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TASMANIA.

REPORT

OF THE

SECRETARY FOR MINES

FOR

1901-1902

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

WITH MAPS AND ILLUSTRATIONS.

Tasmania:
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ERRATUM.

In legend of map accompanying the Report on the Cannel Coal at Preolenna, facing page 88, *read* "Palaeogene" *for* "Palaeozoic."



BLYTHE RIVER IRON MINE.

REPORT OF THE SECRETARY FOR MINES.

Mines Department, Hobart,
18th September, 1902.

SIR,

I HAVE the honour to submit my Report upon the Mines Department, and the progress of the Mining Industry for the year ending the 30th June, 1902.

Appendices.

Appended will be found the following Reports and Papers:—

Annual Report of the Mount Cameron Water Race Board.
Mine Managers' Examination Papers.
Report of the Government Geologist.
Report of the Assistant Government Geologist.
Report of the Chief Inspector of Mines.
Reports of the Inspectors of Mines.
Reports of the Commissioners of Mines.
The Government Geologist's and Assistant Government Geologist's Reports on:—
Some Wolfram Sections near Pieman Heads.
The Coalfield of Llandaff; the Denison and Douglas Rivers; Deposits of Tin Ore on Schouten Main; and Outcrops of Quartz near Buckland.

The recent discovery of Cannel Coal in the Parish of Preolenna, and upon the New Victory Copper Mine, near Arthur River.

The Tin Mines of the Blue Tier, County of Dorset.

The Coal Seams at Thornedale, near Thompson's Marshes, and the Jubilee Colliery, near St. Marys.

The occurrence of Coal near Catamaran River, Recherche Bay.

The Tin Ore Deposits of North Dundas.

The Country on the East Shore of Lake Sorell, and on a Discovery of Coal near Oatlands.

The Ore Deposits (other than those of tin) on North Dundas.

The Coalfield in the Neighbourhood of Recherche Bay.

The Deposit of Opal at Bothwell, and an alleged Discovery of Gold at Hunterston, on the Shannon.

Gold and Coal at Port Cygnet.

Deep Sinking at the Moonlight-cum-Wonder Gold Mine, Beaconsfield.

Some Discoveries of Copper Ore in the vicinity of Point Hibbs.

The Microscopic Structure of some Tasmanian Rocks.—W. F. Petterd. Esq.

Evidence of Graptolites in Tasmania.—T. S. Hall, Esq., M.A.

The Magnet Tramway.—R. F. Waller, Esq., A.M.I.C.E.

The Hercules Company's Self-acting Tramway.—S. Thow, Esq.

Operations of the Mount Lyell Mining and Railway Company, Limited, for the year 1901-2.

General Remarks.

Tasmania, like most of the other States, has suffered from the prevailing depression in mining matters during the year under review.

With the exception of coal, there has been a decrease in the value of the minerals raised, as compared with the previous year, of £222,231. The quantity of silver-lead ore raised shows an increase of 13,372 tons; but, notwithstanding the substantial increase in the output, the value of the ore for the year is £63,198 less than the value of the output for the previous year, owing to the decline in the market price of silver and lead.

The average price of tin was £118 15*s*., being a decrease of £8 10*s*. 9*d*.

The number of sections applied for is only 76 less than the previous year, and the area 262 acres.

Gold.

Beaconsfield.—Between 600 and 700 men have been employed continuously in and about the mines of the field. Although the outside companies are still persevering in their exploratory work, the Tasmania Mine continues to be the mainstay of the district. At the latter mine the crushing plant of 65 heads of stampers has been extended by the addition of 40 heads, which increases the crushing capacity by 100 tons per day. The new battery has been running very satisfactorily. During the year the reef has been struck in the crosscut level at a depth of 1000 feet, and is authoritatively stated to consist of stone of the same value as the average of the mine. After cutting through 3 feet 3 inches of it, a horse of mullock was met with, which gave rise to a burst of water from which much trouble ensued. A gratifying feature is a general decrease of water in the mine. Developmental work is being pushed forward with a view of satisfying the requirements of the new battery. The general manager reports that he is convinced that no reason exists for believing otherwise than that the size and value of the main lode will continue to a great depth. Since the formation of the company 463,905 tons of quartz have been crushed, yielding 569,860 ozt. gold (inclusive of returns from chlorination), value £2,016,314 7*s*. 9*d*. The dividends distributed have amounted to £769,071 15*s*.

The main shaft at the Moonlight-cum-Wonder Mine has been sunk to 800 feet, at which depth crosscuts and levels have been driven. The formations which have been followed have, unfortunately, not yielded payable stone, neither have the long exploratory crosscuts intersected any reefs of value. The proprietors are now prospecting other portions of their property at shallow depths, with the aid of tributors.

The North Tasmania Company has been working its mine on tribute. The Tasmania United has made some discovery of quartz, and the Tasmania West Extended is endeavouring to arrange resumption of work. Quite lately the Bonanza Proprietary has started to sink a main shaft, with the intention of striking the Tasmania reef on its underlay. It is expected to cut stone belonging to the reef at a depth of between 500 and 600 feet, and to pass through the main body in the shaft at about 900 feet. The East Tasmania is waiting to hire the Government diamond-drill for putting down a line of holes to fix the position of the Tasmania reef on their property. The Ophir alluvial lead on the east side of the Cabbage Tree Hill is being explored in its deeper parts, but without any appreciable gold being discovered. At a depth of 323 feet fine colours were obtained from the drift, but sinking has proceeded to the bedrock 490 feet from the surface without result. A drive at 325 feet is now being worked.

The Blue Tier Gold Mines, though not belonging to Beaconsfield proper, are situate in the same district. The Duchess of York Prospecting Association has been formed to prospect ground at the south end of the Tier. The old tunnel-workings of the mine formerly called the Gladstone are being explored, and rich slugs of gold have been found in a soft gossanous formation. This discovery is inciting the owners to further search. The Salisbury Gold Mining Company has also started to work a neighbouring claim, which contains ground of a similar nature.

Lefroy.—Matters at Lefroy have remained stationary, principally owing to the New Pinafore Company having failed to meet with continuously payable stone in its deep levels. With admirable perseverance this company has continued its exploratory work at a depth of 1200 feet, and has driven considerable distances on three different makes of stone, but without discovering anything permanently remunerative. Attention has been paid to the Pinafore South lode, which is the main hanging-wall of the formation, and a little payable quartz was met with for a time in both ends; but this cut out on being followed upwards. The drive on this lode has been extended west for 500 feet, and in places the reef was 20 feet wide, now and then carrying a pennyweight or two of gold. Two winzes were then sunk, and the west winze is now carrying 3 feet of quartz with coarse gold in the centre of the stone. The intermediate lode is also now being driven upon, and as it shows traces of gold, a slightly more hopeful view is taken of it. In this deep work the company has availed itself of the Government subsidy provided by statute. Some prospecting has also been done on the Native Youth section, with a view of picking up parallel reefs, but without success. In addition, the company has arranged to take over the Golden Point and Crown section, where a good lode was sunk upon to 400 feet.

The fact that gold is seen in the New Pinafore stone at a depth of 1200 feet encourages a belief that it exists also at a still greater depth. The possibility of its improvement, and the benefit which its discovery would prove to the field and district, are powerful and reasonable incentives to deeper work.

The work done during the year on other claims at Lefroy has been comparatively unimportant. They have, however, absorbed half the aggregate labour of the field.

Lisle.—Alluvial digging has continued upon the usual moderate scale. The Lisle Dredging Company has worked intermittently on large alluvial deposits with encouraging

results, but its work was seriously interrupted by want of water in the dry season. Operations, however, are now being resumed.

At *Golconda* and the *Denison* a little more activity has prevailed lately, and it is hoped that the prospecting work which is now going on may prove remunerative.

Mathinna.—The New Golden Gate Mine is as healthy as ever. The main shaft, the deepest in the State, is now down to a depth of 1630 feet, being 230 feet below the deepest workings. Opening sets have been placed at 1500 and 1600 feet, at which levels about 130 feet of driving will intersect the western lode, which at 1400 feet has been driven upon for 500 feet, returning an average assay value of 17 dwts. gold per ton. The slate rocks at the greatest depth attained do not differ in aspect from those which enclose the reef at 1400 feet, and all indications are favourable for the future of the mine. For the year just closed 19,405 tons of quartz were crushed, from which 14,642 ozs. of gold were obtained, valued at £53,848. The total quantity of quartz now obtained from the mine is 202,261 tons, which has yielded 188,739 ozs. of gold, valued at £697,502. The total amount paid in dividends is £320,000, or £10 per share, and the amount paid to the Government for dividend-tax is £14,878 10*s.*

A good deal of work has been done at Mathinna during the past year. The shaft at the Volunteer Mine is sunk to a depth of 110 feet. Main and intermediate levels have been extended, rises put up, and stoping started, proving a large body of auriferous stone. A first crushing of 500 tons has resulted in 144 ozs. gold, equal to 5 dwts. 18 grs. per ton. As the company claims that 3 dwts. per ton cover all mining and administration charges, the profit should be very satisfactory.

The New Golden King main shaft is down 100 feet. Levels have been extended north and south, and 166 tons of stone have been crushed for 442 ozs. of gold. The com-

pany contemplates further sinking, and the erection of a battery.

The East Volunteer has suspended work at the 400-feet level for want of funds, when the objective was nearly reached. Tributors have since sunk upon a new vein, and taken out a trial crushing, which is now going through the battery.

The Havelock (late Hickson's) has kept work going underground from the gold won, but the mine is hardly opened up sufficiently to be self-supporting on low-grade stone. It is now on tribute.

On ground south of the New City of Melbourne tributors have just crushed 15 tons of quartz for 31½ ozs. of gold. Prospecting is going on at the Revenue, Lady Havelock, Golden Stairs, Malahide, Golden Prince, and other claims, with more or less success.

The English-owned mines are still idle. It is understood on good authority that a well-known mining engineer is now on his way from London to report *re* the introduction of capital to develop the properties of the Tasmanian Exploration Company and the Tasmanian New Golden Gate Company, Limited. Among these properties are the Old City of Hobart and the North Gate Mines.

Mangana and Fingal.—Results in this district have not been so good as at one time they promised to b. The Golden Entrance has more than paid its way, and given a high return of gold per ton. The yield has fallen off somewhat since, and more prospecting work is desirable. At the Fingal reefs the big reef has proved patchy in gold contents, and the small lode not wide enough to be profitable, though rich in gold. Further prospecting is arranged for.

The shaft at the Mangana Gold Reefs has been sunk to 634 feet, but driving at the 619-feet level has brought no result, and the mine is now practically in the hands of tributors, several of whom are making wages.

