—

	Fixed Carbon.	Volatile Matter.	Ash.	Sulphur.	Moisture.	Coke.
Upper part of Seam	54·5	35·0	8·5	0·8	1·2	Firm
Lower part of Seam	55·0	28·2	15·1	..	1·7	Firm

Mr. J. D. Millen, F.G.S., of the Mt. Bischoff Smelting Works, assayed a sample for Mr. Stevenson, the result

* Determined with a Hicks' mercurial barometer.

of which I am permitted to quote. For comparison I place these analyses in juxta-position with standard analyses of samples (taken by Mr. M. J. Griffin, Inspector of Mines) from the Mt. Nicholas and Cornwall seams; not, however, with the intention of saying anything depreciatory in respect of the coal from any colliery nor setting off one against the other, but to show that notwithstanding minor variations, which may exist even in different parts of the same seam, all of them belong to a series of deposits which must be considered as geologically identical.

	Fixed. Carbon.	Volatile Matter.	Ash.	Sulphur.	Moisture.	Coke.
Mt. Rex (J. D. Millen)	52·90	38·20	8·90	...	...	Good and firm. Gas properties profuse.
Mt. Rex (W. F. Ward)	54·50	35·00	8·50	0·80	1·20	Firm.
Mt. Rex „	55·00	28·20	15·10	...	1·70	Firm.
Cornwall „	55·00	31·02	9·56	0·56	3·86	No coherent coke.
Mt. Nicholas „	57·50	28·40	9·28	0·54	4·28	ditto

These analyses confirm the conclusions derived from geological considerations, which point to the Mt. Rex seams belonging to the same series as those on Mt. Nicholas. The Mt. Rex coal, however, forms a good firm coke in the laboratory, and the gases will in normal samples probably range from 35° to 38°. The proportion of ash in one of the samples is rather high, but may possibly be accounted for by some of the band material being included. Broadly, the coal contains about the same proportion of fixed carbon as the Nicholas varieties, but more volatile matter, and normally, I think, will be found to run about the same in ash.

Mr. Mark Ireland, manager of the Mt. Rex Tin Mine, reports that a trial of the coal was made at the mine, but that it was unfortunately mixed with bands. If the coal were delivered properly sorted, he says it would prove to be a good steaming coal.

An important feature in the analyses of this coal is its coking property. This, Mr. Arthur Green, Secretary of the Launceston Gas Co., informs me, has not yet been observed in the coal of the Mt. Nicholas series. If this property is maintained in larger tests, a very satisfactory fact will have been established. The percentage of sulphur

present is less than that in the Greta, and some other of the New South Wales coals, and is also not so large as in many British gaseous bituminous coals. The percentage of volatile matter is sufficient for a gas coal, and with a few units more it would have made an excellent coal of that description: the deficiency in this respect is so slight, that it would be worth while submitting a sufficient quantity for trial. A few tons ought also to be got out and tried for steam purposes on the railway and on the river steamers. Greater confidence could be placed in the results of such trials than in conclusions drawn from a few analyses in the laboratory. But the analyses, as far as they go, decidedly support the opinion that the coal is of a quality well suited for both steam and domestic purposes. When tried even on an open hearth, I noticed that after a very little preliminary crackling, it burned freely and quietly, emitting considerable heat, coking visibly, and giving out a fair quantity of gas with a tolerably clean flame.

The discovery of this powerful seam at Mt. Rex is certainly geologically interesting, and may prove important even outside the question of its own economic value, for it indicates the possibility of the extension of coal-bearing strata still nearer to Conara. The diabase-topped hills which continue north of the railway westwards may carry coal-seams wherever these Mesozoic sandstones occur on their flanks. On the west side of Buffalo Brook, opposite the coal-shaft, I could see the precipitous diabase face of the range known as the Black Rock, but at that distance I could not identify any sandstones which might possibly be at its base. It is quite possible that the valleys indenting the broken country to the west may expose coal measures hitherto unsuspected.

Of one thing I am convinced, viz., that the possibilities of the country along the Fingal line with respect to coal are by no means exhausted by the known discoveries. The line runs through a large coal-field, which, though here and there interrupted by igneous rocks, contains numerous strong and persistent seams which are known at certain points, but which are also almost certainly existent in other parts of this extensive area. The local demand for coal is not yet sufficient to support the existence of large collieries in addition to those already at work, unless some advantage is offered in respect of quality or cost. But any improvement in these would result in increasing the

present demand, and favourably affect the prospects of a shipping trade. Discoveries like that at Mt. Rex may be considered as tending in this direction.

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

W. H. TWELVETREES,
Government Geologist.

W. H. WALLACE, *Esq.*,
Secretary for Mines, Hobart.

SKETCH MAP OF MT REX COAL-FIELD

5 cm

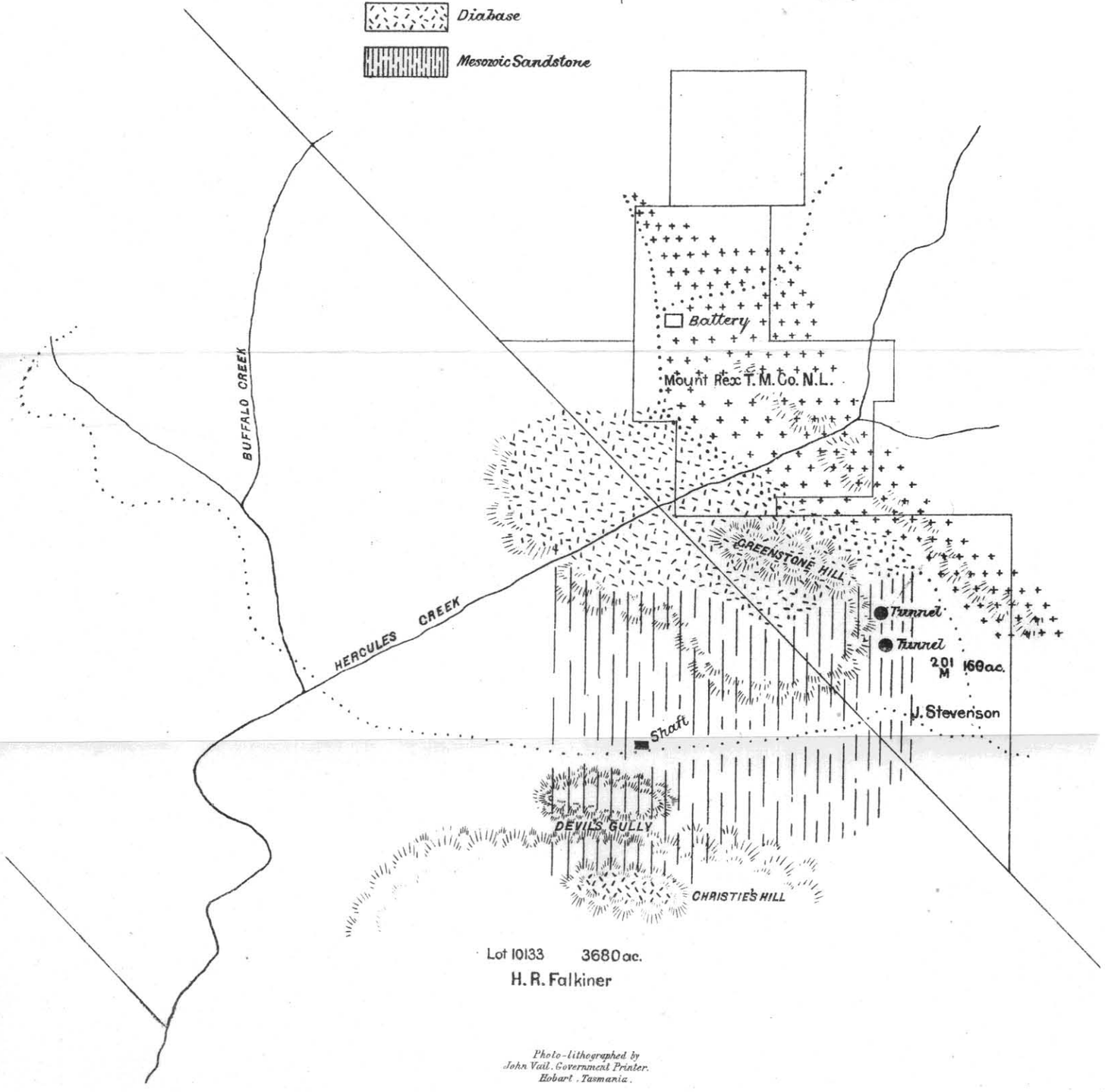
Scale 10 5 0 10 20 30 Chains

Granite

Diabase

Mesozoic Sandstone

W.H. Twelvetrees
Government Geologist
19th April 1905



Lot 10133 3680 ac.
H. R. Falkiner

Photo-lithographed by
John Vail, Government Printer,
Hobart, Tasmania.

MOUNT LYELL COMPANY'S MINE.

REPORT ON NORTH-WEST COAST MINERAL DEPOSITS.

[Six Maps.]

Government Geologist's Office,
Launceston, 26th July, 1905.

SIR,

As instructed by you, I journeyed to the North-West Coast on the 10th January, and visited various mineral fields and occurrences of ore all along the coast, at the Forth, Penguin, Howth, Blythe, Stowport, Boat Harbour, and Rocky Cape. I returned to Launceston on the 10th February.

GEOLOGY.

This is far from being simple. The older rocks which are seen along the sea-shore are varied, sometimes metamorphosed beyond easy recognition, and disguised, too, by changes in colour and texture by the action of the atmosphere and sea-water. They comprise slate, quartzite, schist, conglomerate, sandstone, &c., penetrated in places by igneous rocks of granitoid, dioritic or gabbroid character, and often overlaid by basalt of Tertiary age.

The age of these ancient rocks is still unsettled, and is likely to remain so, as long as the stratigraphical succession is not elucidated by actual survey. Some of them may be Lower Silurian or Ordovician, others Cambrian, while crystalline and gneissoid schists, such as those in the Forth Valley and Inglis River, and quartzites, as at Rocky Cape and the Sisters, are probably Pre-Cambrian.

The oldest known fossiliferous strata in Tasmania are the friable yellow sandstone beds at Caroline Creek, between Railton and Latrobe, where Mr. Thos. Stephens, M.A., discovered trilobites, &c. (Dikelocephalus), characteristic of the Upper Cambrian; and a Dikelocephalus sandstone on the Tiger Range and elsewhere in the Florentine Valley, also discovered by the same acute observer, and referred by Mr. R. Etheridge, jun., to the Upper Cambrian. We have, therefore, in these Caroline Creek beds a definitely-known horizon, and a systematic survey would connect them stratigraphically with the strata on the coast, and enable a better idea to be formed of the age of the

latter. Meantime, uncertainty exists as to which are Silurian, which Cambrian, and which Pre-Cambrian. The term Cambro-Silurian has been adopted in Tasmania as a temporary device, to avoid unjustifiable precision, but it is objectionable, as some of the strata designated by this name may be more ancient than the Cambrian.

Pre-Cambrian.—The Sisters' Hills and the Rocky Cape promontory are considered as probably belonging to this age. They consist of massively-bedded quartzite striking north-easterly and dipping north-westerly; at the Port the dip is north-easterly, and the strike north-westerly. West of the Port contorted quartz schists preserve the same dip and strike. The Rocky Cape hills run back from the sea for about seven miles to the main road, and continue southwards for another mile, when they sink rather abruptly to the level country. The quartzite of which they are composed is white and saccharoidal, not quite so dense in texture as that at Port Davey.

The schists and slate to the west are covered near Hellyer by deposits of recent sand and ferruginous drift. The country between Dallas and the Detention is occupied by cultivated basaltic soil. The junction of the quartzite with basalt along the main road between Detention and Boat Harbour appears to be at Mr. Moles' farm, half a mile east of Deep Creek.

At Boat Harbour the schists and quartzites may be considered as belonging to the same ancient series. The quartzite forming the promontory at the Penguin is also probably Pre-Cambrian, as well as other quartz schists which are visible along the coast-line. A gneissoid hornblende schist occurs in the valley of the Forth, a mile south of Hamilton, and must also be ranged among the Pre-Cambrian. This belt of rock strikes north-westerly, and from its direction would emerge on the coast in the neighbourhood of Clayton's Rivulet.

Cambro-Silurian.—These strata have been considered as filling an undetermined gap between the Pre-Cambrian and the Upper or Middle Silurian. They are supposed to include some of the slates which crop out between Burnie and Ulverstone, and are exposed in the gorges which score the basalt-covered plateau inland. Owing to synclines and anticlines, they alternate with the more ancient schists, and it is very difficult to unravel the succession. The term is susceptible of more than one interpretation. It might be used as denoting strata with organic remains characteristic of both the Silurian and Cambrian systems,

as these are developed in the northern hemisphere; and as being equivalent to both these systems combined. Whether such an equivalence exists or not, cannot be affirmed, as no fossils have yet been found in these coastal beds. Or it might be taken as meaning a set of strata intermediate between Cambrian and Silurian, and filling the gap which is represented by the unconformity existing between the rocks of those systems in Europe. It is, however, employed here in neither sense, but simply as a cloak for ignorance. The data at our command are not sufficient to enable us to refer any of these rocks definitely, either to the Silurian or the Cambrian. Indeed, some of them may be Pre-Cambrian. It seems most likely that the work of future geologists will result in wresting many of these strata successively from their present provisional position, and adding them to the Pre-Cambrian division.

Eruptive Rocks.—Following the Silurian rocks in point of time are the igneous rocks of the coast (excepting basalt, which is much younger). These eruptive rocks are intimately associated with the occurrences of ore, so it is well to pay close attention to them. In time they occupy the interval between the Silurian and the Devonian. The conglomerates of the Dial Range are supposed to be Devonian, and (if we except provisionally the ill-understood breccia at the Neptune Mine) are not penetrated by the eruptives, or by any reefs proceeding from them; and they are singularly destitute of ores, excepting ores of iron. It is natural to suppose that the eruptive action took place before the conglomerate was laid down. The igneous rocks comprise gabbro, serpentine, basic diorite, syenite, granite, quartz-porphyry. These rocks are not widely separated in geological age, and throughout the whole of the north-western district they are associated with ores either of copper or lead. I have in another report* suggested the existence of a genetic relationship between our basic and acid rocks (gabbro and serpentine on the one hand, and granite on the other), a progressively decreasing basicity of the rock magma finally resulting in the formation of granite and reefs of quartz as the end term of the series. The deposition of copper apparently lasted throughout this process, as the ore occurs in connection with both the acid and basic rocks.

There is an exposure of serpentine about 200 feet wide on the west side of the Forth, half a mile south of Hamilton. A mass of quartz or felspar porphyry occurs higher up the same river, at the waterworks building. On the

* On the mineral resources of Beaconsfield, 1903, p. 54.

beach at the Blythe, opposite the railway station, is an intrusion of greenish gabbroid or dioritic rock into the quartzites, 100 feet in width, containing disseminated pyrite and copper pyrites. A somewhat similar rock crops out in the bay east of Cooee Creek and at Parsonage Point, West Burnie. At the Esplanade, west of Boat Harbour, a copper-bearing igneous rock of undetermined nature has intruded into the schist and quartzite for 150 feet in width. At J. Lee-Archer's copper mine a dyke of diorite, between 80 and 90 feet wide, in the Rocky Cape quartzite carries copper pyrites. At Hardstaff's mine, Dial Range, a copper-bearing quartz lode traverses granite; and at the Dial Creek group of mines pyrite and copper pyrites occur in the brecciated contact rock between granite porphyry and slate. The copper lode at Rutherford's mine, Stowport, is within a mile of the boundary of the granite running across the country east to Riana.

Devonian(?) Dial Range Conglomerate.—This formation comprises beds of cemented pebbles of quartz, quartzite, and jasperoid rock, lying horizontally or moderately inclined upon the ancient schists, and forming the bulk of the Dial Range. It apparently descends to the sea-beach east of the Penguin, for on examining the strata of the old Neptune Mine, I found an angular breccia lying horizontally on the older rocks. Near the summit of the range, the pebbles of the conglomerate are converted into hematite, and deposits of pure iron ore occur on Denney and Jones' sections. No mineral lodes have been discovered in the conglomerate, unless the uncertain case of the Neptune Mine is an instance.

Permo-Carboniferous.—The boulder clay or glacial till at Wynyard, with its embedded pebbles and blocks of rock, forms the base of the Permo-Carboniferous system. Granite blocks weighing several tons occur in this bed, which has been described by Messrs. Johnston, Stephens, Montgomery, Waller, and Kitson. Fossils derived from Middle and Upper Silurian strata are found in the pebbles of the conglomerate, and this indicates the existence of strata of that age in the back country. Such beds are known at the Heazlewood. This till is the basement on which the well-known fossiliferous Lower Eocene beds have been laid down. Permo-Carboniferous mudstones and sandstones occur along the coast east of Wynyard, and are known to the south at a distance of from 10 to 20 miles, where they enclose seams of excellent coal and kerosene shale (Preolenna). No mineral lodes need be sought in this formation.

Mesozoic Diabase.—This is known in Tasmania by its various field names of greenstone, bluestone, ironstone, or trap-rock, and is never absent from our coal fields. At Preolenna it crowns the high range between the Flowerdale and Jessie Rivers. No economic mineral has been discovered in it, but at its contact with the coal measure sandstones and shales in various parts of Tasmania, deposits of hematite and chalcedony have been formed.