Mount Victoria.—Work at the Ringarooma Company's mine is still suspended, owing to the tight state of the financial market. The necessary capital for working this property on a proper scale has not yet been obtained, but there are now indications which point to the likelihood of outside attention being attracted. The tribute let by the company on its New Mercury section has proved satisfactory to the tributors. A small syndicate has been doing very well at the Long Struggle claim, near Alberton. At the New River the Central Ringarooma Mine has been worked on tribute.

The whole field is languishing for want of sufficient capital wherewith to carry on serious developmental work. Such work is warranted by the past yield of the district.

West Coast.—The Whyte River Dredging Company has had its dredge at work throughout the year, with numerous interruptions by floods, droughts, logs, &c. While winning small quantities of gold, the general results have been disappointing. The Queen River dredge, after a long interval, has made another start recently. The King River tributors have worked perseveringly, sluicing their auriferous formation, but no results of importance have been obtained yet. At Mount Ramsay a syndicate is engaged in lode-mining for gold and bismuth.

Silver.

West Coast.—Despite a falling metal market, the silver-lead mines of the Zeehan district have, with the exception of the Western and the South King tribute, held their own. The Mount Zeehan (Tasmania) and Zeehan-Montana Mines are the principal producers. Owing to the low prices ruling for silver and lead, the Western Mine has been compelled to close down for a time, as under present conditions it cannot be worked profitably. Several of the Zeehan mines are, during this interval of adverse markets, being worked on tribute, and with advantage to the tributors.



Arba Tin Mine, Branxholm.

The company is still making calls of 3*d.* per share every other month, to pay off its debt to its bankers. The amount thereof has been considerably reduced without parting with any of the equipment of the mine, which is being kept in good order.

There has been an inquiry from London for the property, and the company has asked terms for selling outright, which will give a good return to shareholders, or for re-flotation, which will give a small cash return, a fourth interest, and a large working capital. There seems some hope that something will come of this.

The Mount Zeehan (Tasmania) Silver-Lead Mines, Limited, has purchased from the Silver Queen Prospecting Association, No Liability, the whole of its property at Zeehan.

A new company has been formed in London to take over and work this property. The name of the new company will be "The Zeehan Queen, Limited." The company will consist of 50,000 shares, of £1 each; 25,000 shares are set aside as working capital, of which, as a first issue, 17,000 shares have been taken up.

The directors will proceed, without loss of time, to formulate a scheme of mining operations which, when ready, will be vigorously pursued.

The tributors have been allowed to continue operations for six months upon the same terms as previously granted.

Zeehan-Montana Mine, Limited.—During the twelve months ending 30th June, 1902, the following work has been carried out on the mine:—

	Feet.
Main drives	2433
Crosscuts	384
Rises	602
Winzes	59
Main shaft	12

The station has been cut at the 500-feet or No. 5 level, and also a chamber for a balance-bob at the same level; 22,174 tons of lode-stuff have been raised, out of which 1850 tons of first-class ore have been hand-picked, and 20,324 tons put through the concentrating-mill, producing 2215 tons of concentrates; the total marketable ore produced for the twelve months being 4020 tons; the net value of this, after deducting freight to Europe and smelting charges, is £48,395 15*s.* 11*d.* The average assay value of the second-class ore entering the concentrating-mill for the twelve months is 7·5 per cent. lead and 12·2 ozs. silver per ton.

The following is copied from the company's annual report for the year ending 31st December, 1901:—

"The amount of exploratory and developmental work carried out during the past year has been greater than in any previous year, and the result, although not so remunerative as anticipated, may be considered satisfactory; for, although the principal ore-shoots operated upon in the upper levels have to some extent become shorter, and getting farther away as we attain depth, yet this is compensated for by the discovery of other shoots of ore which have made directly under what in the upper levels proved to be barren lodes. This is certainly a very encouraging feature, and worthy of particular notice. The following is a list of development work and stoping, with cost per ton and lineal feet:—

	Lineal feet.
Main drives on lodes	2294
Crosscuts	412
Winzes	89
Rises	612
Main shaft	99
Total development	3506

"A very considerable sum of money has been spent in additions to plant and erection thereof, among the most

expensive being the purchase and erection of a new boiler, the purchase and erection of a surface-condenser, the building of new ore-bins and smith's cottage, building new boiler-shed, and the laying of 1½ mile of 4-inch pipe for the supply of pure water for boiler-feed. These have run into a lot of money, but all are necessary expenditures, and I think the benefit will be felt in further reducing the cost of mining, and add years to the life of our plant. As shown above, the cost of the mine has been considerably increased by these extra expenditures, and, as all this is taken into the cost of production, it is evident that the actual cost of mining is being considerably reduced, although mining operations necessarily become more expensive as greater depth is attained. A further reduction will probably be shown for the coming year, as a result of the heavy expenditure in the past.

"The total mine developments, as shown by the main workings throughout the mine, are as follow:—

	Lineal feet.
Main shaft	541½
Winzes	1496
Rises	3156
Crosscuts	4401½
Main drives	15,977
Stopes	79,769
Total	105,341

"The total production from the mine since the commencement is 100,941 tons of lode-stuff, producing 12,693 tons 11 cwts. 3 qrs. of hand-picked ore, and 9261 tons 11 cwts. of concentrates, or a total of 22,155 tons 2 cwts. 3 qrs. of marketable ore, at a cost of (including the cost of the complete plant) £199,660 5*s.* 1*d.*, or an average cost of £9 0*s.* 3*d.* per ton of marketable ore."

Mining operations are being carried on simultaneously at five levels. At the present time the lodes at No. 5 level are very much disturbed by numerous faults, and up to the time of writing we have not been able to meet with settled country. A new shoot of ore has been met with at No. 5 level, and, although the vein is only small and patchy, it is very interesting to know that the ore continues to maintain its usual high assay value both of silver and lead.

I am indebted to Mr. T. Vincent, manager of the Mount Zeehan (Tasmania) Silver-Lead Mines, Limited, for the following report on the company's Spray and No. 2 Mines:—

"By way of introduction, I may say the Spray lode was discovered in February, 1898, by Mr. J. McDermott, to whom I let a tribute on easy terms. He and his partner began work by driving a tunnel to cut the lode some 30 feet below where he first discovered galena; when some 40 feet were driven, the lode was intersected, carrying a little ore, but not payable at this point.

"The hill having a steep rise southerly, and the outcrop rising in the same direction, they naturally started their drive south from their tunnel, and continued the drive for about 130 feet, meeting with a little ore, but not nearly payable.

"At this juncture, the tributors being short of funds, I gave them employment on wages, to enable them to recover themselves.

"On making a careful examination of the lode and the enclosed rocks, and discovering the western wall was composed of quartzite, and the hanging or eastern wall of slate, I decided to go down the ravine and put in a low-level tunnel, so as to intersect the lode about 150 feet below the tributors' drive. Started cutting approach in September, 1898, and when 520 feet had been driven, the lode was intersected August, 1899. Where cut the lode was 3 feet wide, composed of rubbly quartzite, slugs of galena, and, next the western wall, a seam of pug up to 15 inches wide. Assays of the pug and slugs of galena gave the following results:—

Pug, 16 per cent. lead and 33 ozs. silver; galena, 64 per cent. of lead and 154 ozs. silver.

"The northern side appearing to be the best, I started driving in that direction, and when 6 feet had been driven, the face showed up to 9 inches of ore, assaying 78 per cent. lead, and 172 ozs. silver—a very rich ore. In the next 2 feet the rich ore gave place to a composition 4 inches wide, assaying 25 per cent. lead and 250 ozs. silver; and so it continued to change daily, assays varying from 25 per cent. lead to 80 per cent. lead, and from 104 to 200 ozs. silver, until 30 feet had been driven, at which point the ore cut out altogether. The drive was continued in all 56 feet without meeting anything payable, and work was suspended.

"With a view to provide ventilation, a rise was started 10 feet north of the tunnel, where we had rich ore, and for 30 feet we had up to 9 inches of galena; but, singular to say, on assay it gave 61 per cent. lead and 49 ozs. silver, thus showing how uncertain the value is in our galena lodes.

"The rise was continued through to the tributors' workings (without meeting with ore of any kind), and good ventilation established, and a start made to drive south. The formation for a length of 47 feet proved unproductive. At the 47-feet point ore began to make, and widened out to 18 inches; an assay made gave 53 per cent. lead and 140 ozs. silver, thus showing at the level the ore maintained its rich character. For a length of 32 feet the lode was highly payable, the 32 feet producing 28 tons, assaying in bulk 55 per cent. lead and 155 ozs. silver, worth, at the then price of silver and lead, £22 per ton. From this point for 300 feet no ore was met with in sufficient quantity to save. In places along the sole of the level we had rich ore from 2 to 4 inches wide for a length of 130 feet, and, as the rich ore referred to above did not continue upward, as was proved by stoping, I decided to put a winze down if possible south of the rich bunch. This work was started in June, 1900, and continued until 55 feet had been sunk. The lode at the start was 4 inches wide, which gradually increased until

it reached 8 feet. The whole of the lode-matter raised in sinking, totalling 206 tons (value £4583), was shipped, thus giving conclusive evidence we had sunk through a rich body of ore; in fact, this was the making of the Spray Mine.

"In the tunnel-level north a chamber was cut of sufficient size for a main shaft 10 feet by 4 feet, and for the erection of a pair of engines, which were installed in due course, and the shaft sunk and a connection made with the winze-level, the drives being driven both north and south a total of 511 feet; winzes were sunk from the tunnel-level, and connections made, giving good ventilation, and providing passes for passing down mullock for filling-in the stoped-out ground.

"For the purpose of getting down for No. 2 level, No. 4 winze was started 30 feet south of shaft, space being provided for steam-pump, ladder, and winding-ways. This winze was sunk 90 feet below No. 1 level, and levels put out at 83 feet; the latter to date have been extended 547 feet, the faces being both poor.

"The main shaft has been brought down to No. 2 level, two of Allen's patent cages installed, and a powerful Cameron steam-pump erected.

"With a view of getting down to No. 3 level, I have resumed sinking the No. 4 winze, which, to date, is down about 35 feet; lode 6 feet wide, half being galena, the balance being good concentrating material. The prospects for deep-mining are very encouraging, the deepest points showing a mass of ore.

"For the purpose of prospecting the ground to the west, the main tunnel at time of writing is in 820 feet, being 300 feet west of the Spray lode—what we term No. 1. At a point 200 feet west of No. 1, we struck a small stringer giving very good assays, but on driving on it a short distance it cut out. It is my intention to drive another 200 feet at least, and possibly I may go further than this.

"Since starting here (four years ago) we have driven 850 feet of crosscuts, about 1700 feet of main drives, 132 feet of

main shaft, sunk 360 feet of winzes, and put up over 300 feet of rises, for the following output:—

	Firsts.		*Seconds.*	*Equals.*		*Value.*		
	Tons.	Cwts.	Tons.	Tons.	Cwts.	£	*s.*	*d*
1899...	43	0	100	43	0	815	16	5
1900...	742	9	100	757	9	13,670	13	0
1901...	2108	10	5878	3016	0	43,667	14	10
1902 (July) ...	1123	10	3025	1668	12	17,855	2	6
				5485	1	76,009	6	9
Tributors have raised	—		—	1578	0	17,575	0	0
Total	4017	9	9003	7063	1	93,584	6	9

"The mine is equipped with good boiler-power, ore-sheds, &c., to enable large quantities of first and second class ore to be handled cheaply, the latter being connected with the Town Tramway Company's system by a well-constructed 2-feet gauge tramway, thus providing ingress and egress in a satisfactory manner.

"*No. 2 Mine.*—Work was first started here in 1891 by the company sinking a shaft 10 feet by 4 feet 6 inches to a depth of 65 feet, but no driving was done at that time.

"In May, 1897, I decided to prospect this part of the company's property, and from that date to the present work has been carried on continuously. Over one mile of drives, including crosscuts, have been put in, with varied success, the best prospects being obtained within the last nine months. On three lodes we have very fair shoots of ore, gone down in the sole of the 65-feet level.

"For the purposes of testing these shoots at a greater depth, we have installed a powerful compound Galloway boiler, and a large Cameron steam-pump; these have been in operation about four months, and are giving every satisfaction.

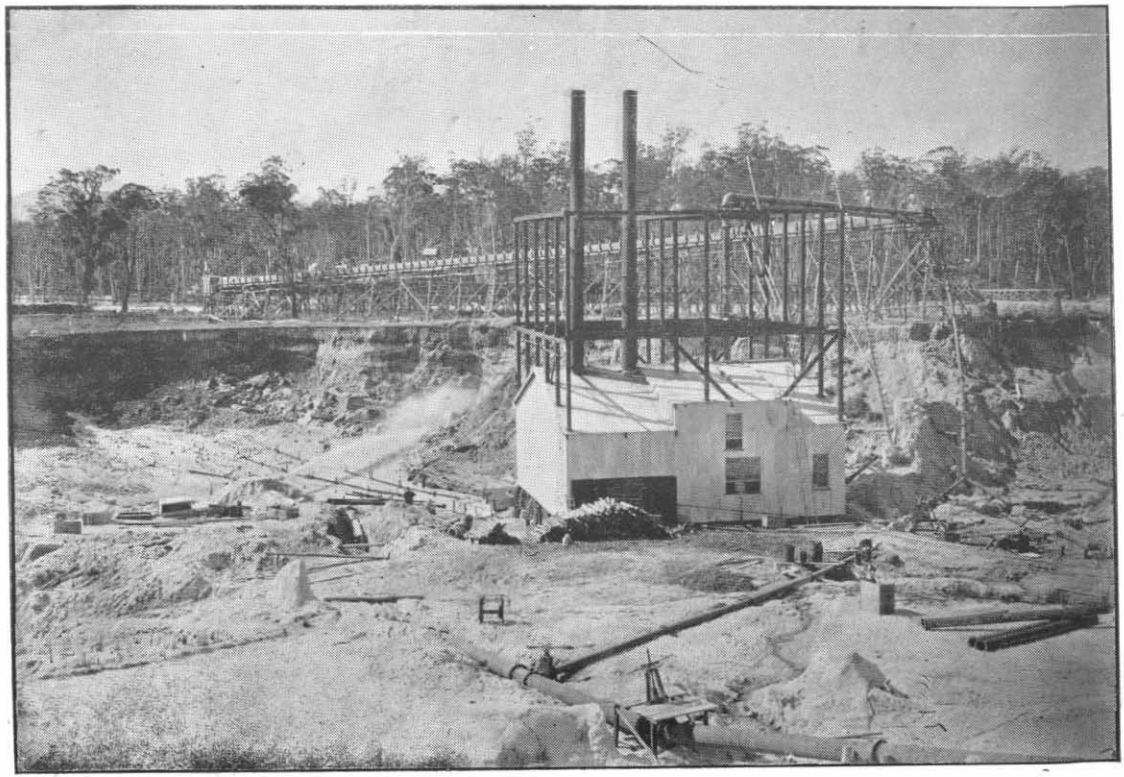
"The shaft has been enlarged to 13 feet by 4 feet 6 inches, and is now being sunk for No. 2 level, which we purpose making 100 feet below No. 1. At the time of writing the shaft is down 70 feet, leaving another 30 feet to sink; the ground is favourable, and fair progress is being made. I am of opinion, when the No. 2 level is opened up, we shall meet with large bodies of payable ore. The hand-picked ore from here assays on an average 75 per cent. lead and 100 ozs. silver per ton—a rich ore.

"With the prospects of the two mines, I venture to say there is no call for the pessimism that is shown towards the Zeehan Silver-Lead Mines, and further, if a proper system of developmental work had been carried out on the surrounding mines, several of them would be working to-day."

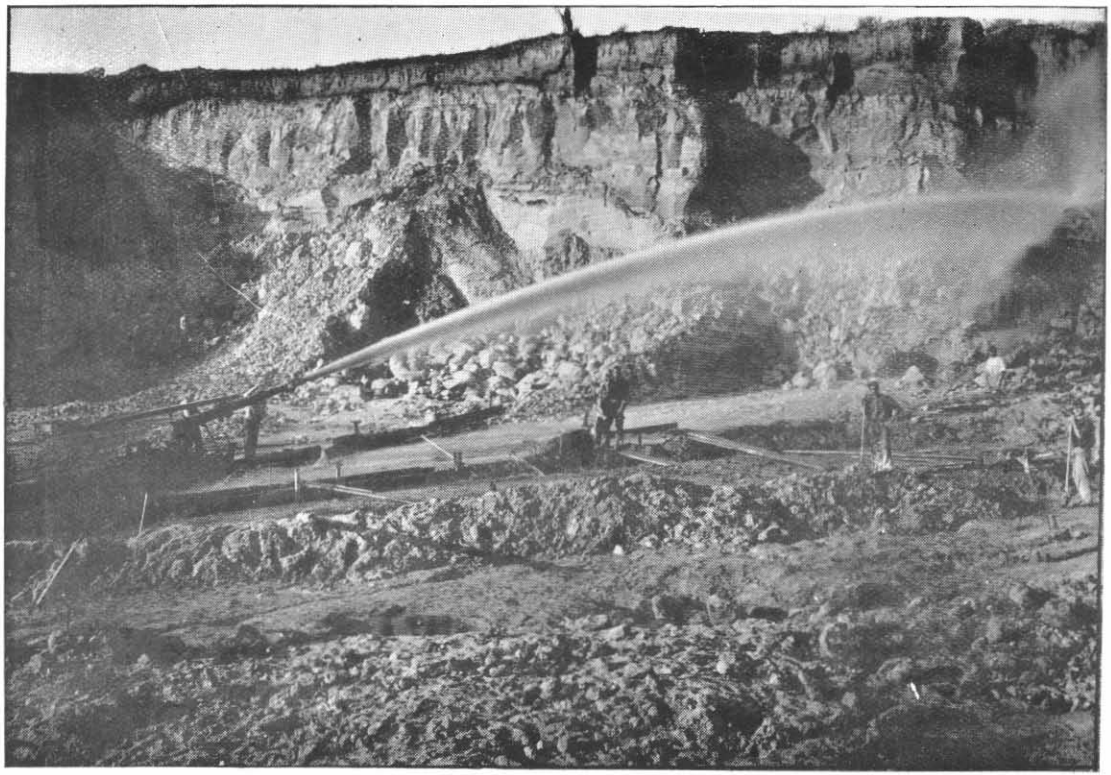
The South Comstock is now British-owned, and the work done there has confirmed the opinion which was entertained of the value of the mine. Preliminary work has been carried out on other parts of that field, in view of the construction of the Government tramway; but the state of the metal and financial markets has impeded the introduction of capital so far.

At Dundas the Comet Mine has opened up very well during the year, good bodies of ore being disclosed.

At Mount Reid the Hercules Company is fulfilling two contracts for the supply of ore; one for 10,000 tons of gossan to the Smelting Company of Australia, the other for 10,000 tons of sulphide ore to the Tasmanian Smelting Company, Zeehan. It sends to Dapto 125 tons weekly, and supplies the Smelting Works at Zeehan with 500 tons monthly. Both contracts leave a good margin of profit. The company has surmounted pecuniary difficulties, and equipped its mine with many necessary appliances, including a new ropeway. The installation of the latter cost £1200—all paid for out of the proceeds of sales of ore. The deeper levels of the mine are now being explored, and it is more than likely that another tunnel will be put in 200 feet lower than any existing level. To date 12,000 tons of gossan have been sold, and recent discoveries seem to show



PIONEER TIN MINE, NO. 1 PLANT, FLUMING.



PIONEER TIN MINE, NOZZLE UNDER 240 FEET HEAD.

that there is still quite as much in sight as ever there was. The general manager reports that the latest discovery of gossan is 33 feet wide—all marketable ore. The deeper workings indicate that copper is likely to replace the zinc-lead sulphides, and are being prosecuted in order to prove whether or not there is sufficient copper ore to warrant the erection of a smelting plant. The company has during the year acquired the East Hercules Mine, mainly on account of the No. 2 level in the Hercules, which will prove the East at a depth of 300 to 400 feet.

At the Magnet Mine, near Waratah, everything is now in good working order. A tramway ten miles in length, connecting the mine with the Emu Bay Company's Railway, has been constructed, at a cost of over £19,000. A large ore-crushing and revolving drying plant has been erected, and extensive and regular shipments of ore are now being made. The export amounts to over 200 tons weekly, and it is intended to increase it at an early date to 1000 tons per month. The ore is sold under contract to the Smelting Company of Australia and the Tasmanian Smelting Company, and is mainly used as a flux; but it returns a substantial profit to the owners of the mine. The lower levels are being simultaneously explored, and the continuation of the lode has been forced south for a considerable distance. The number of hands employed is between 80 and 90, and quite a township is springing up at the mine terminus of the tram. The board is considering the advisability of the erection of a leaching plant for the treatment of large bodies of silver ore which will not pay to export, but could be made of service by a lixiviation process.