Eocene.—This is represented at Sandy Cove Bluff, west of the mouth of the Inglis River, and consists of about 85 feet of limestone, charged with Eocene marine shells, resting on 3 or 4 feet of Eocene conglomerate. The lower part of this limestone for about 5 feet in thickness is characterised by its remains of Crassatella; over it for about 80 feet the rock carries Turritella and other shells, with leaves of dicotyledonous trees, and has yielded remains of a fossil marsupial. Seventy or 80 feet of Tertiary basalt overlie the whole. A catalogue of the shells has been recently published by Mr. Jno. Dennant and Mr. A. E. Kitson.* These beds are well known to Australian geologists, and visitors come to Wynyard from time to time for the purpose of seeing them.

Lower and Middle Tertiary.—Quartz gravel, or drift, in which a little gold occurs, is spread over the country at a height of 200 to 500 feet above sea-level, under a covering of basalt and basaltic soil, and protrudes from beneath the edges of this volcanic sheet, in the sides of the valleys which have been cut down by the creeks and rivers to and into the bed-rock. This drift is not really confined to the valleys, but caps the high land between them, where very often the basaltic cap has worn away and exposed the gravel and cement. The grit or gravel is often cemented with iron, derived from the overlying basalt, and concretionary iron ore (limonite) has formed in it, the whole bearing some resemblance to lode gossan, for which it is frequently mistaken. I had occasion several times in this journey to remove an impression that this sub-basaltic ferruginous cement or ironstone grit was the gossanous capping of lodes, *e.g.*, at Mr. Taylor's, Primrose Park (Howth), Mr. Smith's (at the Blythe), Mr. Bramich's (at the Blythe), and on the hill between the Blythe and Howth. Lignite and brown coal occur in this formation, with impressions of leaves of European trees, similar to those found in beds of similar age in the basins of the Tamar and Derwent, at Mt. Bischoff, Burnie, Strahan, &c.

* (Rec. Geol. Surv., Vict., Vol. 1, Part 2, 1903.)

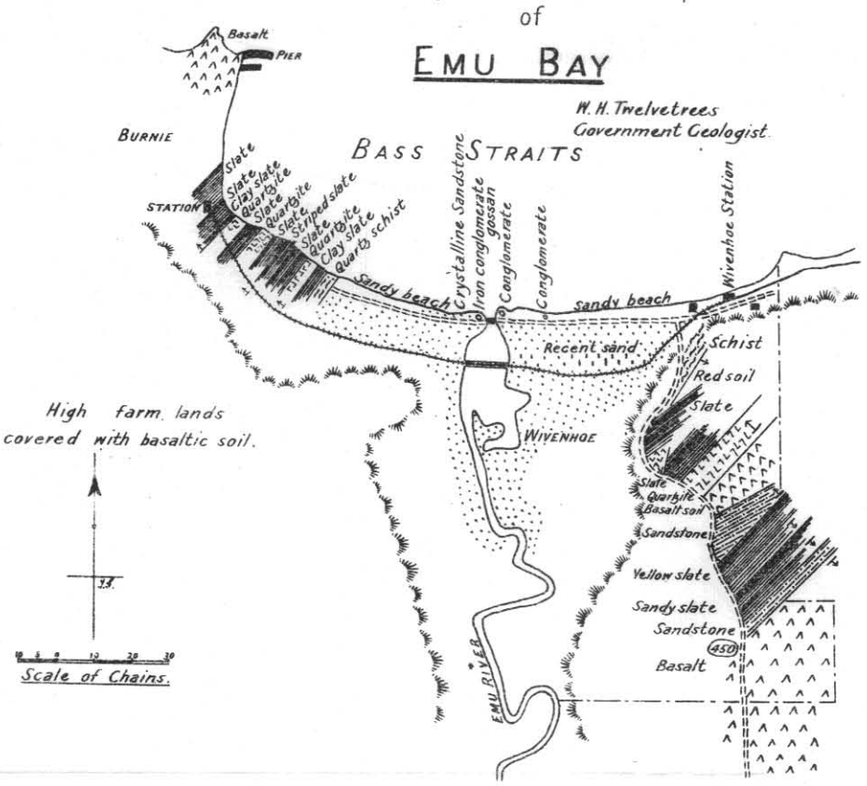
Heated solutions from the basalt have cemented the underlying drift into a hard quartz conglomerate at times, which is not always easily distinguishable from the older rocks in the neighbourhood. This may be seen on the hill on Mr. Bramich's section at the Blythe; and on the side of the hill on the western side of the Howth Valley, about 100 feet above sea-level, where cliffs about 25 feet in height expose a section of the conglomerate underneath a bed of coarse shingly wash. Caves are hollowed out in the softer portions of the formation at Howth. Gold has been found in these sub-basaltic gravels at different parts all along the coast, but so far no gutter has been located. The indications are those of a widespread sheet of gravel, rather than of beds of separate creeks or rivers. The fossil leaves and wood point to estuarine conditions. Still the uniformity of the deposit over such a wide area strongly suggests beach action. The coastal land at the time was evidently much lower than at present, and as it subsided, these drifts were laid down. At the same time, it is difficult to see how gutters could avoid being formed, running seaward; and if these can be found, there would be some hope of discovering payable wash.

Creeks in the districts of Table Cape, Boat Harbour, and Rocky Cape contain zircons and sapphires. The source of these has not been discovered. They appear to have been proximately derived from the sub-basaltic drift, but their ultimate source is still a matter of conjecture.

Tertiary Basalt.—This covers the whole country for many miles back from the coast, forming a rich red soil—the so-called chocolate soil—on a plateau 400 to 500 feet above sea-level, and occasionally, as at Penguin, Burnie, and elsewhere, descending to the sea-beach. The solid basalt is seen in road-cuttings everywhere, softening and decomposing into the fertile soil for which the North-West Coast is so famous. At Burnie, near the pier, it is prolonged into the sea in the form of a pavement of hexagonal columns, a structure due, as is well known, to the contraction of the cooling rock.

The Table Cape Bluff, which is a promontory rising to a height of 600 feet above sea-level, is composed of a rather coarsely crystalline basalt, of somewhat sodic constitution. It forms a striking object in the landscape, and is visible for a great distance along the coast. The adjacent township is Wynyard, at the mouth of the Inglis, in a thriving condition, and destined to improve as settlement progresses in the back country.

Geological Sketch Map of EMU BAY



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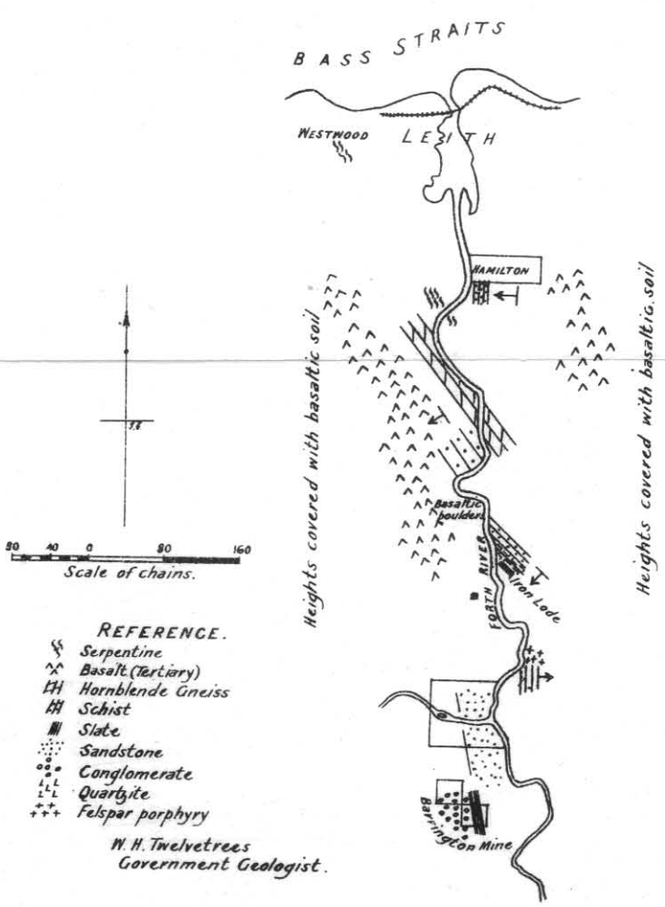


JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

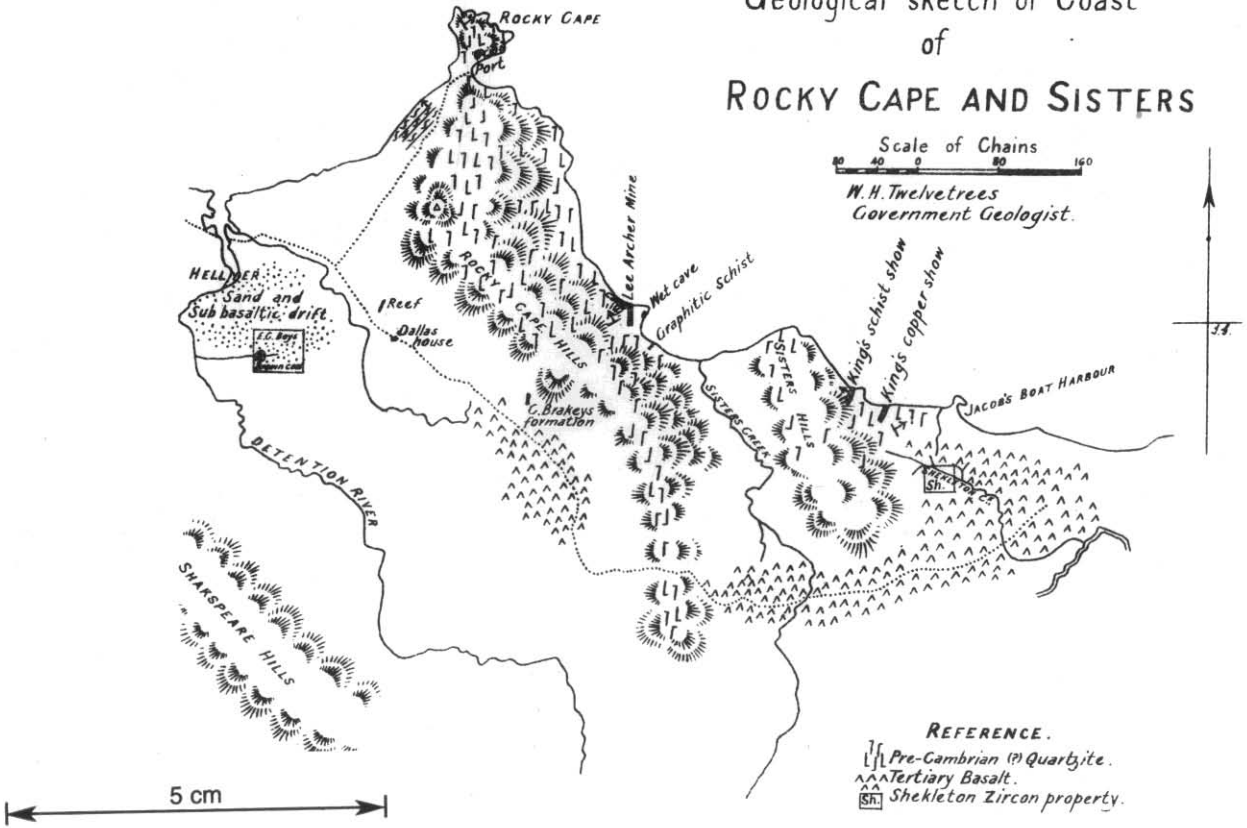
Recent.—Beds of beach sand and pebbles at intervals along the sea-shore denote an elevation of the land in recent times. These are seen easily at the bridge over the Emu River and at the bridge over the Blythe, where (at the latter place) there must have been an elevation of from 40 to 50 feet. Recent sands extend inwards on the flat land at Emu Bay and Wynyard, and the gravels of this age also contain a little gold, but not payable.

To summarise the above remarks, and present the geological series in order of age, I append the following:—

Succession of the Geological Record.

Recent and Late Tertiary (Neogene).	Flat country along coast-line. Raised beach sands at Wivenhoe, Blythe, &c. Flats at Wynyard and on Calder-road.
Middle Tertiary.	Basalt sheet on high land at Forth, Ulverstone, Penguin, Blythe, Stowport, Burnie, Wynyard, Flowerdale, Boat Harbour, Detention. Promontories or bluffs of basalt at Table Cape and Circular Head.
Lower Tertiary.	Clays, sands, and gravels below basalt; exposed at Penguin (Pine-road), and on road near cemetery; at Howth, in creek on Mr. Taylor's farm; on hill west of Howth; on farms in Blythe district; below Burnie township (Wilson-street); Seabrook Creek, Mt. Hicks-road, Calder-road, Detention district, &c. Drift often cemented by deposition of iron, and becomes an ironstone cement and gossan, with bedded and concretionary brown iron ore. Sands frequently silicified and converted into quartzite and conglomerate (at the caves, Howth; Smith's and Bramich's mining sections, Blythe. Clays contain beds of brown coal and lignite, with leaf impressions (Howth, Blythe, Detention). Lower Eocene fossiliferous beds at Wynyard, Table Cape.

MESOZOIC.	Intrusive diabase (trap-rock, greenstone, &c.). Has intruded into the coal measure sandstones, and forms summit of range between the Flowerdale and Jessie Rivers at the Preolenna coal field.
PERMO-CARBONIFEROUS.	Sandstones, clays, and fossiliferous grits and mudstones on Arthur Track 1200 feet in thickness. Seams of coal and kerosene shale occur in the sandstones and clays. Glacial conglomerate (Wynyard formation) at Wynyard, Table Cape.
DEVONIAN.	Granite, at Dial Creek and Hardstaff's mine, Dial Range; at south end of Riana township, thence westwards to the Blythe River and south of Rutherford's mine, Stowport; with deposits of copper ore. Quartz porphyry, Forth River. Augite- and hornblende-diorite intrusions along the coast at intervals. Augite-diorite of gabbroid type of structure at Blythe, opposite station; ditto east of Cooee Creek and Parsonage Point, Burnie. Hornblende-diorite at Lee-Archer's mine east of Rocky Cape. Augite-diorite dyke north-east point of Rocky Cape. All these contain disseminated copper pyrites. Serpentine on Wilmot Road, ½ mile south of Hamilton-on-Forth. Conglomerate on Dial Range; west of Blythe iron outcrop on O. Allen's land.
CAMBRO-SILURIAN. (?)	Slate, sandstone, quartzite, &c., along coast at Ulverstone, Penguin, Blythe, Burnie, &c.; east of Dial Range; below basalt and in river gorges in Leven, Blythe, and Stowport districts, with deposits of galena and copper and iron. Many of these will probably prove to be Pre-Cambrian.
PRE-CAMBRIAN. (?)	Quartzite at Rocky Cape and Boat Harbour. Hornblende-zoisite schist in Forth Valley.


Geological sketch of Coast
of
ROCKY CAPE AND SISTERS
Scale of Chains
80 40 0 80 160
W. H. Twelvetrees
Government Geologist.
ROCKY CAPE
Port
HELLYER
Sand and
Sub basaltic drift.
Reef
Dallas house
ROCKY CAPE HILLS
Lee Archer Mine
Wet cave
Graphitic Schist
C. Brakeys formation
DETENTION RIVER
SHAKSPEARE HILLS
SISTERS HILLS
SISTERS CREEK
King's schist show
King's copper show
JACOB'S BOAT HARBOUR
Sh.
34
5 cm
REFERENCE.
Pre-Cambrian (?) Quartzite.
Tertiary Basalt.
Sh. Shekleton Zircon property.

Rocky Cape District.

The Rocky Cape hills form a high range, which is prolonged seawards as a bold promontory, building the eastern horn of a bay, of which the Circular Head peninsula is the western horn. The distance across this bay as the crow flies is 13 miles. The trigonometrical station is fixed on one of the summits of the range $2\frac{1}{2}$ miles from the extreme point and 2 miles north of the post road at the post office in the surveyed township of Dallas (locally known as Detention). The basalt country covers the area to the south of the main road, between it and Detention River. North of the road the quartzite hills begin.

The usual sub-basaltic gravel and ironstone grit or cement occurs on the farms in the district. I visited Mr. H. Boy's farm, which I am told is the oldest in the locality. The land is an ironstone conglomerate, composed of grit and clay and concretionary iron oxide. I was shown the site of a well which had been sunk for 40 feet, down to pipeclay, which is a well-known sub-basaltic formation all over the island wherever a basaltic area obtains. A creek (Coal Creek) which flows through the property west and into the Detention River has a bed of quartz-sand, brought down from the ironstone cement formation. Zircons and occasional sapphires are found in the creek, and it was here that the late Mr. Jas. Smith found a large sapphire, which, I am told, realised £15. I may here mention that a creek on the east side of the farm, east of the road, also contains zircons (locally, rubies); as also another creek running northerly through the farm. I was told, too, that zircons have been found in a creek near Dallas'.

It seems pretty certain that these gems are lying in the drift which underlies the basalt, but whence they were originally derived is unknown. It may be assumed that they have come either from some of the granite or syenite in the back country, or from ancient zircon-bearing schists. About eight years ago some carbonaceous material was discovered in Coal Creek, and some work has been done upon it, with a view of proving the deposit, which is about 5 chains from the western boundary of the farm. A shaft has been sunk 40 feet in drab clay, some of it a little carbonaceous. Higher up the creek, a pit was sunk 10 feet in the carbonaceous formation, and is not yet through. The deposit is a bed of impure brown coal and lignite, similar in character to the other deposits of this material at other places on the coast. Its thickness has not been proved, and its precise value is an unknown quantity, but

it is improbable that its heating power exceeds that of wood. To make the material marketable, it would have to be pressed and moulded into briquettes (steam or air-dried), the cost of which per ton at the mine might be anything between 10s. and 13s. per ton. The calorific power being so low, the article would only be suitable for domestic purposes, and the likelihood of its displacing wood or coal at present is very small.