More work is now proceeding at the mines at the Heazlewood and Whyte River. At the Mount Stewart a Waratah syndicate is breaking out silver-lead ore worth about 125 ozs. per ton. As it has to be packed six miles, and then carted to Waratah (14 miles), it leaves but a small margin of profit. The owners talk of constructing a horse-tram to connect with the main road. The winter interferes with work, but

it is considered that there is sufficient inducement for the expenditure of a good deal of money.

A good many tons of argentiferous sandstone have been won and sold from Bell's Reward Mine, at the Heazlewood, and work is still in progress. A long tunnel has been put in to cut a large gossan outcrop supposed to be Godkin's lode.

A Victorian syndicate has been working at the old Godkin Mine with some reasonable chance of success. At the Confidence, or Washington Hay Mine, tributors have been winning high-grade silver-lead ore in small quantities.

On the Mount Farrell field the North Farrell Mine has been steadily producing ore, and has now a large quantity sampled, bagged, and ready for export. The second-class ore is also accumulating for mill-treatment. As the proposed Government tramway did not receive legislative sanction, the company has commenced the construction of a horse-tram from Boko Creek, and this is expected to be finished about October.

The Mount Farrell Company, after spending a few thousand pounds on the southern part of its mine, is now confining its energies to a deep crosscut near the north boundary, in order to intersect the lode, which is yielding the ore at North Farrell. This crosscut has to be driven 600 feet, of which 100 feet are already accomplished.

The mines on the other parts of this promising field are still undeveloped, and have no prospects unless communication with the railway is established.

Copper.

The Mount Lyell Company has continued to work its large pyritic deposit with its usual success. Besides stoping out and breaking down ore, the company has carried on sinking and the contouring of the ore-body, with the view of defining its limits. Notwithstanding deliveries having ceased from the Lyell Tharsis and Lyell Blocks Companies, the daily supply of 1000 tons of ore to the furnaces has been

kept up. The company has acquired additional properties; these now comprise the South Tharsis, Royal Tharsis, King Lyell, Glen Lyell, and Block 4691 Mount Lyell Reserve Leases. The prospects of the mine remain unchanged, but the shareholders have felt the fall in the price of copper.

At the reduction works 296,056 tons of pyritic ore, 28,047 tons of metal-bearing fluxes, and 58,509 tons of purchased ores have been treated, and produced 9716 tons of blister copper, containing—

	£	*s.*	*d.*
9608 tons of copper, valued at ...	£594,660	0	0
21,462 ozs. of gold (fine), valued at...	91,171	0	0
678,654 ozs. of silver, valued at	79,753	2	2
Total	£765,584	2	2

The amount paid in dividends and bonuses was £144,375.

The development of the North Mount Lyell Company's important property has received a temporary check during the past year, through delays in the construction of furnaces and concentrating plant suitable for the ores which have to be treated. It is hoped that this unfortunate period will now be terminated by actual demonstration of what the reduction plant can do in the course of regular work.

The managing director has supplied the following:—

Particulars Relative to the Mine.—"The North Mount Lyell Copper Company's Mine is situated on the eastern slope of the "saddle," or high ridge connecting Mount Lyell with Mount Owen, and near the southern flank of Mount Lyell proper. The property within the mineral zone consists of three leases of ten acres each, although a much greater area is held under lease. These outside blocks are mostly for protection of trams, and outlets for the ore, as well as for prospective sites for future treatment operations. Within the area comprised by the three sections above stated, all the mining operations are being carried on; these consist of tunnels, where numerous explora-

tory works have been made, defining the extent of the ore-bodies, and stoping commenced, together with open-cuts, and quarries, where the ore is being extracted from the surface. The locality of the payable ores, as far as is known, extends in a north and south direction for 20 chains, and east and west direction for eight chains. Within this limit the ore-bodies may be classified into three occurrences, or varieties, viz.:—Quartzite, containing the ores "bornite" and "chalcocite"; talcose schist, containing "bornite" and "chalcocite"; and a mass of quartzite and schist, containing "chalcopyrite" and much "pyrites," large portions of this deposit being wholly pyritic. The whole of these metalliferous occurrences are bedded along, and contact with a series of conglomerate, quartzite, and sandstones, containing much iron oxide, and known as "contact-rocks."

"The ore deposits of the mine consist of the main ore-body, a mass of quartzite laying against the contact-rock, which had an outcrop on the surface, and has been surrounded by three different levels, viz.:—Open-cut, No. 1 tunnel, and No. 2 tunnel (330-feet level). Several connections between these levels have been made, and a fairly accurate determination of the contacts and value arrived at. The schistose ores also occur abutting the contact-rocks, and include four "chutes" of copper-impregnated schist, known as "contact-schists," varying from 50 to 60 feet in length, with an average width of 20 feet; these masses are regular as to size, and persistent down to the lowest level yet attained (330 feet). The third ore occurrence, known as the "eastern ore-body," is the least known of the lot, although the first opened, as its position is, in most parts of the east side of the contact-rocks, in a much disturbed area, the rocks containing ore-body being greatly crushed, and in places reduced to "pug" copper through the action of percolating water and decomposition of the iron pyrites. At the same time, the whole mass may be somewhat out of position, as the portion of the country is not quite conformable with the regular contact, but, as it appears, there is a well-defined mass of quartzite and schist of pyritic nature covering an area on the

surface of 150 feet by 50 feet, having a value from 2 per cent. to 8 per cent. of copper. This ore-body has been opened up for 100 feet in length by open-cut to a depth of 35 feet towards its western side, while its eastern side has been determined by a winze from No. 1 tunnel to 100 feet, or practically the 330-feet level of the mine. These workings show the ore to be bornite, very rich in places, being masses of quartzite in softened schist. The neighbour mine, the Mount Lyell Blocks Company, has done a good deal in proving the existence of a large quantity of payable ore hereabouts, having worked its stopes up to our boundary.

"The main features of the North Mount Lyell mining operations may be briefly summarised as follows:—

"*No. 1 Tunnel Workings.*—At this level the main ore-body was cut after driving 829 feet, stopes then opened up by the whole mass being undercut from the foot to hanging-wall, and securely timbered, the area thus opened giving 190 by 60 feet. As stoping proceeds the back is supported by timber "stacks," or "pig-styes," and rock from the surface carried down to entirely fill the stope. This surface-rock is the waste from the open-cut where ore is being mined. A lot of driving north and south along the contact has proved the continuity from the surface down to this level of three of the schistose ore-bodies before-mentioned. Stopes have been opened, and ore-extraction is being carried on. In the aggregate over 2000 feet of driving, 170 feet of sinking, and 180 feet of rises have been made.

"*No. 2 Tunnel* (330-*feet level*).—At 860 feet in from the opening downward, continuity of the mine ore-body was cut, surrounding-drives and crosscuts show the area to be 150 by 110 feet. Stoping is being done on this mass, and the value found to be much the same as at the level above. Connection to the No. 1 tunnel stopes is being made by two rises (110 feet vertical) in the ore-body, showing good ore to exist throughout the section. Contact-drives corresponding with those at No. 1 level are being pushed along to meet the continuation of the schist ore-bodies. Up to the present

one only has been cut, and stoping begun. Further driving will have to be made before the other known ore-bodies are met. At this level the main tunnel is proceeded on, and connected with the Crown Lyell Company's shaft, giving complete ventilation throughout the workings.

"A winze is being sunk at a point outside the ore-body, and is now down 50 feet. This sink is contemplated to work the main ore-mass at 100 feet below the present deepest level. The ore-body will very likely be cut at between 60 and 80 feet. According to the position of the ore-body at the winze level, so will be determined the exact location for a main shaft, to be suitably equipped to meet all emergencies, as regards water, &c., to work to deep levels. Above the No. 1 tunnel level many headings and intermediate drives and connections have been made, which are used in conjunction with the open-cut excavations in breaking and handling the ore.

"The estimated quantity of ore above 6 per cent. grade, including the main ore-body and contact schists, is 290,000 tons. Within this mass is contained areas of exceptionally high grade ore, occurring from the surface to the 330-feet level. In addition to the quantity as above, there are large masses of low-grade quartzite and schist, about 3 per cent., of which no estimate can yet be made.

"The eastern ore-body is, in itself, a large deposit; but as it is subject to such rapid changes of shape and size, through the disturbed nature of the country, no estimate of quantity has been made.

"Over 120,000 tons of ore, of an average value of 9 per cent., has been broken from the mine and sold, while lower-grade material has been dumped. The present output of the mine is 130 tons daily, but this can be increased to 400 or more tons, as soon as the increased quantity is required. The mine is in connection with the railway by 2-feet gauge steam tram and aërial ropeway, also with the Mount Lyell Company's haulage-line by 2-feet tramway. An air-compressor plant is in continuous work, supplying air to the

rock-drills used in stoping the main ore-body at Nos. 1 and 2 tunnel levels."

At the Mount Lyell Blocks a wide band of clayey matter, carrying native copper, has been discovered at a depth of 450 feet, and is now being raised and concentrated by means of a puddling plant. The Lyell Comstock is preparing to put out ore.

Irregular prospecting work has proceeded on six or seven other properties on the Lyell field. The remaining claims have been compelled by the low price of copper to suspend operations for a time. The present market rate (£53) is considerably below the average of 1901, which was £67 19*s*. 3*d*. per ton, and that again was lower than in 1900, which was £72 16*s*. 6*d*.; but it is still higher than the averages of the previous three years.

This has also undoubtedly been a factor in retarding the development of the Jukes-Darwin field. This field is potentially important, and, with the influx of capital and more favourable market prices, is sure to attract attention before long. Copper ore is widely disseminated in the country-rock, and thorough prospecting may be expected to locate zones in which the mineral has been concentrated into workable deposits. The King Jukes Company is continuing operations on Mount Jukes; the other companies have ceased for a time.

A little work has been done near Point Hibbs. The country there appears to merit prospecting.

Rosebery.—The zincy copper ore deposits remain unworked, the problem of profitable extraction not yet being solved. Experimental work has been continued on the Tasmania Copper Company's ores, and now and again the trials have seemed to foreshadow ultimate success. The manager has recently been to Melbourne to consult Messrs. Gibbs, Bright, and Co., the agents for the Sulphide Corporation, *re* the shipment of ores to the Cockle Creek Works.

The results as to costs and recoveries at Cockle Creek are not sufficiently established to warrant a statement, nor

are conditions sufficiently normal to justify the Sulphide Corporation purchasing zinc ores, or offering a working test on the Rosebery ore, so that the company is compelled to wait several months pending the results of further experiments at the Cockle Creek Works.

So far as indications go, the company is quite hopeful that the process will, when it is in thorough working order, show a margin of profit on the ore, but, in the meantime, everything that is possible is being done towards the solution of this most difficult problem, and the early resumption of work on the mine.

Barn Bluff.—The pyritic copper deposit is being steadily prospected, but a good deal of work is required to fully establish its economic value. The reports are hopeful.

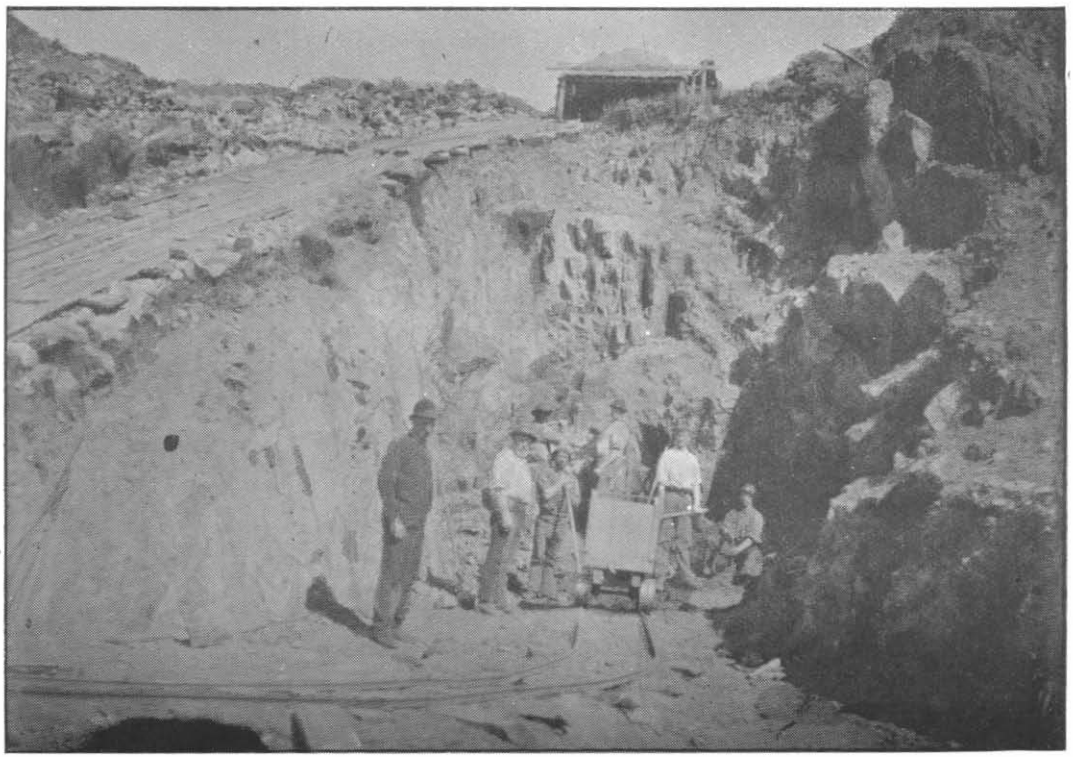
Tin.

At the Mount Bischoff Mine the batteries have run as usual, producing 1291 tons of tin ore. The amount distributed in dividends in the past year was £60,000. Since the formation of the company, the output of ore has totalled 60,310 tons, and the dividends £1,831,500 or £152 12*s.* 6*d.* per share.

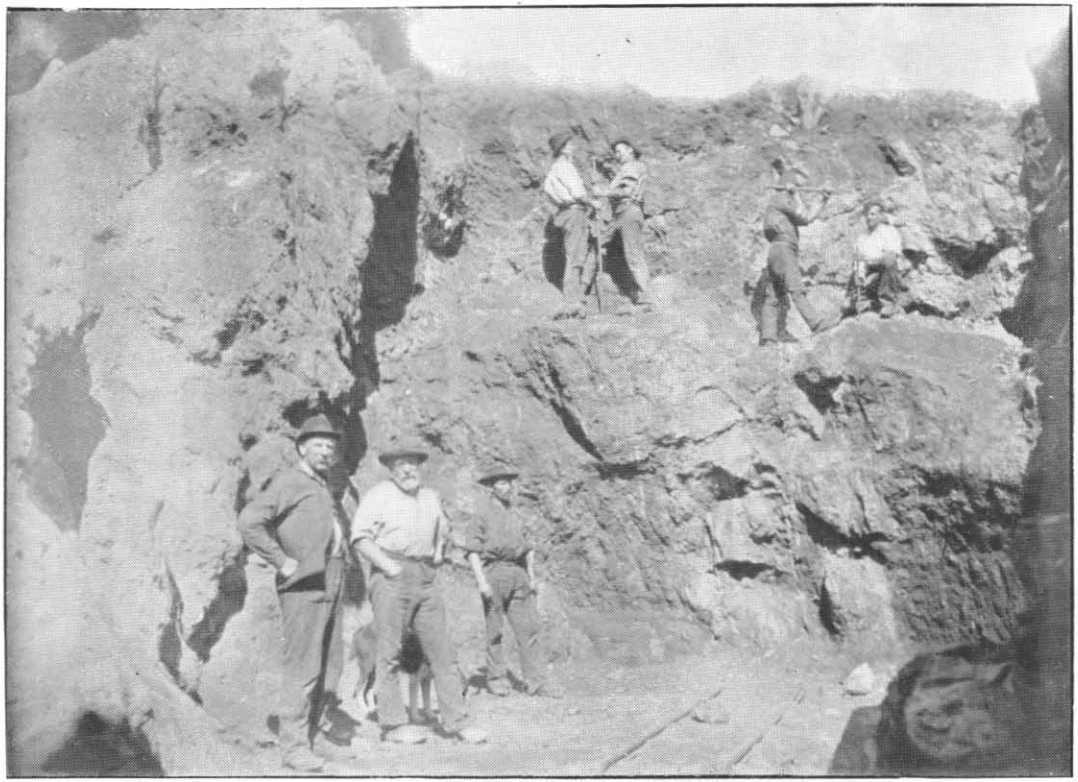
The East Coast production varies largely with the rainfall, and, to a lesser extent, though uniformly in the direction of a decrease, according to the rate at which alluvial deposits (which cannot last for ever) are worked out.

The mines on the Blue Tier have been worked, most of them intermittently—the Anchor Mine rarely having its full complement of 100 heads of stamps at work. Its new water-race from the North George River, a distance of 27½ miles, has just been completed, at a cost of £13,078. The quantity of stone crushed during the year was 48,174 tons, yielding 166 tons 15 cwts. of tin ore. The average number of men employed was 120, and the amount spent in wages, stores, and other expenses was £13,894.

The Australian Mine has been crushing stone of fair quality. On the Blue Tier there is unquestionably a large



Federation Tin Mine, Heemskirk.



Federation Tin Mine, Heemskirk.

area of tin-bearing rock, considerable portions of which would pay to work if dealt with on a large scale. There is, however, a totally inadequate supply of water for power purposes, and until some scheme of reasonably cheap power (hydraulic or electric) is applied large quantities of stone must remain unworked.

At the Stony Ford a battery plant is being provided for the mine which has been opened there during the year. Several companies have been raising tin from the alluvial ground near St. Helens. The Anchor Company's Smelting Works at George's Bay failed to secure sufficiently regular deliveries of ore, and had to stop work.

At Derby the Briseis Mine is being opened out vigorously, and is looking well.

The new water scheme (the Briseis-Ringarooma-Maurice race) was completed and opened up on the 16th April last, since which date the water supply to the mines has been slowly increased as the race settled down to its work, until the full supply of 100 sluice-heads (for which it was designed) was being delivered hourly—and this has been maintained. From experience gained in past years, and measurements taken, it is expected that in the driest summer the supply from this race will never fall short of 60 sluice-heads.

This fine work, finished within 16 months from the turning of the first sod, covers in all 30 miles of difficult country, including four syphon-columns of 38 and 40 inches diameter steel pipes, measuring upwards of two miles.

Caretakers have been established, and a telephone-line constructed throughout the whole length. The company now owns 40 miles of head-races, supplying a maximum of 232 sluice-heads, equal to 2,088,000 gallons of water per hour, the average being something less than two-thirds of this quantity.

At the mines the work has been confined almost entirely to removal of the overburden, which, since the advent of the new water-supply, has been got rid of at the rate of 10,000 cubic yards per week, and this rate will be increased.

The output of ore has averaged, for the year ending 30th June, 1902, about 15 tons per month, equal to eleven tons metallic tin per month.

It is intended to continue the policy of removal of the overburden until the tin-bearing drifts can be attacked on a large scale without fear of serious stoppage.

Advantage has been taken during the past six months to utilise the company's extensive dumping-area for disposal of tailings, the Ringarooma River having been saved this way over 150,000 cubic yards, and it is intended to carry out this scheme to a still greater extent.

A new and powerful electric plant is under erection, driven by a 3-feet diameter Pelton water-wheel, for lighting and other purposes; while the economical method of elevating by hydraulic pressure the ground below sluicing-level has been put into use, and will be extended.

Until now the upper and middle sections of tin-bearing drifts have alone been worked, with a result which is in itself eminently satisfactory; while the richness of the lower deposits in what is known as the "gutter" of the lead is a matter already proved by the original workings of the Krushka Bros., by bores and shafts sunk at various times, and by the natural specific gravity of the ore, whereby it has in greatest proportion gone through the drifts to the bottom.

The New Brothers' Home No. 1 and the Ringarooma Tin Mines are busy stripping the heavy overburden which lies on their stanniferous gravels. The latter company is also winning tin ore.

At Bradshaw's Creek the Pioneer Tin Mining Company has been working the old lead with pronounced success, and the mine is now on the dividend list. During the year 227,900 cubic yards of drift were pumped and sluiced, and 218 tons of stream tin obtained; of this quantity, 154½ tons were raised during the last six months. The alluvial ground in the Boobyalla basin has also received some attention this year.

Miners have done well at the different alluvial claims in the Moorina district. At Branxholm the Arba Company has made preparations for working on a more extended scale.

At Gladstone the Scotia claim has been the principal producer. The ground in the Gladstone district which will now best repay working is situate too high for the present water-supply. The old ground, which has been worked for so many years, is becoming exhausted, and many parts of the area are dependent upon the rainfall. The Government boring plant has been employed to test the gravels filling the supposed channel or deep lead of the ancient Mussel Roe River, in which accumulations of tin ore were surmised to exist. A very complete series of bores has shown that these supposed concentrations are absent.

Operations at Mount Rex Mine were suspended for the major part of the year, but the sinking of the main shaft is now to be resumed. So far there is a difficulty in finding a satisfactory market for the complex ore (containing variable percentages of lead and copper); but a consignment is now being treated in England, and, in addition, the company has received favourable assurances from experts respecting extraction of the objectionable accessory metals.