Mr. Boys obligingly showed me over his farm, and gave me an opportunity of examining the geological features of this area. To the north, between here and the sea, the ironstone drift becomes overlaid by more recent sand.

Rocky Cape itself forms a small peninsula, the port being on the east side of the narrow isthmus. About 150 feet above the jetty a natural cave exists in the quartzite cliff, on the floor of which are shells; but I did not notice any chipped stones or traces of the handiwork of aboriginals.

On the beach west of the Cape, associated with contorted quartz schists, is an outcrop of light-green actinolite-rock. It is a finer-grained and much less fresh rock than the diorite dyke at Mr. Lee-Archer's mine, but it belongs to the same type, and might carry the same minerals.

At the north-eastern point of Rocky Cape a wide dyke of greenish rock was noticed by Mr. Thos. Stephens, M.A., forming a well-defined intrusion between walls of quartzite. This is an augite-felspar rock, of dioritic affinities, and though no hornblende or actinolite is observable in it, it also must probably be classed with the Lee-Archer dyke and the other intrusions in the quartzites.

Lee-Archer Copper Mine.

This is situate on the beach 3½ to 4 miles south-east of Rocky Cape port, in a broad dyke of eruptive rock which traverses the quartzite strata in a north and south direction, and runs out to sea. A steep gully leads down to it from the high land; the line of this ravine indicates the line of the dyke inland. The dyke rock may be best described as diorite.* The width of the dyke from wall to wall is 84 feet.

* Composed of hornblende and plagioclase felspar. The hornblende is frequently changed to actinolite and asbestos A little epidote is present. Titanic and specular (micaceous) iron ore disseminated plentifully. No primary quartz.

Two shafts have been put down. The first was sunk in the dyke to a depth of about 30 feet, at 19 feet from the east wall. The stone broken is greenish-grey in colour, carrying disseminations of iron and magnetic iron pyrites, somewhat asbestiform in parts, and with a few blebs of bright copper pyrites. The joint planes of the rock show a facing of red hematite. I was informed that pieces of copper ore, as large as the tip of one's finger, had been found. Looking over the heap, however, I could not see that at this spot sufficient has been found as yet to drive upon.

Seventy-seven feet further north a small shaft, 5 feet by 4 feet, has been sunk to a depth of 40 feet, from the bottom of which a drive has been extended eastwards across the dyke for 25 feet. This was not accessible at the time of my visit. I was given some ore, stated to represent a seam met with in the drive, and this assayed 3·6 per cent. copper; as well as some stone from the last shot in the shaft, which assayed 2·3 per cent.; but though such results as these may be obtained here and there, workable ore has not been disclosed in these workings. Pieces of richer stone can also be got at surface, about low-water mark. The shaft has not been sunk lower than the level of low water, and the drive which has been commenced is too shallow to be of much use. The west wall of the dyke is formed by a reef of quartz 7 to 8 feet wide, and on the line of this the shaft was sunk. This quartz is laminated and white, and encloses in parts portions of the dyke converted into schist. This schistose rock appears to be the selvage of the dyke. Both quartz and schist contain iron and copper pyrites. The reef would seem to have been formed subsequent to the dyke, and the latter also is intersected by small veins of quartz. The copper ore appears to be mainly associated with the quartz, though the solid dyke rock is also impregnated here and there with this mineral. In the middle of the dyke is a band of carbonate of iron 3 to 4 feet thick, and it would be interesting to see what primary mineral exists below this in depth.

The dyke at present may be said to be entirely undeveloped, for the work done hitherto is too shallow to prove anything one way or the other. At the depths reached, nothing of any practical value has been discovered, for isolated pieces of pure copper ore scattered through a dyke like this are no more than mere indications of the existence of the metal. If it is desired to test the dyke in

depth, and ascertain what underlies these surface signs, the shaft on the west side should be sunk at least a further hundred feet, a crosscut extended from it at that depth across the dyke, and a drive put in on the course of the quartz reef. Of course, such work would be entirely speculative, as there are no surface exposures of secondary ores indicating any quantity of primary ore below. Mr. Lee-Archer has, however, laid out a certain amount of money in the work which has been done, and is, I understand, desirous of seeing the test carried to a conclusion.

At about 100 feet above the mine on the west side of the gully is a cave in the quartzite cliff. Its floor is strewn with shells of edible molluscs, and the cavity was no doubt used at one time by the aborigines. The cave at the port, already mentioned, is of the same type. It is difficult to account for these cavities in such an insoluble rock as quartzite, unless by reason of some faulting action causing the beds to slide along their lamination planes.

Another description of cave is situate to the east round the headland, also about 100 feet above the sea. This one is in sandstone, and is always full of drainage or spring water. I was told that dry seasons do not make much difference in the level of the water. It has a low roof at entrance, but inside is about 20 feet high. The sandstone is pure white, and soft. At the time only Permo-Carboniferous measures occurred to me, but I have since wondered whether the deposit is not of Tertiary age. This overlooks the Sisters' Bay, on the beach of which is some graphitic schist with disseminations of iron and copper pyrites.

Brakey's Show.

At Mr. Chas. Brakey's farm, 2 miles south-west from the above, either inside the northern boundary or on the Crown land outside (which, is not certain), is a mineralised outcrop of igneous rock. The rock is greenish, much decomposed, but some ill-preserved felspars can just be identified in it, and it must be either dioritic or granitic. It is traversed by seams of iron oxide, carrying a little copper pyrites. A cutting has been put into the bank of the creek, but the strike of the formation has not been disclosed, nor can anything further be said about it at present. It is probably one of the igneous intrusions which run out seawards, but it is over a mile to the west of the line of the Lee-Archer dyke.

Detention Quartz Reef.

Past Dallas', and north of the road, is a reef on which some work has been done, but a thunderstorm prevented my visiting it when passing. Some quartz runs across the road, and I was told it was considered likely to be the continuation of the reef. The samples which I took from this did not contain gold, but I am informed that a little has been found in the reef. The country is one in which mineral may very well be found, but prospecting has been very imperfect. The strata belong to the most ancient in the island, and the numerous occurrences of eruptive rock in the district are favourable indications for the existence of mineral deposits. So far, nothing very decisive has been discovered here in the old quartzites and schists; but quartz veins are not uncommon, and traces of gold and silver in pyrites and small quantities of copper have been obtained. The quartzite is coarsely laminated, and is not characterised by the minute folding found in so many of the West Coast strata, and which doubtless greatly assisted the infiltrations of ore solutions and the replacement of the country-rock by ore. So far as the quartzite, by reason of its hardness, resisted the folding process, to that extent it would be less prepared for the access of mineral in solution, and the quartzite areas consequently would not be very encouraging for prospectors. But it must be borne in mind that prospecting here has been very superficial; and while there are close at hand the igneous rocks, the sources of all our metals, a discovery of payable ore may be made any day.

The Rocky Cape quartzites have not been traced definitely far south; not more than a mile south of the main road. They there enter the geologically unknown country which extends south across the Arthur River to the Heazlewood and Long Plain. The quartz schists of the latter resemble those west of Rocky Cape, and are on the same strike. The Rocky Cape quartzites bear in the direction of the Heazlewood. They are not seen there, but may have been obliterated by the intrusion of the Heazlewood igneous rocks. The Arthur River country is practically *terra incognita*. Prospectors have penetrated it from time to time, and reported discoveries of mineral; but there is a great area of 50 miles by 20, on which no authoritative reports exist, and which may in the future contribute largely to our mineral output. Tracks through it exist on paper, but some of these, disused for a long time, are no longer practicable.

Jacob's Boat Harbour.

The Rocky Cape series of quartzites and schists extend eastwards to here. At the Town Reserve, the land overlooking the sea is 300 feet above tide-level. The dark-red soil of the thriving farms of the district indicates the existence of the basaltic sheet; but the underlying ancient rocks are seen in the face of the sea-cliff.

King's Mine, at Esplanade.

The discovery of some copper in the rocks on the sea-beach a mile west of the promontory overlooking the harbour was made about six years ago. There is here an intrusive dyke intersecting the quartzite for about 150 feet in width. The rock is greenish in tint, actinolitic in character, much decomposed, carrying a little pyrites, specular iron, asbestos, and copper pyrites. Only two or three shots have been put into it so far. I was informed that the best exposures are to be seen at low tide, and was shown some clean copper pyrites, said to have been obtained from that part of the dyke. My samples of specimens assayed 2·2 per cent. copper. The dyke has a direction of N.E.-S.W., and the quartzite here runs north-westerly, with a north-easterly dip. Veins of quartz traverse the eruptive rock, principally on its eastern side. The best way of testing the formation is to go up the bank some 20 feet, and sink on the strike, say, 150 feet or upwards, and crosscut the dyke at that depth. A discouraging feature is the absence of secondary copper ores at surface; this contra-indicates the occurrence of much copper pyrites lower down. The dyke belongs to the Rocky Cape series of intrusions; these are identical in geological age, and if good ore can be established in one of them, there is a chance for the others.

King's Schist Show.

Half a mile further west, and a mile east of the Sisters' Cape, at the base of the cliff on the sea-front, quartz schist is exposed, with some veins of quartz 2 to 6 inches in width, containing a little copper pyrites and specular iron. These veins are lenticular, and conformable with the laminations of the schist. A few yards further west the quartz schist is accompanied by an argillaceous variety, studded with iron pyrites and specular iron ore, and stained with

the oxidation of iron. I could not detect any free gold in the samples taken, but if the discoverer wishes to test the formation, it is easy to drive into the hill, though there is not any great inducement. The eastern exposure is the better one of the two, but it is only a collection of small quartz lenses through 6 or 7 feet of country. As shown in the face of the hill, it is of no value, but a drive on its course would show whether any improvement is likely. These indications of mineral are poor things compared with those displayed by outcrops on the West Coast, but it would be unwise to positively reject them as unworthy of any attention, considering how little we know of the mineral contents of the ancient strata along this part of the coast.

Shekleton Zircon Deposits.

South of the town reserve at Jacob's Boat Harbour, and about $\frac{3}{4}$ mile from the sea, the land forms a saddle, from which a small creek flows northwards into Bass' Straits. A few zircons, or rubies, as they are called locally, have been found in the bed of the creek. From this saddle two or three zircon-bearing creeks flow south into the Shekleton Zircon Creek, which rises in the quartzite hills of the Sisters' and falls into the Flowerdale River further east. A couple of small zircon-bearing creeks also join the latter creek from the south. Mr. R. L. Skinner obtained a lease for zircon and corundum in March, 1889, which was transferred to the Shekleton Mining Syndicate, No Liability, in November, 1899.

The bed of the creeks consists of quartz and quartzite wash, evidently derived from the neighbouring hills and from the underlying bed-rock. Stones of basalt occur in it, and these have no doubt come from the overlying basaltic sheet on the farm lands. But the creek gravel is not basaltic in any way. It carries no inconsiderable quantity of small red and reddish zircons, with occasional sapphires. A good many of these gems preserve, roughly, their crystal form, but all are worn smooth, much smoother than the grains of quartz which accompany them. This, considering the superior hardness of zircon, points to an origin more distant than the Sisters' quartzite; and yet there is none of the granitic quartz which is usually found in the sub-basaltic gravels along this coast. Grains of black mineral resembling pleonaste are abundant in the sand, and there are also grains of a dark-brown mineral with conchoidal fracture and vitreous lustre, which, judg-

ing from Mr. W. H. Gaze's analysis, might be pyrochlore, or some mineral related to it. If this determination is correct, it complicates matters, and tends to make the origin still more obscure, as pyrochlore has only been recorded from elaeolite-syenite, which is a rock that has not yet been discovered in the north of the island. Mr. Gaze's published analysis is as follows:—*

Nitrate of uranium and chromium, a variety of pyrochlose:—

	Per cent.		Per cent.
Uranium	5·0	to	0·5
Chromium	10·5	to	12·5
Titanium	12·0	to	13·0
Niobium	4·5	to	2·5
Iron	25·5	to	27·7
Magnesium	2·2	to	0·5
Alumina	7·3	to	6·2
Lime	2·6	to	1·5
Silica	15·0	to	12·0
Didymium	7·5	to	0·5
Lanthanum	6·2	to	2·2
Thorium	1·0	to	traces
Yttrium	1·5	to	traces

In 1896 a ton or two of washed sand was exported to Melbourne, and some was sent to Europe, as it was thought that the zirconia and thoria might be utilised in the manufacture of the Welsbach gas mantles, which, as is well known, are made by saturating a cotton fabric in a solution of salts of some of the rare earths and metals, and then burning off the organic matter, so as to replace it by the metallic oxides. First, Welsbach used zirconia and lanthanum in equal proportions; then he found that by replacing zirconia by thoria he could increase the resisting power of the mantle. It seems, however, that the great improvement in modern mantles has been brought about by using small quantities of ceria with thoria; practically in the proportion of 1 per cent. ceria and 99 per cent. thoria. Curiously enough, pure thoria and pure ceria separately are valueless as light-producers, but the slightest addition of ceria makes all the difference.

The European trials of the Shekleton material did not disclose sufficient thoria contents for economic purposes, and work ceased on the claim. For some time after, however, search was made for specimens of corundum and zircon sufficiently large to sell as gem stones. Some were found large enough to cut, but the sapphires are generally

* *Mining Standard*, Oct. 8, 1896, p. 1373.

fractured. The wash is from a few inches to a foot in depth. Mr. King, jun., kindly piloted me along the creek in very bad weather. The bed of the stream is greatly choked by growing timber and fallen logs, so that examination is difficult. There is no doubt, however, that the zircons are abundant, and it is quite possible that, with some unforeseen turn of the market, the deposit may eventually prove valuable.

Reverting for a moment to the question of origin, the presence of zircons and sapphires in creeks at Detention, and also south of Wynyard in a creek falling into the Inglis, indicates a wide distribution. For the present, we seem unable to say more than that they occur in drift of early Tertiary age, generally in drift which has at some time been capped by overlying basalt. Their original source must have been some more ancient rock, which cannot yet be identified. Although at Boat Harbour I could not see much sub-basaltic grit or cement, such as is so prevalent elsewhere on the farms, it is very possible that a good deal has been denuded, together with the basalt, towards the Sisters', at some time or other.

Table Cape District.

Having visited the back country on a previous occasion to within a few miles of the Arthur River, I did not go up country again this time. The flat land round Wynyard carries gravel deposits of late Tertiary and Recent age. Though these contain a little gold, there is not much reason for believing that they will ever be found to pay for working. On the other hand, the gravels which are now or at any time have been sub-basaltic, and which are of early Tertiary age, are sensibly auriferous, and have been worked for gold all along this coast at Big Creek, Camp Creek, Seabrook Creek, &c. Heavy gold has been found in numerous branch creeks and gullies. It is extremely probable that auriferous leads exist beneath the basaltic sheet, and that gutters might be found by driving into some of the hill ridges below the basalt. Possibly, such gutters, where struck, would not prove payable, but exploratory work would disclose their direction and enable them to be traced and tapped further inland, where the gold might be expected to be heavier. A lot of unremunerative work has been done in the district, with the result, I believe, that the real leads have not been dis-

covered, and workers have only been operating on gravels which have been widely distributed by the action of the sea, and cannot therefore be expected to be rich. But below this distributed material, there are almost certainly hidden and buried gutters, in which, judging from analogy and from actual indications, gold will be found in more concentrated deposits.

While in the district I was told of tin being found up the Inglis River, and also at the Cam. The probability is that the occurrences are in the early Tertiary gravels, but as granite rock is only found at a great distance inland, it is not likely that stream-tin will be at all plentiful. Some granite is rumoured to exist somewhere west of the Inglis, and I am trying to verify this.

But the country behind Wynyard, as far back as the Arthur River, is, once the basalt is left, dominantly a coal measure area; and these measures also extend below the basaltic covering.

Preolenna Coal Field.