The Shepherd and Murphy Company has also had difficulty in finding an appropriate market for its tin—bismuth and wolfram ore—but experiments are in train with a view of establishing a working method of separation, after which it is likely that adequate capital will be forthcoming for exploiting these promising lodes on a proper scale.

West Coast.—The old Heemskirk tinfield has again been brought to the front by the discovery of a rich ore deposit at Mount Agnew. A good deal of ground has been taken up, and more ore has been found. In the first glow of excitement, discoveries were exaggerated, but there is reason to believe that continued search will reveal additional deposits along the margin of the South Heemskirk granite.

The tin ore properties of North Dundas (Renison Bell, Cornwall, Mount Lyell Copper Estates, Penzance) have attracted attention during the year, though not much work has been done on any of them. Most of these have good possibilities, and only await capital for developing.

A little alluvial mining has been carried on at the Whyte River, Heazlewood, but the area is not extensive.

Coal.

Much interest has been evinced in the coal deposits of the State, and the existing collieries have been very busy. The output of the two principal mines on the Nicholas Range has, unfortunately, been affected by strikes, and the Cornwall Mine is at present closed down, owing to one of these. During the year the Tasmania Company at Beaconsfield withdrew its custom from the Cornwall Mine in favour of Newcastle coal, but, *per contra*, the latter company established a market for its produce on the other side of the Straits. A derangement of deliveries has occurred through the present unfortunate strike.

The Jubilee Mine, 2½ miles north of St. Marys, has come into production during the year. The seam is from 7 to 8 feet thick, and the coal finds a market in Launceston.

Further important discoveries have been made north of St. Marys. The Cardiff colliery, between three and four miles from the township, has opened upon a 10-feet 6-inch seam, and has begun to effect sales of the coal, which is of a satisfactory quality. Other powerful seams crop out below this one, and will receive attention. The eventual creation of a port of shipment on the East Coast is contemplated.

The Coronation Coal Syndicate has just started on property 1¼ mile from Cullenswood Station, on the north side of the line. Several seams have been discovered; one has been opened upon (4 feet to 4 feet 6 inches), and a few tons have been got out, and are now being distributed to shareholders prior to a proposed construction of a tram to connect with the railway line.

Attention has been invited to the Thornedale seams near Thompson's Marshes, six miles north-west of Seymour. Three sets of seams, from 2 feet 3 inches to 9 feet in thickness, have been broken into, and await the introduction of capital.

At Mount Rex a 12-feet seam of coal, reported to be of good quality, is being opened up about half a mile below the mine. The output will be run down by a tramway to Hanleth Station, six to eight miles distant.

The Government bores at Llandaff passed through several unimportant coal seams in the lower part of the ranges, the thickest of which was 3 feet 10 inches, but of poor quality. Reference to this work is made later, under the head of "Government Drills."

A coal seam 3 feet 6 inches to 4 feet thick was examined at Mike Howe's Marsh, seven miles north-west of Oatlands. Its extension requires proving. For the present its situation precludes it from entering into competition with more easily accessible fields.

The coal mines at York Plains and Colebrook have continuously raised coal, though to a limited extent, and the same may be said of the Dulverton and Spreyton collieries in the Mersey basin.

Coal-winning has continued at the Mount Cygnet colliery. The seam here is 4 feet thick, and the coal commands a sale in the Hobart market.

Recherche Bay.—The Moss Glen Company has started work near Leprena. Among several seams, attention for the present is being confined to a seam 4 feet 6 inches to 5 feet 6 inches, on which a short tunnel has been driven. For the past few months operations have consisted of boring, to locate the prolongation of the seam on its dip, and it is understood that these have been successful. The company is about to use the Government diamond-drill for testing the strata at a greater depth.

A syndicate is also about to commence to prospect coal-bearing property at Catamaran River, Recherche Bay,

where a seam of about 6 feet of coal has been passed through in a shallow shaft. Other seams also exist on these sections, and it is intended to prove their extensions with the aid of the Government diamond-drill. The coal is of an excellent quality, giving little ash, and has satisfactorily passed several tests for steaming qualities. While the diamond-drill is in the neighbourhood, it is proposed to put down a couple of bores on Crown land south of the Catamaran, where there is a promising area of undisturbed coal-measure sandstones. These Recherche properties, being near both water and market, operations will be watched with interest, as, if the results are in accordance with expectations, an important coalfield will be opened up.

Preolenna.—A discovery has been made of outcrops of coal and oil shale in the Parish of Preolenna, south of Wynyard. The few seams which have been found are not thick, but comprise (in one instance) 20 inches of high-grade oil shale show that it is of excellent quality for gas-making. The present syndicate contemplates making a preliminary survey and examination of the ground, and picking up the seam, if possible, towards the Inglis Valley, several miles nearer the shipping port, and on lower ground, which would have the advantage of being more suitable for a tramway.

Latrobe.—The dysodile shale at Latrobe is being prospected by the Tasmanian Shale and Oil Company. There is an extensive area over which seams exist, varying in thickness from 6 to 9 feet. The quality of the shale has been tested exhaustively, and it is estimated that a large proportion of valuable lubricating oils can be profitably extracted from it. Other associations have also taken up leases in the shale area.

Beaconsfield.—The strata which underlie the coal-measures of the State have long been known to exist in the Beaconsfield district, and an official examination is now in progress, with the object of ascertaining whether any of the

coal-measures have escaped denudation in that neighbourhood.

West Coast.—Sandstones, carrying carbonaceous markings and fossil coal-plants, occur near the Henty River. Thin seams of coal and clod have been found in them, and, in view of the vast importance which the discovery of good coal would have for the West Coast mineral industry, the Henty district is now being tested with one of the Government diamond-drills at sites selected by the Assistant Government Geologist.

Mining Managers' Examination.

Six candidates presented themselves for examination in March last, five of whom succeeded in obtaining second-class certificates; the sixth candidate failed to pass.

Appended will be found copies of the Examination Papers set.

Zeehan School of Mines and Metallurgy.

The number of students attending regularly during the year averaged 37, being a decrease of six as compared with the previous year. This decrease is directly due to the closing of the Western and other mines, which caused many students to leave Zeehan to seek employment elsewhere. The attendance was at its lowest during the first term of 1902, but has now quite regained its normal level, the number of students in regular attendance at the present time being 46.

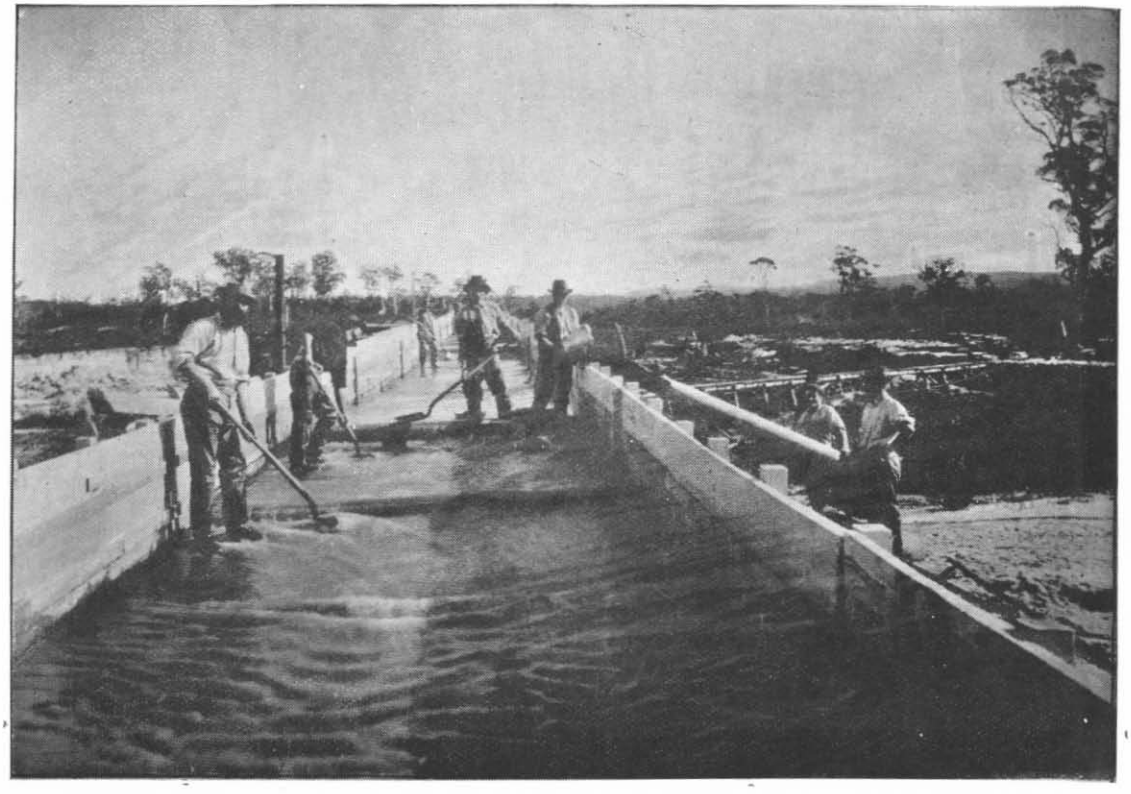
The average attendance at the various classes has been as under:—

Mathematics	16	Engine-driving	5
Mining mechanics... ...	5	Mine-surveying	8
Mineralogy	7	Mining	4
Mechanical drawing ...	7	Analytical chemistry.	10
Geology...	9	Theoretical chemistry	5
Ore dressing and sampling...	7	Fire assaying	5

The want of an additional instructor in the subjects of the mining course is keenly felt, but cannot be remedied until an increase is made in the annual grant by Government. Mr. R. J. Allen, of the Ballarat School of Mines, has been conducting a class in surveying. Mr. D. C. Urquhart, M.H.A., and succeeding him Mr. W. B. Townley, have rendered assistance as honorary instructors in elementary mathematics. During the last term of 1901, Mr. John Craze, general manager of the Montana Mine, gave instruction in mining. At the close of the year under review, Mr. H. T. Waller resigned his position as acting director and lecturer in metallurgical chemistry and assaying. Mr. A. O. Russell also resigned his position as secretary of the school. Applications were called for the dual position of director and registrar, and Mr. F. W. Reid, A.S.A.S.M., instructor in the subjects of the metal-mining course at the school, was appointed. Mr. W. Shand Watt, Associate of the Otago School of Mines, was appointed lecturer in metallurgical chemistry and assaying.

The committee have been successful in raising the required sum of £400, entitling them to a subsidy of £1000 from Government, for the purpose of erecting a new school-building. Plans and specifications for a one-storey brick building have been prepared and approved by the Lands and Works Department, and the sum of £1000 passed for payment to the school committee. Tenders were called for the work, and that of the lowest tenderer (Mr. James Wilson) accepted. The amount of the tender is £853 10*s*., which, together with bricks to be supplied by the committee, and installation of electric light, brings the probable cost of building, exclusive of fittings, to £1133 10*s*. The work is now well in hand, and will be completed in about three months' time. The foundation-stone was laid by Mr. A. D. Sligo, chairman of the committee.

When the new premises are entered, it is anticipated that there will be a considerable increase in the number of students attending the school, owing to the more central situation, and the increased facilities for teaching.



PIONEER TIN MINE, CLEANING RACE.

Beaconsfield School of Mines.

During the year the students have made rapid strides in the various subjects taught, no less than six out of seven obtaining their first year's certificate in theoretical and practical chemistry. When it is considered that the school had up till the examination last December been only a few months in full swing, the result is highly satisfactory, and reflects great credit on the instructor (H. F. Michael), who has spared neither time nor labour in his endeavours to impart knowledge to the students.

Mechanical drawing under Mr. Gordon Douglas, and the mathematical class under the secretary (H. E. Walduck), have both improved to a marked degree, as the following statement will show:—

Number of individual students on the roll to 30th June, 1902, 36; increase for the year, 20.

Average yearly attendance at various classes:—

Theoretical chemistry	7
Practical chemistry	10
Assaying	9
Mineralogy	7
Mechanical drawing	11
Mathematics	17

Government Drills.

As the best coal seams at Llandaff crop out in the high ranges at inconvenient heights for working, it was considered desirable to test the ground lower down the mountain slope and at the base, with the view of ascertaining whether similar seams could not be discovered in positions more advantageously situated for general purposes. The No. 1 diamond-drill was accordingly sent to Llandaff in charge of an experienced foreman, and has been engaged in putting down three deep bores there.

No. 1 bore was started on the 24th August, 1901, at about 90 chains west of the road from Llandaff to Bicheno, and 150 feet above sea-level. It was carried down to a depth of 475 feet from surface, striking solid granite at 465 feet,

and penetrating into it 10 feet. At 236 feet the drill passed through 9 inches of coal, which was analysed by the Government Analyst, with the following result:—Fixed carbon, 35·2; gases, 20·1; ash, 43; water, 1·7; coke rather powdery. And at 251 feet a seam of coal 3 feet 10 inches thick was bored through, also poor in quality, as appears from the following analysis made in the Government Laboratories:—Fixed carbon, 43·7; gases, 24·6; ash, 29·3; water, 2·4; coke powdery. At 318 feet, 6 inches of coal were passed through; at 335 feet, 1 foot of coal; at 366 feet, 5 inches of coal; at 372 feet, 9 inches of coal; but all these contained excessive proportions of ash (34 per cent. and upwards). Below this depth no coal was found, and boring was stopped on the 18th October.

No 2 bore was commenced on the 14th November at about 105 chains, a little west of south from No. 1, and at 50 feet above sea-level. This was at the base of the range. It was carried down 718 feet, and left off in granite rock. Coal was passed through at various depths, as under:—

At 21 feet	6	inches	...	...	1	foot	3	inches	dark shale and coal.
At 23 ,,	9	,,	...	...			3	,,	coal.
At 34 ,,	0	,,	...	...			2	,,	coal.
At 34 ,,	10	,,	...	...			4	,,	coal.
At 36 ,,	0	,,	...	...			6	,,	coal.
At 42 ,,	0	,,	...	...	small vein of coal				
At 56 to 89 ,,	0	,,	...	...	sandstone with small veins of coal.				
At 212 to 254 ,,	0	,,	...	...	sandstone with small veins of coal.				
At 292 ,,	0	,,	...	...			2	inches	coal.
At 346 ,,	0	,,	...	...	1	foot	8	,,	coal.
At 347 ,,	10	,,	...	...			7	,,	coal.
At 352 ,,	0	,,	...	...			6	,,	coal.
At 389 ,,	0	,,	...	...			10	,,	shale and coal.
At 477 ,,	4	,,	...	...			8	,,	shale and coal.

The coal struck at 346 feet was poor, and contained 35 per cent. ash. Below 477 feet no coal was found. The bore was stopped on the 24th January.

No. 3 bore was started on the 1st March, 1902, at 70 chains north-west of No. 2, and at a height of 380 feet above sea-level. It was carried down to 751 feet, striking granite

at 737 feet from surface, and boring ceased on the 8th May. The coal passed through in this bore was as follows:—

At 153 feet	4 inches	...	...	8 inches coal.
At 234 „	2 „	...	...	1 foot 3 inches coal and bands.
At 539 „	6 „	...	...	8 inches coal
At 543 „	8 „	...	...	6 inches coal.
		...	...	4 inches band.
		...	...	1 foot coal.
		...	...	6 inches band.
		...	...	9 inches coal.

The coal-markings which were prevalent in the strata throughout this bore continued to a depth of 690 feet.

The results show that the seams, which occur towards the base of the Mesozoic measures, are inferior to those in the upper part, and that they have been very poorly developed in the beds belonging to the Permo-Carboniferous system. The bores confirm the views previously entertained of the general development of seams in these two systems on the East Coast. The upper seams are shown by their outcrops to occur at a considerable height above the flat country which borders the coast, and the boring results indicate that any calculations of coal output will have to be based upon the seams in the ranges. An official report upon these has been issued during the year.

West Coast.—Already in 1890 a previous Government Geologist (Mr. Alexander Montgomery, M.A.) recommended that the country in the Henty district should be tested for coal with the diamond-drill. Since then a little coal has been observed at Eden, and this year the No. 2 diamond-drill has been sent to this field, in order to prove the strata which, as is well known, belong to the lower coal-measures system.

The first bore was started on the 15th March this year, and was sunk to 456 feet 9 inches through hard shale and grits, containing no indications of coal. The bore was stopped on the 4th June, and the drill has been removed to a second site to the north-east of the previous one.

Boring at Gladstone.—The work of testing the drifts, supposed to be tin-bearing, in the ancient channel of the Mussel Roe River, has been carried on throughout the year. Boring with hand-drill was started on the 20th July, 1901, and proceeded continuously till the 17th May last. Six lines of bores have been put down. No. 1 line, of six bores, was ten chains in length across the old Mussel Roe lead at Carroll's Flat, north of the Proprietary workings. The granite bedrock was struck in the deepest part of the gutter at a depth of 49 feet 6 inches. A few inches of drift showed a little tin ore from 4 to 11 feet below the surface, not payable.

No. 2 line of bores was 20 chains in length across the Edina valley, the deepest bedrock being at 54 feet 6 inches. No tin was found in this drift.

No. 3 line, of 32 bores, extended for 108 chains west and north and east of Watt's claim, the deepest part of the gutter being 84 feet from surface. Close to the north-west angle of Watt's section, the bottom drift at 22 feet showed a 2-feet layer, containing payable tin ore (29 lbs. to the cubic yard). Stanniferous wash was found at various depths along this line of bores, but not payable.

No. 4 line, of three bores, was east of the Tamar face, and extended down the hill for twelve chains towards the Empress dam. The slate bottom was found rising to the surface.

No. 5 was a long line of 32 bores, extending for one mile and eleven chains from the north-west of the Scotia claim to Stinking Springs. The greatest depth reached was 114 feet 6 inches, which is 67 feet below the bedrock in the Scotia claim. A little tin was found at different depths, but not payable. The channel which has been proved by this line is as deep as the present bed of the Ringarooma.

No. 6 line consisted of four bores on the McGregor claim, the deepest to granite bedrock at 58 feet. A little tin was found, but not payable.

The borings in these fragmentary portions of the old lead tend to show that no reliance can be placed on the drift as a source of tin ore. This part of the river course was pro-

bably too distant from the stanniferous range to the south to admit of heavy concentrations of ore. In addition, the upper parts of the drift have probably been redistributed by marine action, and their tin contents scattered far and wide. The main supplies of tin ore from this district will have to be sought in the terraces at the base of Mount Cameron, the minor leads which proceed from the mountain and along the contact-line of the granite with the slate, where tin-bearing rock occurs. But these sources of supply are not commanded by the Mount Cameron Water-race in its present position.

Mineral Products.

The following return shows the quantity and value of minerals and metals produced during the year ending 30th June, 1902—

	Quantity.		Value.
Gold won (fine).....	*69,798	ounces	£296,528
Silver ore raised.....	37,699	tons	200,594
Tin ore raised	2807	tons	198,127
Coal	71,820½	tons	44,047
Copper (blister).....	9734	tons	766,483†
Copper ore	8029	tons	84,068
Iron ore	2044	tons	1027
Total.....			£1,590,874

* Including 21,452 ounces obtained from blister copper.
† The value of the gold contained in the blister copper has been deducted from this amount.

A decrease of £222,231 on the previous year.

The total amount paid in dividends and bonuses was £272,764 0*s.* 9*d.*

Mining Board.

The board appointed by "The Mining Act, 1900," with the object of assisting the Minister of Mines in carrying out the work of the Department, and also to enable the Commissioners to have an opportunity of meeting together twice a year, and giving the country the benefit of the information and experience acquired by them, held its first meeting in

Launceston in October, 1901, and dealt with a large number of applications for exemption from the labour covenants of leases, drafted new rules for procedure at all future meetings of the board, also amendments and new regulations under the Mining Act. The second meeting of the board was also held in Launceston, in April last, when a large number of applications for exemption were dealt with, and further amendments to the regulations were suggested.

Mount Cameron Water-race.

The report of the board is annexed.

Departmental Staff.

The following changes have been made during the year:—

Lloyd Eld Chambers, appointed Commissioner of Mines, *vice* G. C. Gilmore, removed to Zeehan.

Edward Henry Fowell, Commissioner, removed to St. Helens, *vice* Henry Dawson, retired.

T. E. Rule, appointed Registrar of Mines at Strahan.

Allan D. Soutar, Registrar of Mines, removed from Strahan to St. Helens.

Henry Lionel Thomas, Registrar of Mines, removed from St. Helens to Scottsdale.

James Donohue, appointed Registrar of Mines at Waratah, *vice* J. Fidler.

The control of the drafting branch of this Department has been transferred to the Surveyor-General, and, up to the present time, the work has been carried on to my entire satisfaction. So long as the drafting-room is kept in close proximity to this office, to allow of ready access to plans, &c., and the work is entrusted to the draftsmen who have had charge of it for years, and who have become accustomed to the working requirements of this Department, there is not likely to be any complaint.