This is about 17 miles south from Wynyard, and comprises the country between the Jessie and Flowerdale Rivers. Seams have been opened on the Jessie Fall by the North-West Coal and Shale Company, disclosing kerosene shale and a high-class gas coal, superior to anything yet found in Tasmania. The seams are not thick, being from 20 inches to $3\frac{1}{2}$ feet. They occur in sandstones, which rest on and are overlaid by the fossiliferous mudstones characteristic of the Permo-Carboniferous system in Tasmania. The seams belong therefore to the lower coal measures. Above these, in the western part of the field, are seams of poorer quality, which occupy high positions in the Preolenna system, and may belong to the Mesozoic series, but no evidence from fossil plants is yet available in support of this view or to the contrary. The Launceston Gas Company has tested the illuminating power of the gas from the Preolenna shale, and found it to be about double that from Greta coal. The superior bituminous coal yielded 12,030 cubic feet of gas per ton, which compares well with the best N.S.W. coal used here. The yield from the latter is about 11,000 cubic feet per ton, but generally works out in practice at 10,500 cubic feet. The following analyses of samples which I took from the various outcrops in 1903 may prove of interest. The assays were made in the

Government laboratories by Mr. W. F. Ward, Government Analyst:—

	Fixed Carbon.	Gases, &c.	Ash.	Moisture.	Coke.
Shale from tunnel	21·00	76·20	2·30	0·50	Rather tender
Shale from cliff outcrop	23·20	71·60	4·10	1·10	Fairly firm
IX-mile 18-inch seam ...	52·50	41·10	5·50	0·90	Ditto
Fault Creek, north fork	52·30	41·70	5·00	1·00	Tender
Fault Creek	45·70	43·40	9·70	1·20	Crumbly
Fenestella Creek, 20 in.	46 90	45·90	6·50	0·70	Ditto
Ditto, 3 ft. 5 in.....	44·40	50·30	4·90	0·40	Tender
Camp upper seam, 18 in.	44·40	48·30	6·60	0·70	Crumbly
Camp lower seam, 20 in.	46·90	44·20	7·10	1·80	Tender
Camp seam, N.E. Creek, south fork, 13 in.	45·70	42·00	10·70	1·60	Fairly firm

As the district develops, transport facilities will be brought within easier reach, and eventually these seams will form a valuable property. For the present, the only work which can be rationally undertaken is that of testing the seams in advance of the outcrops by two or three bores with a core drill. Freedom from faults would be ascertained in this way, and possibly some even better seams might be proved to exist below the known ones. The seams most likely extend to the north, and the country ought to be explored in that direction, so as to tap the coal nearer to the coast. A discovery has quite lately been reported between Camp and Seabrook Creeks, east of Preolenna, and nearer the sea. I anticipate that more seams will be disclosed in this district in the future, and I would urge continuous search. Unless Mesozoic measures are discovered, the seams are not likely to be thicker than those already known, judging from the analogy of the seams in the Mersey basin, which is of the same geological age, and in which the 10 and 12 feet seams of the Mesozoic measures do not appear to occur. The quality of the coal in the Wynyard district, however, is unsurpassed in Tasmania. The shale is identical with the so-called "cannel" coal of Barn Bluff. Both Mr. Thos. Stephens, M.A., and Mr. A. Montgomery, M.A., mention the occurrence of shale similar to that of Barn Bluff on the sea-beach at Wynyard, and in the Inglis River and in Seabrook Creek. I was able to verify this independently, and all this serves to strengthen the supposition that shale and coal seams still remain to be found much nearer the coast than Preolenna.

Cooee Creek.

East of Cooee Creek, about a mile west of Burnie, is a broad bay, with sandy beach, through which protrudes an intrusive igneous rock, of dark-greenish hue and coarse gabbroid texture. Its constituent minerals are augite, hornblende or actinolite, and felspar, and it may be classed with the other dioritic dyke rocks which have been mentioned above as occurring along the coast. Disseminated through its substance are crystals of pyrite and a little copper pyrite here and there. An intrusion of a similar rock occurs at Parsonage Point, West Burnie, and the same rock may be seen at one or two other points between there and Cooee Creek. Although these rocks contain copper pyrites sporadically, there are no indications of ore-concentrations being present in payable quantities.

Stowport Copper Field.

This field embraces the country between the Emu and Blythe Rivers, a plateau about 500 feet above sea-level, cut down into by Chasm Creek, which is a rivulet falling into the sea between Wivenhoe and Heybridge. The township of Wivenhoe is in the delta of the Emu River. The strip of land along the sea-shore for half a mile on each side of the mouth of the Emu consists of recent sands, covering most probably clays and gravels of Tertiary age. The latter occur in the township of Burnie, with characteristic fossil imprints of leaves.* On the east bank of the Emu mouth are boulders of hard quartz conglomerate. What formation these really belong to is somewhat uncertain, but I am inclined to refer them to the Tertiary system, and specifically to the highly siliceous conglomerates which are found below the basaltic sheet. The loose crystalline sandstone, which is scattered in tabular blocks over the beach at Burnie, appears to belong to the same series. Boulders of manganiferous iron ore at the mouth of the Emu River are also probably of Tertiary age. They form a confused mass of ferro-manganese gossan, running in a north-easterly direction, and prolonged to the eastern side of the river. They are embedded in the sand, but a close examination shows that the gossan is most probably a modification of the conglomerate just referred to. A hundred yards further west are embedded boulders of

* Some of these, obtained in sinking a well in Wilson-street, were sent to the Victoria Museum, Launceston, by Mr. R. S. Sanderson, several years ago.

highly crystalline and siliceous sandstone, which, according to the theory now suggested, is a part of the same series of strata. The manganese formation has been sunk on for gold, of which traces are said to have been found. My samples, assayed by Mr. W. F. Ward, Government Analyst, returned nil.

Towards the west end of Emu Bay the underlying Cambro-Silurian slates and quartzites crop out on the beach, striking north-easterly and dipping north-westerly. At the breakwater these are covered with basalt, which here has a pronounced columnar structure, and runs out seawards. At the eastern end of the bay the road to Stowport winds up the hill to a height of 450 feet before reaching the chocolate basaltic soil of the farm lands. The road shows the hill to consist of a succession of mica schist, quartzites, slate, and sandstone, with a north-easterly strike. There is an anticline in this hill, the western strata having a north-westerly dip, the easterly a south-easterly dip. The lower part of the road, about 500 yards from the Wivenhoe railway station, exposes dark micaceous and quartzose schists, which, for about 80 feet, are strongly seamed with quartz. An excavation has been made in a ferruginous bank by the road-side, where the soil is red, and has the appearance of covering a lode. This is opposite the sawmill.

These ancient rocks, when the brow of the hill is reached, near Mr. Norton's house, are covered with a capping of decomposing basalt and soil derived from it for a distance of 4 to 5 miles, when they again appear as the Rutherford mining property is approached. A mile south of the Rutherford Mine, the edge of the granite is reached, which stretches across the country east to Riana.

The Emu River has cut down first through the basalt, then through the underlying gravels and clays with their seams of lignite and brown coal, and into the underlying Cambro-Silurian slate and schist. The various creeks on the basaltic plateau frequently show the older rocks coming out from below the edge of the volcanic sheet.

Mr. W. Rutherford showed me an exposure of the sub-basaltic clays on his 92-acre lot east of the Emu River, 250 feet above sea-level, on a small creek which flows into Glance Creek. Mr. Rutherford has sunk a small hole 7 feet through brown coal or carbonaceous clay into underlying sand or gravel composed of small beach stones. This black outcrop has been noticed for a distance of 45 or 50

feet. At other points, pipe-clay or a drab sandy clay has been met with under a foot or two of the brown coal.

The overlying basalt along the east side of the Emu Valley forms a capping of from 50 to 100 feet in thickness. The farms on this land yield splendid crops of potatoes and oats. Wheat is grown here and there, but does not thrive like oats; and either the soil or the position is not the best for fruit. I was informed that a fair yield for potatoes is 5 to 6 tons per acre, and a good yield, from 8 to 10 tons. For oats the yield ranges from 50 to 60 bushels up to 80 bushels per acre. This rich agricultural land, lying side by side with a mineral zone in the same area, forms an ideal district for both industries.

At about 6 or 7 miles from the coast, the slate strata are more or less strongly impregnated with iron and copper pyrites for a width of a couple of miles from east to west, at intervals. The strata here have a north-easterly strike. In the western part of the field, at the Norton-Tattersall property, they dip to the south-east; in the eastern part, at the Rutherford Mine, the dip is in the same direction. Between the two properties mentioned, on the banks of Chasm Creek, on Mr. Edward Gee's land (formerly J. Griffith, 107 acres), the slate is impregnated with iron pyrites, but, judging from samples shown to me, there is nothing at present to warrant any expenditure on discoveries made, though this does not discourage search for something better, which possibly may be found.

Norton-Tattersall P.A.

On Mr. J. Laxton's 50 acres east of the Emu River a zone or belt of slate and sandstone, heavily charged with iron pyrites, runs N. 25° E., dipping south-easterly, and some work has been done on this, with the view of proving it, and if satisfactory, of developing the formation. A tunnel has been driven into the hill for 90 feet. After driving 56 feet through slate, the mineralised slate and sandstone strata were driven into a distance of 34 feet. These are veined with quartz, and heavily charged with iron pyrites. Here and there a little copper has been observed, but the samples which I took in the tunnel yielded, according to the Government Analyst, negative results for gold, silver, or copper.

The strike of the formation would take it into Crown land, as well as into Mr. J. Laxton's 147 acres further north, and copper ore may occur somewhere along its

course, but the absence of this mineral in the tunnel discourages further work at this spot.

In the creek, between here and the farm, there are two occurrences of graphitic slate. At the lower place it has been exposed by a cut in the side of the bank, showing graphitic slate and quartz intermixed. Higher up, within 50 feet of the brow of the hill, 4 or 5 feet of graphitic material is seen in the bed of the stream. Being softened from exposure to water, the occurrence was difficult to examine. The Government Analyst's assay disclosed poor results for graphite (carbon). Two years ago half a ton was got out, and it is reported to have realised £3 per ton. The present exposure of this slate is insufficient for any estimate of the extent of graphitisation, but a great improvement will have to take place for anything profitable to ensue. The history of graphite mining elsewhere in the world is replete with examples of unprofitable and abandoned mines, with deposits of only 10 per cent. to 20 per cent. carbon contents. If it is wished to test this occurrence, and to ascertain the average quality of the bulk, the creek should be diverted and the seam excavated sufficiently for the purpose.

Rutherford Copper Mine.

The Rutherford Copper Mining Company's mine is on Section 4496-93M, 60 acres, and purchased land 120 acres, F. C. Groom; with continuation of the lode south into T. S. Rutherford's purchased 320 acres. It has now been discovered about five years. A tunnel was first driven into the hill some 150 feet, intersecting a small copper lode near the entrance. This was then sunk upon, and drives opened on its course at 16 feet and 32 feet. The lode proved to be of varying width, 1 foot, 1½ foot to 2 or even 3 feet. The ruling width is 1 foot or 18 inches. When I was there, foul air prevented me from entering these workings, which up to recently had been worked on tribute, 70 tons of ore having been raised, with recoverable metallic contents worth £4 9s. 2d. net per ton after making smelters' percentage deductions. In addition to about 7 per cent. copper, the ore carries 3½ ozs. silver per ton.

A site has been chosen for a main shaft, and this has been sunk 99 feet. At 95 feet a crosscut was being started for the lode, and it was estimated that this would be cut in 50 or 60 feet.

The ore at the 16-feet and 32-feet levels is in the oxidised zone, and consists of copper pyrites and black oxide of copper in a silicified slate gangue. The lode strikes N. 40° E., and dips north-westerly. About 5 chains west is a belt of ironstone 4 chains in width. This is good hematite ore, containing 53 to 58 per cent. iron, 2 per cent. to 5 per cent. silica, and 0·5 per cent. phosphorus. South-east of the mine is a long belt of iron ore passing through Section 960M, 48 acres, G. F. Jewkes, and a good distance through T. S. Rutherford's 320 acres, where the outcrop forms a hill several chains in length and about 10 chains in width. The iron lode is bordered on the west by quartzite (locally known as porphyry), and metamorphic slate forms the country intervening between the latter and the copper lode. I followed the iron formation to within about half a mile of the granite country which comes in on the south of the 320 acres. The close proximity of granite suggests strongly a causal relationship between it and the iron lode. The copper ore deposit, too, may be regarded as having a similar origin. Finding good copper ore here with a strong iron lode as a near companion, the indication is that elsewhere along the same strike where there is a good development of iron ore, copper ore will be found in its vicinity.

The iron lode continues north into the 120 acres, F. C. Groom, but becomes concealed by basalt, which covers also 318 acres, A. J. Morris, and most of the 186 acres, W. H. Atkinson, still further north. The iron re-appears in the northern part of the 186 acres, and then continues as the well-known lode leased by the Blythe Iron Mines, Limited.

The Rutherford property has not been provided with adequate funds for its proper development, but the good ore already met with in the shallow drives is warranty enough for exploring the lode at increased depth. The width of pay ore is not yet sufficient to correspond with all requirements, but it is clear that remunerative ore exists, and its extent cannot be proved without further work. The mine is still in its prospecting stage, and perseverance in a vigorous programme of exploration is necessary for any results to ensue. The lode is likely to contract and expand along its course, and if it is not as wide as expected when intersected from the shaft, that should not discourage further work, but it should be followed, with a view of reaching points where it will be found to widen, as these will certainly occur.

North Commonwealth Mine.

This is on Section 876M, 80 acres, in the name of T. J. Dorgan, on the west bank of the Blythe River, 3 miles north of the Rutherford. I approached it by a track from the 250-acre farm of Mr. J. Morris. Inside the east boundary-line of this farm, the basaltic soil is replaced by the older rocks, which here consist of grey metamorphic sandstone, intersected by veins of quartz. A descent is here made gradually into the timbered valley of the Blythe. The first work on the property was started last July, by putting a short cut into the hill east of a small creek, where a foot of soft broken slate is showing. A few yards further north, about 35 feet were driven through clay slate with bands of pug, and at the end of the crosscut is a vein of quartz 2 feet to 18 inches wide, narrowing as it goes north, and also underfoot. The pug and quartz carry iron pyrites, but no copper so far. A good deal of iron is coming away with the water from the quartz vein. A few inches of quartz follow the north side of the drive, with pug and pockets of iron pyrites. The country is disturbed on this side of the drive, and as the latter is only 15 feet from the surface, it is too shallow for an opinion to be formed of the ground. There is evidently a silicified band of country, and it would be promising enough if any mineral could be seen other than iron pyrites. The crosscut is in an awkward place, below the level of the creek, and the hill spur falls going north. The better way would be to go further down the creek, and crosscut from there, though with increased length.

Further north, on the eastern boundary-line of the section, the hill spur which falls north-easterly to the River Blythe has been trenched across, but the trenches are not quite deep enough. Ferruginous quartz gossan occurs in pieces here and there, but no sign of copper is to be seen.

At 10 feet above the Blythe, below these trenches, the low north tunnel, a crosscut across quartzites, has been driven north-westerly for about 80 feet. At 36 feet in the tunnel a level has been driven off the tunnel, along a junction of sandstone with graphitic slate, where there is a band of silicified country. The distance driven was about 30 feet, but the lode-matter was soon left on one side, and the drive continued in graphitic slate slightly impregnated with iron pyrites. Further in the tunnel past this drive is a little quartz in soft black slate, and then hard, blocky grey quartzite continues to the end. The indications scarcely justify continuing the tunnel,

besides which it is too near the north end of the hill spur to gain much depth. To prove the ground, it would be better to go further up the river, where the hill is higher, and then put a prospecting tunnel into the hill. About here are a few copper carbonate stains, and also a little copper pyrites.

A little south of the tunnel is a bold outcrop of grey quartzite traversed by numerous veins of quartz. It bears across the Blythe River to the north-east, running up the steep high bank on the other side, but seems to be quite barren of mineral.

Although this property is known as the North Commonwealth, and is, in fact, north of the Commonwealth, it is not on the same run of country as the latter. The Commonwealth belt runs to the east of it.

Commonwealth Mine.

This is on Section 874M, 80 acres, in the name of C. J. Leighton. The River Blythe runs through the section, but the mine is on the east side of the river.

About 30 feet above the Blythe a tunnel has been driven for 280 feet, 15° south of east, to intersect a lode outcropping higher up the hill. The outcrop line is bearing N.W.-S.E., so that if that direction is to be taken as a constant one, the tunnel has not taken the shortest course to cut it, and, in fact, would have to be driven 300 feet more before reaching the point of intersection. But this north-west direction is so different from that of all the other lodes in this copper-bearing belt, that the owners looked upon the course observed at the outcrop as abnormal at that particular point, and drove the tunnel east, believing that the lode would come round again to its natural strike. When the tunnel had been driven beyond where it was anticipated that the lode would be cut, a shaft was sunk on the outcrop to a depth of 30 feet. The lode in the shaft is split by a horse, and from the bottom a drive has been put in for over 20 feet south-westerly without picking it up again. The lode material is indurated slate and quartzose rock traversed by parallel veins of quartz, crossed in all directions by veinlets of the same mineral. There are signs of disturbance of the strata here, which is unfortunate just when the position of the lode is required to be located.

At the entrance to the tunnel a pyritic seam has been cut, and at 20 feet in a soft formation was passed through for a distance of 25 feet, and further in one or two seams

of gossan and iron pyrites were intersected. The tunnel shows the same succession of strata as on the surface, striking north-easterly and dipping south-easterly. At about 200 feet in the slate becomes hard and dark, with large heads, and carrying pyrites on the joint planes. A little distance behind the end the slate arches over and forms a flat roof. A disturbed zone is apparently being entered, which makes it difficult to assure one's self of what is ahead. The present end is close upon 300 feet south of the shaft, and it would take 300 feet to continue the tunnel in its present direction in order to reach the lode, assuming the latter to maintain the same bearing as at the shaft. This distance could be reduced to about 170 or 180 feet by turning the adit in a north-easterly direction. There is some doubt, however, whether the lode has not recovered its normal bearing, and been intersected already by the tunnel. If this is so, its position in the tunnel ought to be about where the soft formation was cut not far from the entrance. Unfortunately, there does not seem to be any metal there. On the whole, it would seem advisable to explore from the shaft, and having located the lode, to follow it. I understand some nice copper ore was found at the outcrop.

At 100 feet up the hill, south-east of the shaft, is an outcrop of yellow gossan bearing north-easterly. This has been trenched upon, but though a nice-looking quartz-iron gossan, did not yield anything beyond iron in the Government laboratories.

On the western part of the section, a long spur of cemented rock comes down, which, for a couple of chains in width, has a gossanous appearance, and has been locally taken for lode gossan. It is, however, a cement of quartz and sandstone fragments, and evidently belongs to the sub-basaltic drift formation.

Blythe Copper Field.

The Blythe and Stowport copper deposits are in one and the same geological area, though geographically separated by the Blythe River. The Blythe River, running north to the sea, has intersected the wide basaltic plateau, and carved its channel deep down into the underlying slate and quartzite strata which enclose the ore deposits. Consequently, these strata are exposed for about half a mile on each side of the river. The same process has taken place on the Emu River and Upper Chasm Creek. The

Stowport strata, having a north-easterly strike, are prolonged across the Blythe River into the Blythe field proper, and the same lode lines, both of iron and copper ores, are continued also. The Rutherford-Copper King line of lode can certainly be traced at intervals along a distance of 5 miles, and probably 7 miles, if McKenna's Heybridge mine on the sea-coast belongs to it, as, judging from its position, is most likely the case. The line passes beneath the basaltic farm lands in G. Rooke's 52 acres and A. Littlejohn's 50 acres, continuing doubtless under the 100 acres of A. Littlejohn, not far from Mr. G. Radford's house, and a mile further north-east ought to be visible in the slate and quartzite of the hills overlooking the sea. So far, however, it has not been picked up there, and this may be due to more than one reason. In the first place, these hills were at one time largely covered with basalt, and the bed-rock is still in many places concealed by the remains of sub-basaltic drift and cement, the latter of which is, as usual, often mistaken for lode gossan. Secondly, the copper deposits do not always happen to rise to the present surface of the slate strata. The persistency of the lode line for such a distance speaks strongly for it being found payable at more than one point in its course. The Blythe iron lode, too, shows a visible length of $3\frac{1}{2}$ miles, its southern exposure being in the 320 acres, T. S. Rutherford, and its most northerly point being on the east side line of the 100 acres, O. Allen, forming the boundary between it and the 238 acres, C. and J. Robinson (60 acres, C. Sice). I have not seen it further north than this. It disappears here beneath the basalt, and does not emerge from it near the coast.

A great deal has been said about the possibility of the outcrop of the iron lode covering copper deposits. Of course, this question does not in the slightest degree affect the future of the Blythe Iron Mine as an iron ore property, because the huge outcrop on which it is proposed to work has been proved to be hematite down to river level. The small proportion of limonite and the absence of lode minerals contra-indicate a copper lode lower down. A very large number of analyses have been made, without disclosing the presence of copper sulphides or of any precious metal. As far as we know the occurrence, it is a large hematite lode. The latest facts learned appear to indicate a genetic association with the granite, which is near the southerly exposure of the hematite on Rutherford's.

At the same time, though the iron in this lode may not be associated with copper, there would appear to have been a deposition of copper along parallel lines, and wherever the iron development is strong, the parallel copper deposit is also pronounced, *e.g.*, at Rutherford's and the Copper King. Copper prospecting on the Blythe Iron Mines property has so far been unsuccessful, but the results are not final. At the northern end of the iron lode on Sice's 100 acres about half a chain of iron ore is exposed, with the characteristic red siliceous contact rock a chain in width on the eastern side of it. This contact rock here is sparsely impregnated with specular iron, iron pyrites, and copper pyrites, which strengthens the supposition that the deposition of both metals formed part of one physical process.

Prospectors on the Blythe Iron Mines Company's property have unsuccessfully sought copper ore on the west side of the iron outcrop, and the company has also done some abortive work in the same direction. A nice-looking outcrop of iron gossan, carrying pyrite and copper pyrites is exposed for a width of 3 feet in descending the hill on Section 1009, 73 acres. The edge of it is visible in a cut put north into the hillside, and it looks as if it might extend several feet further east. About 25 feet below, the company's prospectors have driven a tunnel below the outcrop, but failed to find anything beyond bunches of gossan with a little copper ore. It would have been better to have started the drive a little lower down. There has not been enough work done to prove the formation. A short T drive has been put in at the end of the tunnel, but the course of the lode should be followed further into the hill. Lower down, near the level of the river, what seems to be the same line of lode has been tapped by a tunnel, but without any result. Speaking generally, the prospecting for copper on this section has been too limited to test the ground adequately.

Copper King Mine.

This property, owned by Mr. L. J. Clark, is charted as 915-M, 63 acres, north of and adjoining the Blythe River Iron Mines 40-acre section. A turn off the main road from Heybridge is made at Mr. Sice's house, which is on the basaltic agricultural plateau, 650 feet above sea-level. On the way, the northern extension of the Blythe iron lode is crossed on Sice's 100-acre lot. South-west of this is a valley which has eaten away the large outcrop between here and the Blythe Company's 40-acre section. The

basalt covering extends a little way down into this valley along its eastern edge.

On the west side of the track going down to the Copper King, and on the boundary between the 63 acres and O. Allen's 100 acres, is an outcrop of quartz carrying pyrites. The country-rock is a yellow sandy schist, or laminated sandstone, striking north-easterly and dipping south-easterly, and the quartz follows this strike. A few veinlets of quartz traverse the rock at right angles to the strike. A sample of the outcrop quartz was assayed by Mr. W. F. Ward, Government Analyst, but contained neither silver nor gold. A few yards below this, boulders of gossan occur, which have evidently rolled down the hill from some point higher up.

The copper lode (Clark's lode, as it is called) runs through the section in a north-easterly direction, with an underlay to the south-east. In strike it is conformable with the country strata, but in dip it certainly, in places, transgresses these.

The first drive which I saw was a cut into the hill on the course of the lode, but the approach had fallen in, and the face in the end was exposed to daylight. The drive has been carried for a width of 6 feet, 3 feet 9 inches of which are in soft lode slate heavily charged with iron pyrites, copper pyrites, and black oxide of copper, the remainder consisting of much harder lode stuff, with nice bands of rich copper pyrites. Some of this hard lode stuff which I sampled, and which was assayed by the Government Analyst, returned 15 per cent. metallic copper.

Ten feet below this, a crosscut tunnel (No. 2) has been driven 31 feet across the lode formation. This is the only place in the mine where the full width of the lode has been proved. Outside the tunnel mouth was a pile of over 12 tons second-class ore, estimated to average 7 per cent. copper, and which was taken from the crosscut in driving across the formation. Its gangue is quartz and carbonate of iron. Some seams of copper ore occur at the immediate entrance to the tunnel, and just inside a short drive has been put in (north) for 12 feet on an 18-inch seam of ore, which, however, has diminished in the face to a few inches in width. Some nice-looking red and black oxides of copper show in this seam. The main tunnel passed through alternate bands of hard rock and black copper ore. For 11 feet the lode matter intersected was poor, but afterwards about 10 feet of gossanous material came in and yielded the ore which is piled outside. The adit has been

driven right through the lode channel to the graphitic slate country on the east wall. In the roof at the end of the tunnel a little gibbsite (aluminium hydrate) occurs. A drive south has followed the gossanous band for 12 feet, exposing some good oxidised ore in a siliceous gangue, the latter forming heads and blocks of stone. In the drive north the wall has broken away, probably through surface disturbance, as the workings are very shallow. At about 12 feet, a crosscut was driven east in gossan, but this is now built up. Good copper ore continues a few feet to the break. Past the crosscut, the drive seems to be on the west side of the lode, and is in a serpentine direction, turning east, however, and recovering the gossan. The latter continues, but lies mostly outside the east wall of the drive, which is practically between the slate and the gossan. Near the end, the gossan is stronger. Towards the end of the drive the lode is carried along the east wall, showing some copper stains and oxidised ore. A crosscut east is necessary here to tap the richer part of the lode. Unfortunately, it is only about 20 feet below the surface, and if the drive were extended, it would soon come out into the creek which lies ahead. As the hill spur runs out here, backs cannot be obtained. This drive is over 100 feet long. Some fair-sized pieces of native copper have been obtained from the gossan, which is often plentifully seamed with veins of quartz. The siliceous gangue is generally strongly charged with iron pyrites. On the whole, the best plan would be to continue the crosscut east in the drive north, and get to the other wall of the lode.

Upper Tunnel (No. 1).—This is a narrow crosscut tunnel driven west for 100 feet into the hill, cutting the lode at that distance. The lode has been driven upon south for 75 feet, and two crosscuts put into it from the drive at 52 feet and 12 feet respectively behind the end of the drive. The lode has been carried the width of the drive, but extends outside the west wall for at least 23 feet, as the south crosscut near the end is in the lode formation for that distance and not through yet. The formation as disclosed in this crosscut consists of hard, massive quartzose rock with veins of copper-bearing matter at intervals. A good deal of quartz enters into the composition of the formation, and a little good ore occurs here and there. The north crosscut also shows hard and barren stone throughout its length of 12 feet, but just behind the face is a vein of oxidised ore (with some gibbsite). The

best ore in the drive is in the present end. Three-fourths of the face consists of graphitic slate, carrying copper and iron pyrites. A pile of about 10 tons of good ore was stacked outside the tunnel entrance ready for market, consisting of erubescite, copper pyrites, and oxide in a gangue of metamorphic slate, with veins and patches of quartz and disseminations of iron pyrites. Grab samples which I took from this heap, assayed by the Government Analyst, returned 10·5 per cent. metallic copper. However, shipments of ore since my visit have been made, returning for 20 *tons an assay* value of 15 per cent., and for 23 tons a value of 24·7 per cent. copper, according to returns furnished by Mr. Clark.

Northern Workings.—About a couple of hundred feet from the face in the drive from the No. 2 tunnel, the lode has been cut again in a short crosscut east from the branch creek. A 9-inch seam of copper oxide and pyrites has been cut through. A crosscut tunnel has been driven to intersect the lode, and at about 30 feet in, this passed through the same graphitic slate as seen outside, but no ore. A drive west passes through what would seem to be the lode formation, but nothing like the fine lode in the cut outside.

The line of lode is a persistent one, and of considerable width, nearly half a chain. The formation must not be looked upon as payable all through this width. The footwall portion seems to be that in which payable ore is most largely developed, though at the same time there are bands of ore elsewhere in the formation which will make frequent crosscutting necessary. The ore deposition partakes of the irregularity which characterises most lodes, but the large quantities of oxidised ore indicates the probability of a strong pyritic lode at greater depth. The mine cannot be done justice to with the present inadequate outlay on development work. According to the returns, the following are the parcels of ore already sent out:—

10 tons,	assay value	13·7	per cent. copper.
12 tons,	,, ...	11·7	,,
20 tons,	,, ...	13·2	,,
20 tons,	,, ...	15·0	,,
23 tons,	,, ...	24·7	,,

This represents the result of work on a very limited scale, and with not the best methods. As such, it is encouraging, and points to a line of ore deposition here which invites vigorous work with ample capital for proper

Geological Sketch Map of

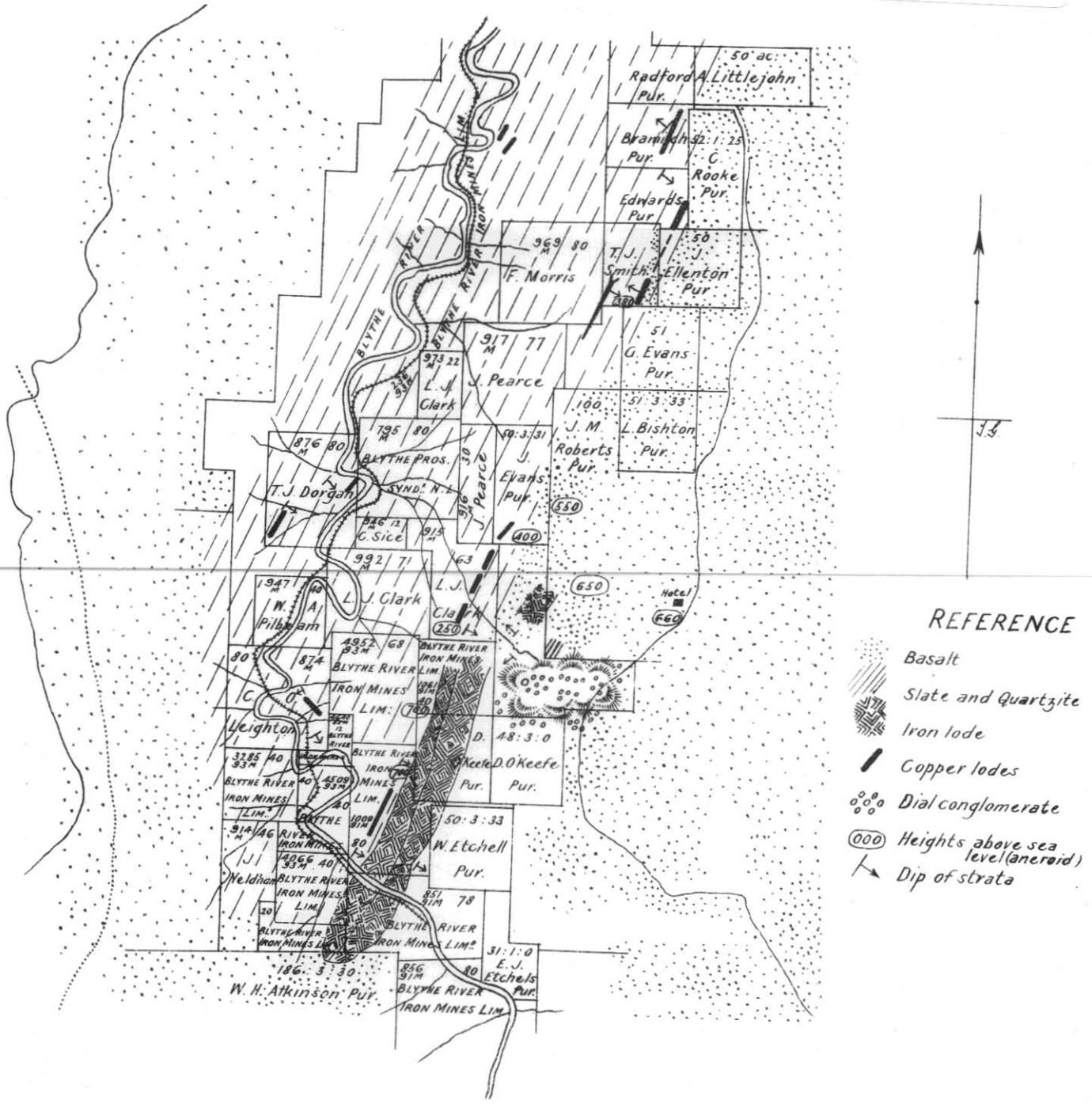
BLYTHE MINERAL FIELD

Scale of Chains

10 5 0 10 20 30 40 50

5 cm

W. H. Twelvetrees
Government Geologist



development. The success of this mine will produce a marked effect on the field, which otherwise is in rather a languishing condition at present.

Evans' Mine.

The north-east angle of Mr. Clark's 63 acres is close to the south-west angle of Mr. J. Evans' (now W. Evans') 50 acres, near which some mining work is being carried on upon the northern continuation of the Copper King lode line.

Mr. Robt. Short started the work towards the end of last year about 80 feet from the south-west corner of the property, and on the strike of Clark's lode, as far as could be judged from the position. A rather shallow tunnel crosscut has been driven across the slate strata for a chain in a south-easterly direction. A lode formation has been cut at about 30 feet in, consisting first of a few inches of white clay in the roof carrying a little copper pyrites and stained somewhat with green carbonate of copper, but widening to 18 inches in the sole of the tunnel. This gives place to 3 feet of lode slate interspersed with quartz, and on the wall of the lode are a few inches of sugary quartz. In the approach to tunnel there is discoloured material for 4 feet with vein quartz and iron pyrites. The lode was cut in the tunnel at a depth of only 20 feet from the surface, and as 10 feet of the overlying material is soil, there is practically no cover. The drive is under a small creek, and consequently wet. Additional 30 feet could be obtained by going down the creek below the tunnel and bringing in another adit. The present adit has been almost useless, as it does not permit of any reliable opinion being formed of the lode. The samples of lode stuff taken did not yield anything appreciable when assayed in the Government laboratories. The kaolin which borders the lode and the slickensiding which is seen in the slate show that some movement has taken place along the line of mineralisation. The Copper King is about 18 chains south of this. Though there is nothing of importance at the shallow depth at which the lode has been tested, it is possible that if the latter could be reached at an adequate depth better results would ensue; but to do this it would be necessary to go a good way down the hill, when the length of crosscut would be extreme. The point to remember in this proposition is that it is the nearest to the Copper King of all the works along this line.

Up the creek at the camp is some gossanous and concretionary iron ore (limonite) of the kind usually found associated with the basaltic drift of the tableland. Being so near to the occurrence of iron ore at the Blythe, the casual observer might easily take the two as related occurrences. A better acquaintance with the district dispels this idea. The hard white quartz conglomerate found round the camp and lying unconformably on the older rocks is the drift sand which was hardened and cemented after having been covered at one time with basaltic lava. The same formation may be seen at the caves at Howth.

Smith's Mine.

A mile north-east of the preceding, Mr. Smith has been carrying on prospecting operations on a 40-acre section east of and adjoining F. Morris' 80 acres, 969-M. The section embraces the continuation of the Copper King metal-bearing strata, exposed along the western edge of the basaltic farm lands. A small creek rises in the north-western corner of G. Evans' 51 acres purchased land, and flows north-easterly into the section on which Mr. Smith is mining. The basalt land is on both sides of the creek, in the bed of which are the blue clay slates, in which several holes have been sunk. This is at about 380 feet above sea-level. The strata preserve their usual bearing of north-east, but are dipping here north-westerly. The section shown by a cut across the lode formation is 1 foot of quartz on the footwall, succeeded by soft puggy slate in patches, graphitic slate containing lumps of dense iron pyrites, and dark slate with curved laminæ, measuring with the quartz 4 feet in width. Seven feet of hard micaceous rock underlies the footwall quartz, and outside this is slate again with veins of quartz and pyrites. The puggy slate in the lode is also veined with quartz. A little copper pyrites is present, associated with carbonate of iron and quartz.

Thirty feet north of this, a cut failed to pick up the lode. A little lower down the creek two cuts have been put in in opposite directions. The western one, which goes into the bank below the basalt, has only passed through slates. The east cut is an excavation of about 9 feet in indurated micaceous slate with thick veins of quartz in it, and very dense iron pyrites along the planes of parting. There is no copper here, but quartz a few yards to the south-west carries a few specks of copper pyrites.

The great development of iron pyrites is a feature of this formation, but there is very little copper. The samples which I took were assayed by the Government Analyst, with negative results. The lode can be prospected by sinking or by crosscutting further up the creek, but before undertaking the latter, it must be ascertained whether the lode does not cross the creek, as there is some possibility of it doing. The question is, whether there is any likelihood of copper ore coming in in depth. At present the quartz exposed has only a few specks of copper pyrites in it, and the absence of staining and oxidation is not a favourable indication. There is undoubtedly plenty of evidence of lode action, and though there is not much to encourage one, the possibility of copper deposition at a greater depth or somewhere else along the course of the lode always exists.

A good deal of ironstone cement exists on the hill to the west of this creek, and about 2 chains in width of this gossan-like cement overlie a tunnel which has been driven south-westerly into quartzite along a quartzose and quartz lode carrying abundant iron pyrites, but no copper. The underlay of the strata here is to the east, and the lode is perhaps more directly on the strike of the Copper King than the eastern workings in the creek are. The ferruginous cement on the surface is locally believed to be lode gossan. This is a mistake. It has nothing to do with any lode which may chance to be below it, but is the cemented sub-basaltic drift so frequent all over the district. Just west of it the basalt covering still survives in a small patch.

Edwards' Mine.

This is on a 40-acre section immediately north of the preceding, and west of the purchased lot, 52 acres, in the name of G. Rooke. The strata and lode formations are the prolongations of those on the section to the south. Messrs. Edwards started operations down on the bank of the creek on the eastern boundary of the section about a year ago. A tunnel has been driven east across slates veined with quartz for a distance of nearly 40 feet. At the entrance is a seam of soft slate mixed with quartz, then the tunnel passes through hard quartzose country, and again into slate. A little ore has been got in driving (copper pyrites). An excavation in slate south of the tunnel has given a little native copper, and but for this indication, the drive would not have been put in here, but

higher up the creek, where some copper pyrites has been found. Up the hill is a broad band of gossan-like iron ore, which, however, contains no valuable metal, and is probably of the same origin as the other occurrences of concretionary ore in the district. Mr. Edwards' mine appears, by position, to be on the continuation of Mr. Smith's eastern show. Though the line of mineralisation right through from Rutherford's is a long one, it does not follow that one and the same lode continues through without interruption. It is more likely that the lode shoots tail out and separate ones start, not exactly on the same line, but on parallel lines, the whole, however, forming a mineralised belt which is continuous all through these mining sections.

Behind Mr. Edwards' farm and below the basalt, a belt of hard grey conglomerate is exposed in the bank descending to a creek. The rock contains iron pyrites sprinkled through it rather plentifully, and a little copper pyrites is said to have been found. The rock is very siliceous, and contains numerous white quartz pebbles and some jasperised stones. There is not enough of it exposed to show the relations of this bed, and it is too isolated an occurrence to justify any definite statement about it as an ore-bearing stratum, but search should be made for a lode along either side of it, as it is not likely that a rock of this hardness will be fissured very much.

Farther south, where the road passes through O. Allen's 100 acres, boulders of the Dial Range conglomerate are seen by the wayside, and a small hill to the west is composed of this rock. This is the only patch of these conglomerates which I have seen in the district. I was told, however, that they extend further south on the east side of the Blythe iron outcrop.

Bramich's Mine.

This is on the 40-acre section north of Edwards' mine, and west of and adjoining G. Rooke's 52 acres, purchased land. A turn off from the main road leads through scrub down to a small creek about 100 feet above sea-level, where work was started a year ago to pick up the line of the Copper King lode. A small drive has been put in for about 18 feet, across dark slate and seams of pug with splashes of copper associated with carbonate of iron and a little quartz. The last 4 feet are in smooth slate, locally called schist. The drive was intended to intersect some

copper-bearing slate seen in the creek about 30 feet further north. Further down the creek another cut shows a band of black slate with veins of quartz carrying iron and copper pyrites; a few more cuts have been put in still lower down the stream. One of these is in hard quartzose rock traversed by veins of quartz and carbonate of iron, carrying splashes of clean copper pyrites here and there. The right course has been pursued in crosscutting into the belt at intervals along the creek, in preference to sinking at one spot.

No body of ore has been discovered, but a good deal of mineral is scattered through the rock in these workings, and it may well be that there is more ore in the neighbourhood. It is intended to go about 50 yards further down, and crosscut through the formations for 100 or 150 feet. This seems feasible, and should be a useful test.

Up the hill to the west a belt of the white Tertiary quartz conglomerate is met with, and still higher is a large spread of gossanous material covering Tertiary drifts and lignite with impressions of twigs and leaves of European trees. The lignite is highly sulphurous, with decomposing secondary pyrite.

A tunnel has been driven into the side of the hill below the gossan at 80 or 100 feet above the creek, exposing 2 inches of pipeclay resting on 7 feet of brown clay and lignite, the whole lying on the upturned edges of schistose bed-rock. The dip of this formation is away from the present creek, showing that the latter has carved out its channel subsequently. The gossan has been mistaken for a lode capping.

North of this section is one held by Mr. Radford, taken up presumably for position. West and south-west between here and the Blythe River the ancient slates and quartzites are exposed, and several discoveries of mineral have been made, which at present are not receiving much attention, pending developments on the field.

Heybridge Mine.

After leaving Bramich and Radford's claims, the Copper King line of lode passes below the basaltic farm lands, and the next trace of any lode action visible is met with at the Heybridge Mine, between the road and the railway, about 15 chains inside the east boundary of Heybridge township.

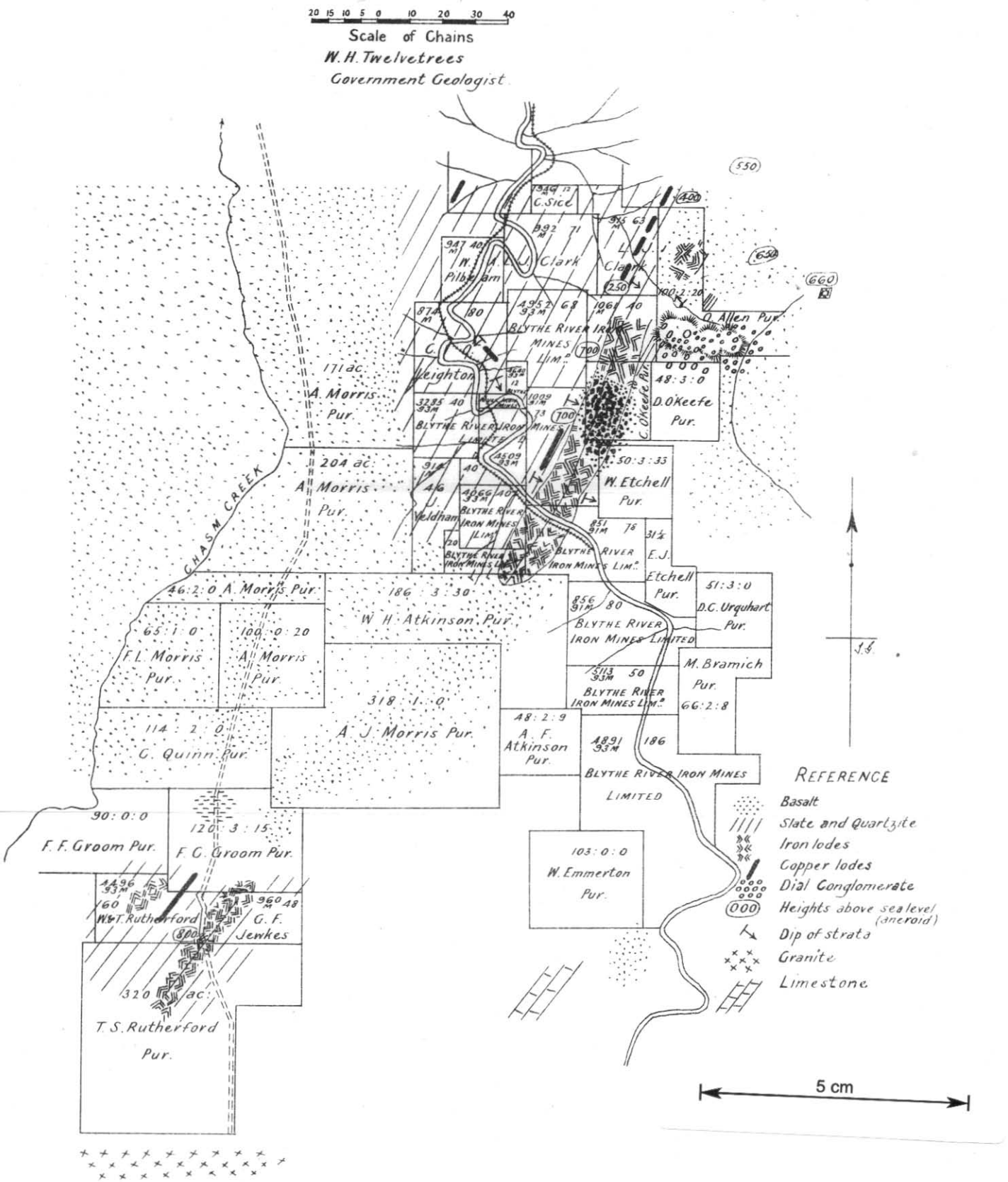
Along the sea-beach slate and quartzite strata are exposed, striking north-easterly and dipping north-westerly. No eruptive rock is shown. These are impregnated with iron pyrites and a little copper pyrites. The pyrite is distributed abundantly on joint faces, as well as scattered through the solid rock. South of the railway an open cut has been driven across the slate, &c., but the deepest level reached by this is not below sea-level. A seam of pug traverses the beds from west to east, varying from 3 or 4 inches to a foot or 15 inches in width, and carrying some copper pyrites. From its direction this cannot well be the main ore channel, unless it is bent out of its course. The lode minerals, quartz and carbonate of iron, are present in the formation, and there is no doubt that a lode channel exists. This is, however, the wrong place to work on it. It must be sought in the hill, and reached under sufficient cover to ensure it being beyond the reach of surface agencies.

About 250 feet above sea-level, on the hill behind this outcrop, the indurated slate carries between its lines of transverse jointing some carbonate of iron with a little iron and copper pyrites. This line, however, would run out to the beach at the point east of the Heybridge Mine. On this hill the strata dip to the south-east.

On this range, east of the Blythe River, are some superficial workings in the Tertiary gossanous cement so often referred to in this report. The first place is on the brow of the hill, where the gossan forms a thin crust overlying the quartzite bed-rock. On careful scrutiny it will be seen to contain small waterworn pebbles. A little way back a trench has been cut down a few feet through the gossan and into underlying pipeclay. Further along, towards the sea, the gossan has been cut again, and shown to be merely a shell.

Just outside the township boundary and 100 feet up the hill facing the sea is a cemented iron ore formation which belongs to the basaltic series of gossans and breccias. The deposit has certainly no connection with the Blythe iron outcrop or any other lode. These beds have been a fruitful source of misunderstanding.

On the hillside overlooking Heybridge Creek and Howth railway station the sub-basaltic gravels and conglomerates are well exposed. They form here small cliffs about 25 feet in height, in which caves have been excavated by natural agencies. The summit of the hill at one time was capped with basalt; at present the superficial covering is either



JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

sub-basaltic gravel or quartz conglomerate, or gossanous material, and in the Howth cliffs below this, heavy shingle wash is seen resting on hard white quartz conglomerate, all of Tertiary age and lying on ancient quartzite. The conversion of these loose sediments into hard siliceous conglomerates is instructive. It is difficult at first to realise that they are not rocks of far higher antiquity.

Manganese at Mouth of Blythe River.

On the beach east of the mouth of the River Blythe there is a blow of manganese gossan, which lies about in lumps over a wide area, though the main outcrop occurs as a reef-like mass of boulders. If it were a reef, it would enter the hill behind McKenna's hotel; but it is improbable that the occurrence is anything other than a deposit. Manganese, removed from older rocks in minute quantities is precipitated as a hydrated peroxide from solutions derived from decaying organic matter. It is found on the beach at the mouths of several streams on the North-West Coast, but mostly impure, or when pure, in insufficient quantities to be of economic value. It is devoid of gold or silver values.

Blythe River Iron Mines.

The huge outcrop of hematite on this property is still unworked. I visited it again this time, to see if a renewed examination would suggest any additional conclusions to those expressed in my report of 30th January, 1901. I do not see any reason for modifying my then stated opinion of the value of this deposit of iron ore, based upon its outcrop and the results of the exploratory tunnels. The mineral discoveries in the district during the last few years have, however, made it highly probable that the ore-body is the result of lode formation, and indeed, directly associated with the granite to the south. Although it has copper lodes as neighbours, there is reason to believe that it is an independent primary mass, and not derived from the oxidation of iron or copper pyrites.

Alluvial at Upper Blythe.

Two miles higher up the Blythe than the iron outcrop, Adams' Creek, rising at Riana, falls into the Blythe River, cutting through a deposit of Tertiary gravel. On the south side of the creek, on Mr. D. Wescombe's property, it is associated with the usual sub-basaltic pipeclay. On

the north side, Mr. Peter Price has put a cut into a terrace of sand and felspathic clay, about 40 feet above the flat ground; and a little higher up the road the wash is exposed in the drain, where it is also very kaolinic in nature, evidently derived from granite not far off. In fact, the granite country comes in a mile further up the Blythe, extending in one direction west to the south of Rutherford's and in the other south-east to the southern boundary of Riana township. This wash, being so near the granite, might be expected to be charged with gold or tin. Some of it shows a colour or two of gold, but nothing at all encouraging. However, it is not impossible that in places better results could be obtained. This is an ancient body of wash, which was deposited before the outflow of the basalt which caps the surrounding hills, and has been cut into and much of it carried away by the modern Adams' Creek. The height of the creek here is about 200 feet above sea-level.

The river flats on the bank of the Blythe are formed of modern shingle and wash. West of the Blythe, on Mr. Edward Addison's 314 acres, I was informed that beds of limestone exist. These would be useful in the event of any local iron ore smelting being started.

Alluvial Ground at Primrose Park, Howth.

On this estate, situate up the Nine-mile Road from Howth railway station, and on the divide between Heybridge Rivulet and Sulphur Creek, the creek east of Mr. Taylor's homestead exposes a bed of clay charged with carbonaceous matter and imprints of Palæogene leaves. This deposit has been sunk into 6 feet without bottoming. On the east side of the creek the bank has been cut into, and shows about 4 feet of conglomerate or cemented wash below 10 feet of pipeclay and grey clay.

A quarter of a mile to the south of this, Mr. Cameron put in a couple of cuts in the bank on the east side of the creek in yellow and red clay, carrying two flat seams of iron and manganese oxides.

These workings are in the sub-basaltic formation, in which no lode can be expected to exist. The lumps and boulders of siliceous chalcedonised rock occurring in the farm soil belong to the same formation, together with boulders of brown and micaceous iron ores ploughed up or occasionally rooted up by falling trees. The height of the basaltic tableland here is 350 feet above the sea. Descending from the house to the road, the bed-rock of white sandstone and

soft schist is exposed, showing a strike of N. 70° E., with a dip to the north-west.

The sub-basaltic drift is distributed so generally over the coastal tableland from Rocky Cape to Ulverstone, that the discovery of leads or gutters in it is no easy task. Its exposure in existing creeks is merely accidental, and no indication of a channel at any of the particular points where it is found. Its general deposition is more likely to have been due to estuarine or even marine action than to rivers, though earlier gutters may possibly be still concealed in it here and there. It is these gutters which will probably yield payable gold, and not the general drift layer, which has filled up the old channels and been uniformly distributed over the country.

In concluding my remarks on this part of the coast, I repeat my impression that the Stowport-Blythe field gives fair ground for hope that in the future it will become an established seat of copper mining. The mineral-bearing series of strata are there, and there are plain evidences of lode action, and modest shipments of quite nice copper ore have been made. The two premier mines have shown lodes which offer every encouragement for deeper mining. In spite of this, a drowsy air pervades the field, and every one seems to be waiting for something to turn up. What is wanting to revive the springs of action is capital. The undertakings are very imperfectly financed, and will really be a hindrance to the progress of the field rather than a benefit, unless adequate funds are provided for working in a proper manner. The splendid farm lands in the neighbourhood will be of great advantage to the mines when the latter are established; but in the prospecting stage they are rather the contrary, for the district is inhabited by farmers, whose chief attention is rightly directed to agriculture, and not by miners and prospectors who would overrun the country and doggedly tear every outcrop and indication to pieces in their search for mineral. To the agricultural community this is new work, and besides, they cannot afford the time. There can be no doubt, however, that fresh discoveries are to be made in country so promising as this is. Meantime, the development of those which have already been made is greatly to be desired.

Eventually, too, the iron and steel industry, which is destined to derive part of its raw material from the Blythe deposits, and to be an important factor in the future commercial prosperity of the State, will draw increased attention to this part of the North-West Coast.

Penguin and Dial Range.

Tasmanian Iron Company's Mines.

The deposits of red hematite are still worked by Mr. J. C. Ellis, though severe Australian competition has been encountered, in consequence of which the output is temporarily reduced to about 150 tons per week. The grade of ore shipped has been maintained at 67 to 68 per cent. without difficulty. The known deposits extend for 1¼ mile along the creek in the form of boulders and nodules of hematite from creek-level up to the edge of the basaltic tableland, and constitute a mass of iron ore of great purity. The ore, as mined, is shipped to New South Wales for flux in smelting furnaces. The nodules strongly suggest the transmutation of pebbly beds of sediment to iron oxide, and the question is whether these beds belong to the Dial Range conglomerate series or to some other similar strata of later age. I am disposed to think it quite possible that they may belong to the gravel and conglomerate wash series underlying the basalt; and hence, may extend below the farm lands for a great way horizontally, though probably nowhere deeper than 200 or 300 feet below the surface.

Along this coast we have at least four different sources of iron ore, and it is necessary to recognise these sources before it is possible to properly appreciate the occurrences. First, there is the outcrop at the Blythe, which may be regarded as a primary derivation from the granite. Second, the Iron Cliff outcrop, which is a hydrated ferric oxide derived from the decomposition of iron pyrites in all probability, and forming the cap of a lode containing metallic sulphides. Third, the iron conglomerate near the top of the Dial Range, where the pebbles of the Devonian conglomerate have been converted to more or less pure hematite. Fourth, the nodular iron deposits of the Penguin Creek, assumed to belong to the sub-basaltic beds of gravel and conglomerate.

Thus, it is of no use to connect these deposits with one another, as is sometimes done, for they are distinct in origin. When the iron industry is started, some of these Penguin deposits will be available, and will contribute in no mean degree to the total output.

Dial Mine.

The old tunnel on Section 3190, driven north, has been abandoned, as well as the one driven south on Section 3188, and a new low adit has been started on Section 3189,

about 20 feet below the south tunnel and at right angles to it, being driven 130 feet S. 70° W. The rock through which the drive passes is, or has been, a crush breccia of a granitic or quartz porphyry nature, which has been developed at the contact of the granite with the slate. At the entrance it has been reduced to a light-coloured clay, and it continues soft for about 100 feet in the tunnel. It then becomes harder, carrying grey and dark patches of pyritic rock and white clay. In the end seams of iron pyrites pass down the face. This clay is not argentiferous, and the pyrites does not contain any precious metal. The idea is to drive right across this breccia formation to its contact with the slate on the west. It is at the contact that the best chance offers of finding lode minerals of value, but the unfortunate feature in these drives is that they are not very deep. However, if anything like a lode is met with, it can be followed into the hill. From the appearances in the various drives, it is not probable that anything of importance will be found far from either margin of the broken country. This shattered zone of rock is 500 or 600 feet in width. There is, however, always the likelihood of a strong deposit of copper being found in depth, and this property will never be satisfactorily tested without deep sinking. Some fair assay returns for copper were obtained from ore from the old shaft on the north section in 1898-1900, which would warrant the belief that payable shoots exist in the pyritic formation. The iron pyrites is especially abundant. It is crystalline, and good cabinet specimens can be obtained. Its precious metal contents are variable, being from traces up to 1 dwt. 15 grs. gold per ton; silver, nil. The same variability exists with respect to the copper pyrites, in which usually traces only of gold are found, and from 15 dwts. to 3 ozs. silver per ton. This ore is often faced with a film of black oxide of copper. The general looseness of the formation makes it possible that a good deal of metal has been removed in solution, and will be found in concentrated form at a greater depth.

Revell's Workings.

On Section 2880-93M, and on the east side of the Dial Creek. The country is part of the same brecciated contact belt as exists at the Dial and Keddie's mines; but the precise width of the formation here is not known. Granite is known to the east, and slate exists to the west, and this significant band of broken, mineralised rock lies between.

Mr. Revell has driven a cut into the hill in a south-easterly direction for 20 feet into the decomposed rock, which carries here iron gossan veins. Where any fresh rock is seen, it is of a quartzose, hornstone-like, and sometimes even of a granitic appearance, and extremely hard. The granite is evidently not far off. There is none of the friable formation which prevails at the Dial Mine, and driving, once the work advances under cover, will probably be slow. Backs of 100 to 200 feet can be obtained by extending the drive into the hill. The lode lies flat—about 45°—and is a good deal stained with blue and green carbonate of copper. The country-rock contains large included fragments, and is blocky, with large heads. Some of the gossan has been copper-bearing, and it would be worth while proving the formation, by driving into the hill. If anything encouraging were met with, the lode could be further tested by sinking near the Dial Creek.

A little further up the creek is a development of hornstone with iron and copper pyrites on the joint faces. The rock is excessively hard, and not favourable for much ore deposition.

A chain further up the stream another cut has been put in; also in hornstone breccia, showing nice-looking gossan and copper stains. This contact-line has been traced still further south, but its boundaries are undetermined, and until they are ascertained, work will necessarily be uncertain, and, in a measure, at random.

Contact lodes such as these are often rich, but always irregular and expensive to work. The lode action which is disclosed on these contact properties at the Dial has been extensive, and the poverty of so much mineral suggests leaching and re-deposition of the valuable constituents at a lower level. This consideration points to the necessity for deeper exploration than has been as yet contemplated. Shallow working cannot be expected to throw much light on the deposits.

Rogers and McKenna's Mine.

This was formerly known as Hardstaff's mine, and is situate south-west of the 104 acres purchased by W. Russell, west of the Leven, 3 miles south of the Dial Creek.

The lode outcrop on the side of the hill, one of the slopes at the base of Mt. Duncan, bears north-easterly and dips north-westerly, at an angle of 45° or 50°. It is in granite rock, and occupies a fissure from 18 to 21 inches wide.

The lode action has altered the granite on each side for about 4 feet, producing a quartz wall-rock, which borders the lode proper. The lode itself consists of quartz and carbonate of iron, carrying iron and arsenical iron and copper pyrites and glance.

About 50 feet below the outcrop line, a crosscut adit has been driven north-westerly into the hill for 200 feet in granite, and at 108 feet in a small lode of carbonate of iron, copper, and iron pyrites, only a few inches wide, was intersected and followed south for 20 feet. The lode passed out of the drive, and the face now shows only barren country. The main adit was then deflected north, to follow a rock face which was believed to be the lode wall, but as nothing was found, its course was brought back to a north-westerly bearing, and driving was continued in the hope of the lode still being ahead. After taking measurements, the conclusion was forced upon me that the lode cut in the adit must represent the one which crops out at surface, and which has suffered a temporary pinch. The owners have now continued sinking the outcrop winze, and intend to drive south from it. At about 30 feet down I am informed that the lode has widened out to 2 feet 6 inches, and carries veins of rich ore. Some samples sent up from the mine and taken from across the lode in the winze were assayed by Mr. J. D. Millen, A.S.T.C., with the following results:—

No. 1.—Copper	.....	19·48 per cent.
Silver	.....	12 ozs. 15 dwts. 1 gr. per ton
Gold	.....	Nil
No. 2.—Copper	.....	6·49 per cent.
Silver	.....	17 ozs. 19 dwts. 8 grs. per ton
Gold	.....	Trace

Samples of the iron pyrites from the outcrop returned 1 dwt. gold per ton in the Government laboratories, and I believe some of the copper pyrites went higher than this. Ore of the above quality, say, averaging 13 per cent. copper, would return the owners about £4 per ton, less the cost of transport to the sea-coast. What is wanted, of course, is that the lode should widen a little and carry a continuous and good shoot of ore. From the outcrop it is difficult to say how the lode will behave in depth. The question can only be settled by actual work.

The country south and east of this mine is unalienated mineral land, and 3 miles south are the copper deposits on Walloa Creek in metamorphic slate strata striking north-easterly and dipping south-easterly. The whole district

bordering the Dial Range on its east side has been imperfectly prospected, and the discoveries which have been made have been imperfectly developed.

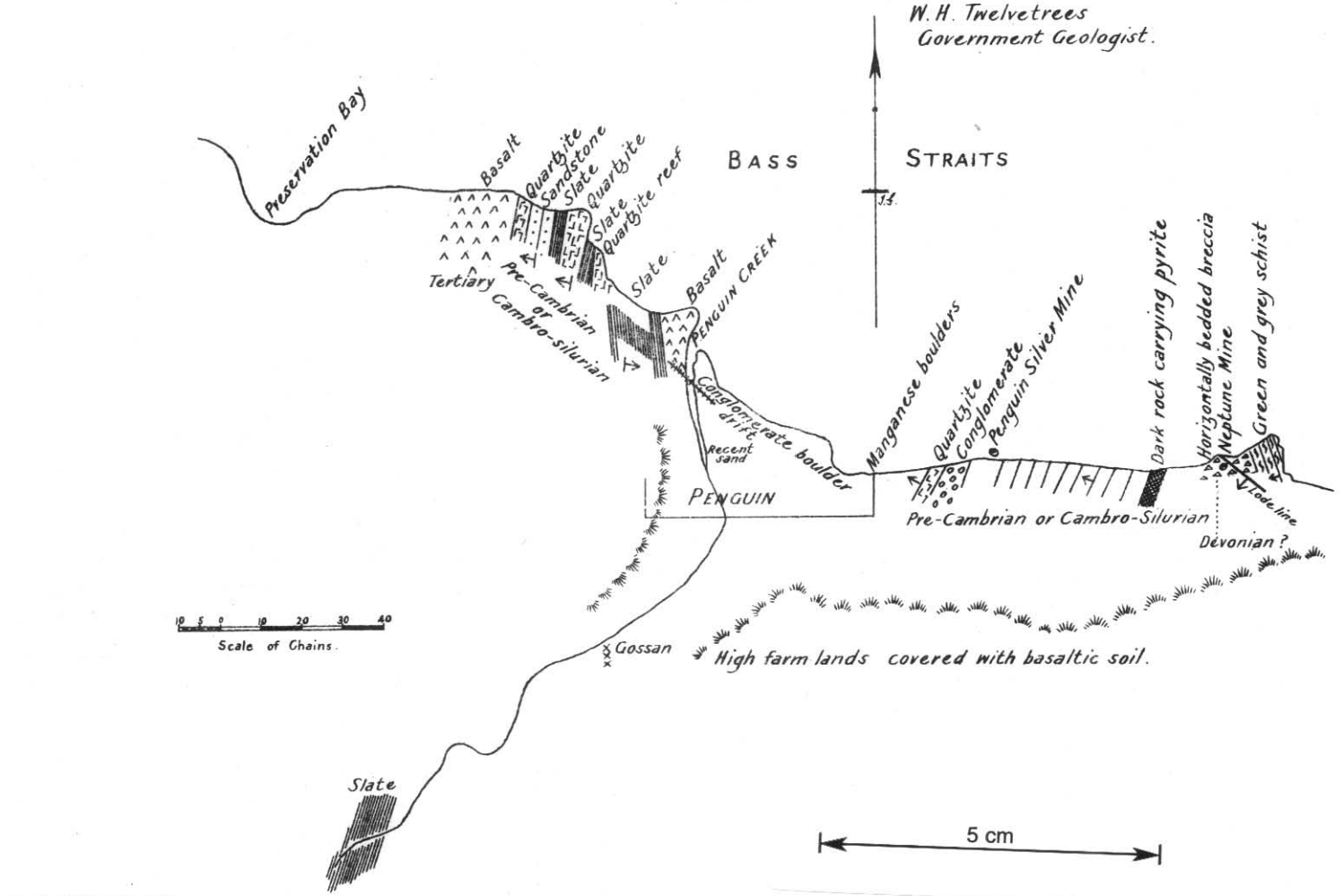
Penguin Coast-line.

The old Penguin and Neptune mines are still in their abandoned state, and I doubt whether any renewal of work would be judicious, unless at a reasonable depth. The country-rock is meshed with veinlets in a way which debars profitable work at the depths at which mining has been carried on here, and the only chance is by getting down below this fractured zone and proving the lode channel in depth. The constant percolation of water has probably assisted in taking the richer elements of the lode to a lower level, besides which, the lode channel will most likely be better defined lower down. The variations in assay returns point very strongly to leaching having taken place. Shafts sunk 300 or 400 feet would give access to the formation at a depth which would disclose its real nature. These beach mines attract the attention of every one travelling along the coast, and one hears fabulous tales of their silver values. When one examines the outcrops and all that there is to see above ground (for the underground works are flooded), the impression left is not encouraging. But the case is not so bad as it seems at the first glance, for drives only 50 and 70 feet below the surface do not prove anything. They might just as well have not been driven for all the results to be expected. From the work done, however (especially by Mr. Ellis, at the Neptune Mine), we see that the ore yields about ½ oz. silver per unit of lead, which is a low silver ratio. Mr. Montgomery's samples returned nearly 3 ozs. silver per unit of lead from the Penguin Silver Mine, but the ore was unusual, for it contained 2·5 per cent. nickel and 0·8 per cent. cobalt. We have really nothing but shallow burrowings and impoverished outcrops to base any calculations upon, so that I do not see that there is as yet any reason for despair.

Parson's Outcrop.

Mr. Parsons has an outcrop of nice-looking gossan south of M. Clarke's 33 acres on the Penguin Creek. It consists of ferro-manganese and limonite, but the samples which I have tried do not contain any precious metal. This discovery seems to be on the strike of an ironstone reef running out to sea west of Penguin Point. It is apparently

Geological sketch Map of Coast Line at PENGUIN



JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

a replaced quartzite. At some points in its course it is not at all unlikely to be auriferous.

From the preceding, it will be seen that there are potentialities in the Penguin and Dial Range district, possibly convertible in the future into actualities. Sooner or later the iron deposits will be more valuable than they are at present, and any successful work, either on the beach lodes or in the ranges, will give a powerful stimulus to the district. The district lies at present in the backwater of the stream of exploratory and industrial mining, but there is really nothing in the surface indications or in the shallow work results to forbid, but on the contrary, a good deal to warrant, the expectation that more thorough exploration and deeper work will reveal payable copper and silver deposits at more than one point in this rather wide area.

Forth.

Basaltic agricultural land caps the hills on either side of the Forth Valley. The volcanic sheet, however, forms only a thin covering of the ancient rocks, which have been cut down into by the stream and are exposed on both sides of the picturesque river gorge. The country has not been surveyed geologically, and hence the stratigraphic relations of these rocks are not known, but from their lithologic characters and aspect there is reason to believe that they belong to our most ancient series, viz., Pre-Cambrian.

I spent a day at Hamilton-on-Forth in 1903, and another day on this journey, and in this space of time could only cursorily note the geological features of the country, which, however, are replete with the interest which necessarily attaches to the ancient foundation rocks of the island.

Opposite the township, and on the west bank of the river, is a crag of white quartzite, forming a belt flanked on the west by mica quartz schist, which runs north and south and dips westerly. About $\frac{3}{4}$ mile south of the township is an intrusion of serpentine rock about 200 feet wide, which seems to follow the general strike of the country, a little west of north, as it re-appears on Mr. Smith's estate of Westwood, near the coast. Half a mile further south a beautiful garnetiferous hornblende schist is seen in Mr. Field's garden along the road, and $\frac{1}{4}$ mile further a reef 6 feet wide of flesh-coloured vitreous quartz occurs at the water's edge in the same band of schist, which is here very ferruginous and specked with iron and copper

pyrites. At the Devonport waterworks intake on the Forth is a dyke of felspar porphyry* of reddish-brown colour, about 3 chains wide. Immediately south of the waterworks building slate comes in with a N.-S. strike.

Cooper-Smith's Iron Formation.

This is on Mr. Cooper-Smith's farm, a mile north of the waterworks. Near the farm-house is an outcrop of ferruginous quartzite, forming an iron ore deposit exposed for about 25 feet in length by 10 or 12 feet in height, and another outcrop, rather impure, occurs on the low flat to the west. East of the quartzite, the strata consist of soft, wavy schists, with laminæ and eyes of quartz, changing in parts into graphitic schists. On this bed-rock floor of schist and quartzite rests a body of wash with large rounded stones. Colours of gold are obtainable in this wash and the river bed. The high flat field to the east is all wash. Basalt caps the hills on either side of the river, and careful examination would no doubt make it possible to distinguish between the older drift, which was once protected by the basalt covering and the modern shingle of the River Forth. The older wash might very well contain a payable run of gold. The lower flat bordering the river is probably modern.

The iron ore is too impure for economic purposes, and is so irregular in its segregation that sufficient quantities could not be relied upon with any degree of confidence.

About 300 yards south of the house is a gossan formation in the bank of the river, which is said to pass over to the western bank. It looks very much like a lode. The rock in which it occurs is not visible, but micaceous schist or quartzite exists between it and the other iron ore. The outcrop is not opened up sufficiently to see exactly what it is.

Barrington Copper Mine.

This is situate about 3 miles south of the angle made by the junction of the River Wilmot with the Forth, and is reached by a foot and bridle track through the bush from the bridge at the junction. South of the bridge, the rock is an ancient metamorphic sandstone or greywacke of a massive habit, somewhat simulating an eruptive rock. It extends for some distance. The mine was started

* Felsite-porphyry (Rosenbusch) = a variety of quartz porphyry, in which the porphyritic crystals are felspar, not quartz.

twenty-five years ago by a local company, consisting of Barrington, Don, and Forth people, and registered February 15, 1881.

A tunnel has been driven into the hill at creek-level for nearly 400 feet in a north-westerly direction on the course of slate strata (dipping south-westerly). The end has passed under an outcrop of gossanous slate occurring a couple of hundred feet higher up the hill, and on which a shaft has been sunk for 30 feet. The end of the tunnel is upwards of a chain north of this gossan, but no lode has been intersected. Three crosscuts have been driven from the tunnel at intervals in a south-westerly direction. These crosscuts have touched a parallel belt of hard pebbly sandstone or breccia, which is also seen outside the tunnel entrance to the west. The first one intersected a flat vein, 1 foot to 1½ foot wide, carrying a little copper pyrites associated with baryta and siderite, as well as vughy quartz. This was followed for some distance by a drive parallel to the tunnel. A crosscut 50 feet ahead of the end of this drive failed to pick up anything; and a crosscut was driven from the tunnel north-easterly to see whether the mineral continued in that direction. Nothing, however, was met with, beyond a little baryta and specks of pyrites. I am told that 9 cwts. of copper pyritic ore was obtained.

Higher up the hill beyond the gossan outcrop is another occurrence of gossan, on which a shaft has also been sunk, but has passed through it. A small cut to the west has also traversed it. It has a nice appearance, but is apparently superficial and irregular. It is in slate country, and near the conglomerate or breccia contact. My samples, assayed by the Government Analyst, yielded neither gold nor silver.

The occurrence of mineral here cannot be well understood without a knowledge of the geology of the country west of the breccia formation, as the latter may possibly be a shattered contact zone bordering an intrusion of some eruptive rock. In that direction there is a rock stained green with chrome, but it is too badly preserved for identification; still further west I was told there is gabbro, and then slate succeeds again.

About 300 feet above the creek is a boss or crag of pebbly quartzite, with segregations of quartz. And at the crown of the hill, Mr. Leslie Smith has sunk 9 feet into a favourable-looking gossan, which, however, has probably

been derived from the country-rock, into which it seems to merge. Samples assayed in the Government laboratories gave negative results for gold and silver.

Some sort of lode action has evidently taken place at this mine, and produced the lode minerals, baryta, siderite, and copper pyrites. The latter may be seen scattered in the breccia, but so far all the prospecting has not revealed anything in the shape of a solid lode. The prevalence of pyrite in the country-rock may account to some extent for the abundant gossan. My examination of the outcrops and work done resulted in an impression far from inspiring, but as said above, there is an unknown factor which may yet lead to some discovery in the breccia belt.

Conclusion.

From the above, it will be seen that the North-West Coast is a mineral area, in which certain belts of country occur possessing indications pointing to the existence of deposits of economic value. Mines showing payable concentrations of iron and copper have already been opened at Stowport, Blythe, and Penguin. And there are other places where mineral has been uncovered, but not yet in sufficiently remunerative quantities. With so many indications, surprise is sometimes expressed that not more discoveries are made. But the districts have not had their fair share of prospecting, and when money has been expended, it has often been laid out improperly and uselessly. Work, too, has been intermittent, and often separated by long intervals of time. The districts are also largely agricultural, and do not possess prospectors of the right stamp. The geological conditions for ore deposits are present, and I do not doubt that mines will gradually spring up, but lodes will not be found indiscriminately distributed all over the coast. I have endeavoured in this report to suggest the zones in which search should be made. These ancient rocks are often extremely hard and tight, and not favourable for ore precipitation, except along certain lines of weakness. These lines require to be sought, followed, and examined intelligently and well. Unfortunately, such work takes time, and in nine cases out of ten, is unremunerative from a bread and butter point of view. In the tenth case it is successful, and the reward is not to the discoverer alone, but is shared by the inhabitants of the district as well as by the State at large. It is this sort of work that is wanted on the North-West

Coast. A cursory trip into the bush will not do. Intelligence, perseverance, and financial support are the requisites.

The great granite contact area at the base of the Dial Range is one which is well worth exploration. The reason why such zones of country are specially favourable for mineral deposition is because after the heat generated by the intrusion of the eruptive mass has subsided, the consequent shrinkage tends to leave an open space more or less between the intrusive rock and the rock upon which it impinges. This space is seized upon by the metal-bearing solutions and vapours, which also penetrate the adjoining strata, so that ore deposits are produced not only at the actual contact, but also some distance away. Subsequent earth movements often follow these lines, which have become lines of weakness, and this faulting prepares the channel anew for the further introduction of metal-bearing solutions. The intelligent miner therefore looks upon these contact zones with favour; and it is because the above-described indications are so pronounced at the Dial that a hopeful opinion of the future of the district may be entertained.

The ores of the copper mining field of Stowport and the Blythe are not exactly contact deposits, though the lode action is connected with the proximity of the granitic mass. It is the nearness of the eruptive rock, with all its mineralising signs, which inspires those who are mining here with the confidence arising from the knowledge that they are working in the sort of country which is relied upon elsewhere as favourable.

So many residents along the coast extended to me hospitality and assistance, that I cannot mention them all by name, but I beg here to thank them cordially for their kindness.

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

W. H. TWELVETREES,
Government Geologist.

W. H. WALLACE, *Esq.*,
Secretary for Mines, Hobart.

RECORD OF OBSIDIANITES, OR OBSIDIAN BUTTONS, IN TASMANIA.

By W. H. Twelvetrees.

During recent years some more of these interesting though still mysterious objects have been found in Tasmania, and it seems desirable to place the localities on record, as a knowledge of their distribution and conditions of occurrence may assist in forming some idea of their age.

The locality list brought up to date stands as follows:—

1. Weldborough, Union Claim and elsewhere.
2. Fossil Creek, a tributary of Main Creek.
3. Springfield, near Scottsdale.
4. St. Leonards.
5. Cox Bight.
6. Middleton Creek, Long Plain.
7. St. Helens.
8. Supply Rivulet, River Tamar.
9. Pioneer Tin Mine.
10. Amber Creek, near Gladstone.
11. Wyniford River.
12. Moorina.
13. Camden Plain, Mt. Barrow.
14. Lisle gold diggings.
15. Back Creek, Lefroy.
16. Thomas' Plains.
17. Norfolk Range.
18. Schouten Main.
19. Tallywong Creek, Weldborough.
20. Hunt P.A. Mine, Derwent Creek.
21. Thureau's Deep Lead Mine, near St. Helens.
22. Smith's Creek, Long Plain.

It may be as well to record the information obtained as to their occurrence before the particulars pass into oblivion. It seems to be clear that no evidence has come to light which would require us to assign to them a date so far back as early or middle Tertiary. They have nowhere been found in gravel protected by the middle Tertiary basalt. I have repeatedly made enquiry at Derby, but always with negative results.

1. *Union Claim, Weldborough.*—Mr. J. C. Macmichael found a perfect specimen of the button type in the sluice-box at the old Union Tin Mine on Fancy Creek. It came from clay 6 feet below the surface overlying tin-bearing gravels, believed to be of Quaternary age. Several specimens were also obtained by Mr. Gaylor.

2. *Fossil Creek.*—One was found in the Quaternary tin-wash of Fossil Creek, a tributary of Main Creek, a mile and a half north of the preceding locality.

3. *Springfield.*—This button was found by Mr. John Cherry at the bottom of a 6-inch bed of quartz-wash, lying on granite, and at 2 feet 6 inches from the surface. Mr. Cherry also found another lying on the surface of the ground a mile distant.

4. *St. Leonards.*—Mr. Simmonds obtained one two years ago half a mile south of St. Leonards railway station, on the surface of soil in a field which had been ploughed at one time. The specimen was well worn.

5. *Cox Bight.*—These specimens were found by Mr. Christopher Iles, when working the tin-drift at this bay on the south coast. The drift is derived from the granite which forms a patch at the southern end of the Bathurst Range. The buttons were found at a height of 100 feet above the sea, under 2 feet of button-grass peat and on the top of about 3 feet of tin-wash, the latter reposing on the bedrock.

6. *Middleton Creek, Long Plain.*—Mr. Simmonds reports one found here in gold-bearing wash, at 3 feet from the surface.

7. *St. Helens.*—A peculiar horn-shaped or shell-shaped fragment, similar to some forms found in Western Australia, came into the possession of Mr. Geo. A. Waller, from some unknown locality near St. Helens.

8. *Supply Rivulet.*—A specimen from here was found by the late Dr. Milligan, and reported to the Geological Society of London by the Rev. W. B. Clarke in 1856 as a volcanic bomb.

9. *Pioneer Tin Mine.*—In 1903 Mr. Cecil E. Ryan, the general manager, showed me a fragment of a button found on the mine at 4 feet from the surface, and resting on a bed of pug or clay 16 feet thick. Below this clay was a layer of fine puggy drift 10 feet thick, over 4 feet of wash of decomposed granite, which, in its turn, reposed on the granite bedrock. Although this is the direction of the

Tertiary Wyniford River, there is reason to believe that the superficial clay is of more recent date.

10. *Amber Creek.*—Mr. Tompsett has found several buttons in alluvial tin-drift in the basin of Amber Creek, near Gladstone. This drift has been deposited since the streams of the district have begun to flow in their present channels.

11. *Wyniford River.*—Mr. C. E. Ryan informed me of another button which was found in some shallow alluvial tin workings on the Wyniford River, about a mile above the Pioneer Mine. The descending section of the workings shows 1 foot of soil, covering 3 feet of sandy clay, which rests upon 2 feet of tin-bearing wash lying on granite. The button was in the stratum of clay at 18 inches from the surface. The age of the clay may be accepted as Quaternary.

12. *Moorina.*—Last year Mr. J. A. Thomson, of Moorina, showed me a button which he had found a few weeks previously in surface tin-workings in a blind creek at Moorina, 60 or 70 feet above the Ringarooma River. Soft creek gravel prevailed for 2½ feet from the surface; below this was a layer of hard cemented gravel, 2 feet thick, and in the middle of the latter the obsidianite was found. Age, Quaternary.

13 and 14. *Camden Plain and Lisle.*—Several specimens were found by Mr. T. Bessell in the well-known gold-bearing gravels at these localities.

15. *Back Creek, Lefroy.*—Mr. R. H. Wallcott reports that there is a specimen with this label in the Technological Museum, Melbourne. I have ascertained that this was found by Mr. J. Birkett, in 1881, with two other specimens at the White Lead, Back Creek, in alluvial gold-wash, 12 feet from the surface, all in a space of 6 feet square. One, a dumb-bell form, was taken to Melbourne by Mr. Birkett, and given by him to Mr. Rule, the then Curator of the Technological Museum.

16. *Thomas' Plains (Weldborough).*—Some are known from this locality, but I have no particulars of the individual occurrences.

17. *Norfolk Range.*—Several have been found in the stanniferous drift derived from this range. Mr. Geo. A. Waller obtained specimens which had been collected about 7 miles north of Pieman Heads.

18. *Schouten Main.*—Mr. Bingham found specimens in recent tin-wash at Schouten Main, 3 or 4 feet from the surface, in the flat ground below Gill's Mine.

19. *Tallywong Creek, near Weldborough.*—Mr. Rundle found one at the head of Tallywong Creek, on the table-land between Main Creek and the Weld River, in the tail-race, when working shallow stanniferous alluvial some 4 or 5 feet thick.

20. *Hunt P.A. Mine.*—Mr. Simmonds found a button in the sluice-box of this mine, on Derwent Creek, 2 miles south of George River, when he was manager of the property.

21. *Thureau's Deep Lead Mine.*—Mr. Baird found one at this mine, 3 miles east of the preceding. A 15-feet bed of wash was being treated, but it is not known whether the specimen came from the top or bottom of the deposit.

22. *Smith's Creek, Long Plain.*—The specimen found here is of a bolt-like form,* and was obtained in alluvial quartz-drift, 10 feet from the surface, when sluicing for gold in 1891.

Of course, the argument founded on the absence of specimens from the Tertiary drifts is a negative one. The evenness of size in the constituents of these leads indicates much rolling, and it may be urged that the brittle glass would succumb to the forces of attrition, and only ill-recognisable fragments of it survive. On the other hand, the discovery of well-preserved, unrolled, and sometimes remarkably shining and fresh-looking specimens in surface soil and shallow modern gravel is a strong indication of an age subsequent to that of the Tertiary sediments.

None of the discoveries in Western Australia, South Australia, New South Wales, or Queensland have been made in undoubted Tertiary deposits. The specimens have been found on the surface of the ground, in clay deposits, in travertine, in auriferous drift, in desert sand-hills, but so far no positive proof of their existence in Tertiary leads has been forthcoming. It would appear, as suggested to me by Mr. W. F. Petterd, that, whatever their source, they fell at one time in an extensive shower, which embraced within its range the whole of Australia and Tasmania.

* Figures 7, 8, 9 in Pro. Roy Soc. Tas. 1897, "On the occurrence of Obsidian Buttons in Tasmania," Petterd and Twelvetrees.

In order to procure a thoroughly authoritative and complete analysis of the glass composing these buttons, I applied to the Director of the Geological Survey of the United States (Mr. C. D. Walcott), who permitted the work to be carried out in the Survey laboratory. Two obsidianites, one from the Upper Weld, the other from the Pieman, were sent, and have been analysed by Dr. Hillebrand, the distinguished chemist of the Survey, whose results are as follow:—

	Upper Weld.	Pieman.
SiO_2	69·80	73·59
TiO_2	0·80	0·70
ZrO_2	?	0·01
Al_2O_3	15·02	12·35
Fe_2O_3	0·40	0·38
FeO	4·65	3·79
NiO	?	none
MnO	0·18	0·15
CaO	3·20	3·76
SrO	none	faint trace
BaO	?	faint trace
MgO	2·47	1·80
K_2O	2·56	1·93
Na_2O	1·29	1·03
Li_2O	good trace	strong trace
H_2O below 105°C.	not est.	0·27
H_2O above 105°C.	not est.	0·53
P_2O_5	none	none
S	?	none
	100·37	100·29
	Sp. gr. 2·454 at 18°C.	Sp. gr. 2·428 at 22°C.

Dr. Hillebrand, in a note kindly sent with this exhaustive analysis, remarks that analysis No. 1 is in so far incomplete as the water could not be determined for lack of material, and there is probably some error in the value given for one of the larger constituents, since the summation is in excess of 100, even without the water, which in all probability is present. He adds:—"The analyses revealed compositions which, while not absolutely unique in petrographic literature, are seemingly approached but once or twice. Very unusual is the molecular preponderance of potash over soda in a rock of this character, so high in lime. According to Dr. Cross' calculations, the Weld specimen corresponds with Almerose in the new classification of Cross, Iddings, Pirsson, and Washington, which is represented on page 219 of Wash-

ington's Chemical Analyses of Igneous Rocks, by an analysis of a cordierite-audesite of Osann's from Almeria, in Spain. (Z.d.D., Geol. Ges. XL., 701, 1888.) The Pieman specimen, in Washington's book, is unnamed, but falls in rang 4, sub-rang 2 (p. 143). The physical character of the glass is in nowise different from that of the usual igneous glasses. The buttons have been of considerable interest to those geologists to whom I showed them before analysis, but while not disputing the difficulty of accounting for them, not one will for a moment admit the possibility of a cosmic origin,* or rather, that such bodies could assume the shape shown. The latter seems to be decidedly artificial, in accord with one of the suggestions I see mentioned in the paper of Mr. Walcott's, which you were so good as to send me."

The analyses of the two rocks to which Dr. Hillebrand refers are as follow: —

	Cordierite-audesite. Almeria.	Segregation in Granite. Silesia.
SiO_2	63·75	68·87
Al_2O_3	17·62	16·42
Fe_2O_3	3·00	1·91
FeO	3·26	2·06
MgO	3·41	2·54
CaO	2·50	4·64
Na_2O	1·75	1·25
K_2O	2·40	1·10
H_2O+	2·77	1·12
	100·45	99·91

The relations of these analyses are perhaps best brought out by reducing the percentages to molecular ratios, as under: —

	Weld.	Pieman.	Audesite.	Granite segr.
SiO_2 ...	1·163	1·226	1·063	1·148
Al_2O_3 ...	0·147	0·121	0·172	0·161
Fe_2O_3 ...	0·002	0·003	0·019	0·012
FeO ...	0·065	0·052	0·045	0·029
MgO ...	0·061	0·045	0·085	0·064
CaO ...	0·057	0·067	0·045	0·083
Na_2O ...	0·020	0·016	0·030	0·020
K_2O ...	0·027	0·021	0·025	0·012

The mean of 18 reliable analyses of obsidian selected by Dr. Washington gives a SiO_2 percentage of 73·85

* Dr. F E. Suess in his treatise on Moldavites maintains a cosmic origin for these natural glasses, which he calls Tektites, dividing the Group into (1) Moldavites, (2) Billitonites, (3) Australites. Australites = obsidianites of Mr. R. H. Walcott, Melbourne.

(= mol. ratio 1·231). The obsidianites vary somewhat in their silica contents, from acid to neutral, but it is easy to see that they are not composed of a glass sufficiently basic to have been derived from our basaltic centres of eruption: and as volcanoes which have emitted acid or sub-acid glass are unknown in Tasmania, the origin of the obsidianites must be sought elsewhere. Dr. Hillebrand's remarks upon their shape being due to artificial causes show how difficult it is for geologists at a distance to appreciate the mode of occurrence. Discussion of the question of origin, however, does not fall within the scope of this paper, which aims merely to place on record facts relating to distribution and constitution.

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