I have again to gratefully acknowledge my thanks to the officers under my charge for their loyal support and the efficient manner in which the several duties entrusted to them have been performed.

Revenue.

The revenue for the year ending the 30th June, 1902, amounts to £19,471 0*s*. 1*d*., showing a decrease of £2098 5*s*. 1*d*. on the previous year. This amount does not include a sum of £2637 16*s*. 11*d*. deposited as survey-fees with applications for leases.

Conclusion.

The mining industry has continued to suffer from investors withholding capital during the late troublous financial times, added to which the fall in the prices of silver, copper, and lead has materially contributed to the restriction of the output and the development of dormant properties.

The termination of the South African war may be expected to liberate capital for investment in mining enterprises, and it is only reasonable to expect that the outlook for the future will become brighter as the prices of metals once more return to their normal condition.

In conclusion, I desire to place upon record my sincere thanks to Messrs. W. F. Petterd, T. S. Hall, R. F. Waller, S. Thow, and the members of the staff of the Mount Lyell Mining and Railway Company, Limited, for the valuable papers contributed by them; also to Mr. John Vail (Government Printer) and Mr. E. Scott (Photo.-Lithographer) for reproducing the plates and plans which accompany this Report. Taking into consideration that the majority of the photographs were supplied by amateurs, and that many of them were very small and badly printed, it speaks volumes for the success achieved by those gentlemen with the appliances at their command.

I have the honour to be,
Sir,
Your obedient Servant,
W. H. WALLACE,
Secretary for Mines.

The Honourable the Minister of Mines.

DIAMOND DRILLS.

Statement of Work done to 30th June, 1902.

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, Mt. Malcolm—For Coal	Ditto	1	562	0 17 11¾
1888	Killymoon Estate—For Coal	Ditto	1	504	0 4 7¾
1888–9	Seymour—For Coal	Ditto	5	2266	0 7 8½
1889 / 1890	Beaconsfield (Phœnix G.M. Co.)—For Gold	Ditto	1	781	2 0 2
1890	Beaconsfield (East Tasmania G.M. Co.)—For Gold	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
	Total	...	52	18,294½	

	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. Company)—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	1	456	0 18 3
	Total	...	42	12,085	

Aggregate number of bores ..... 94.
Total distance bored ..... 20,379½ feet.

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

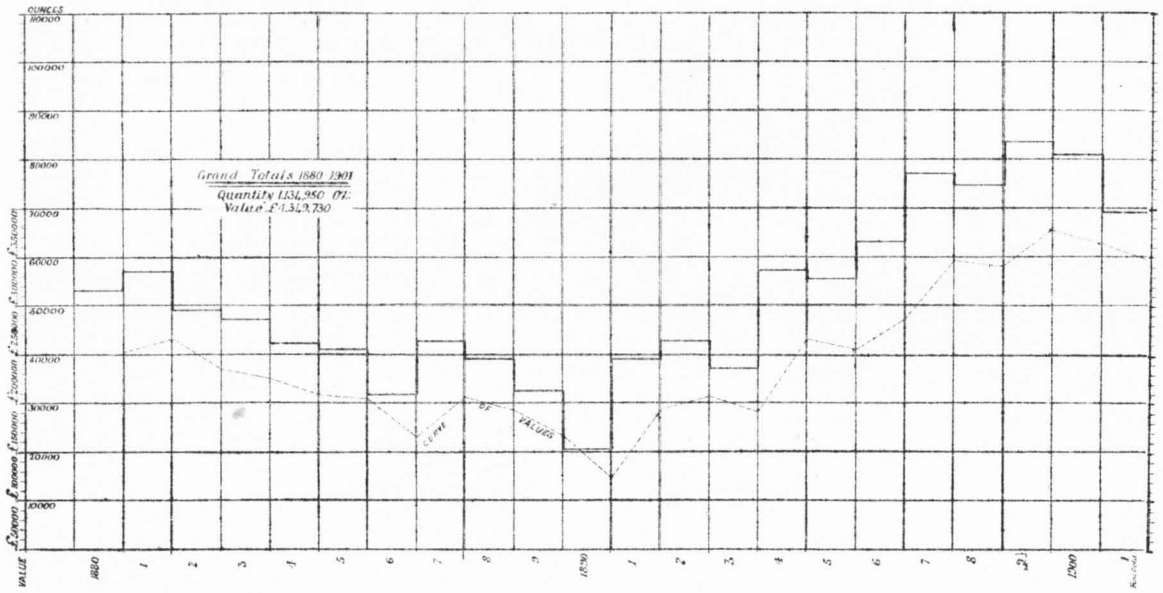
No. 1.

COMPARATIVE Statement 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, *and the first Half-year of* 1902.

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	145,458
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	77,151 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, for the first Half-year	*35,186 0	149 485
	1,170,135 19	4,499,215

* Fine gold.

Diagram showing Total Quantity & Value of Gold won in Tasmania for the years 1880–1901



JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

5 cm

No. 2.

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

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, for the first Half-year	*34,966	148,552
	1,034,317	3,961,504

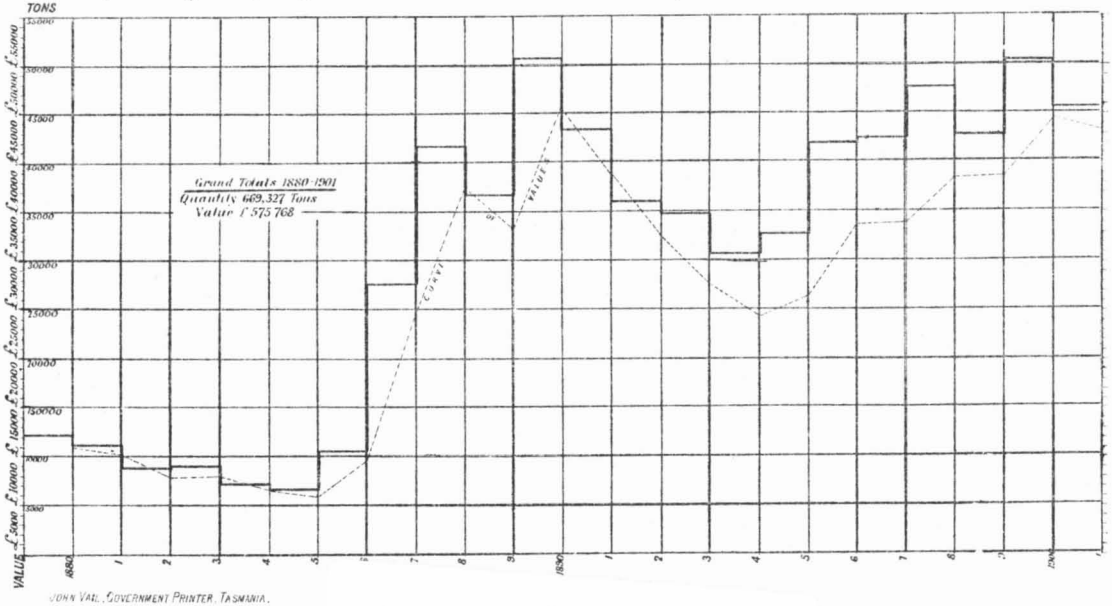
* Fine gold.

No. 3

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, *and the first Half-year of* 1902.

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, for the first Half-year	22,528½	19,149
	691,865½	594,917

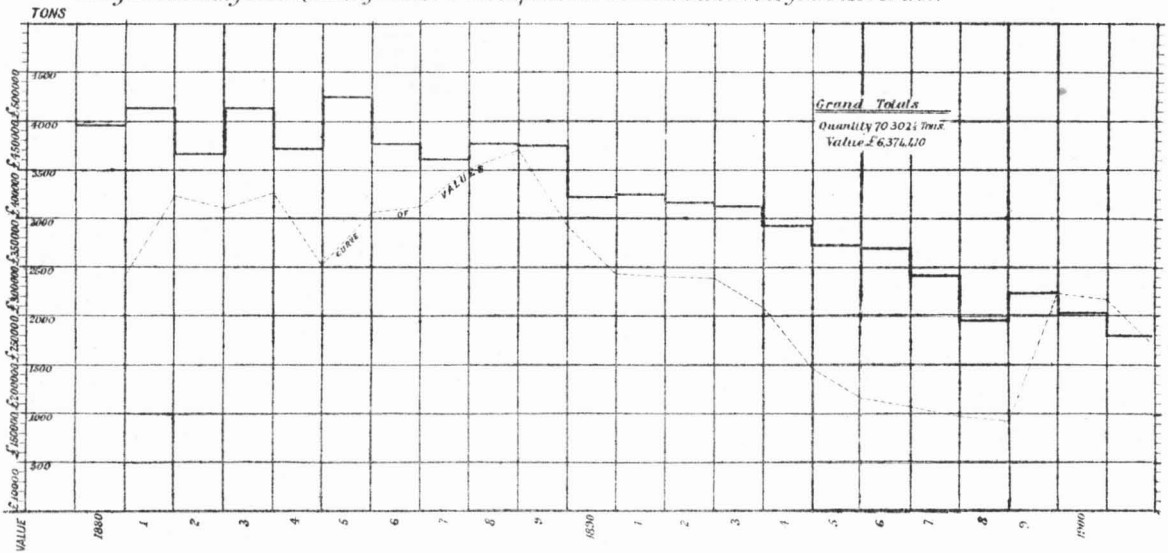
Diagram showing Total Quantity & Value of Coal Raised in Tasmania for the years 1880 to 1901



JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

5 cm

Diagram showing Total Quantity & Value of Tin exported from Tasmania for the years 1880 to 1901.



JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

5 cm

No. 4.

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, *and for the first Half-year of* 1902, *compiled from Customs Returns only.*

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, for the first Half-year	813¾	99,807
	71,116¼	6,474,217

No. 5.

QUANTITY and Value of Silver Ore produced in Tasmania during the Years 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, *and the first Half-year of* 1902.

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, for the first Half-year	19,965	101,814
	232,040½	2,262,229

No. 6.

QUANTITY and Value of Blister Copper produced from Tasmania during the Years 1896, 1897, 1898, 1899, 1900, 1901, *and the first Half-year of* 1902.

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, for the first Half-year	4466	326,236
	42,191	3,572,867

No. 7.

QUANTITY and Value of Copper Ore produced from Tasmania during the Years 1896, 1897, 1898, 1899, 1900, 1901, *and the first Half-year of* 1902.

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, for the first Half-year	4169	43,771
	21,809½	276,003

No. 8.

QUANTITY and Value of Iron Ore produced from Tasmania during the Years 1897, 1898, 1899, 1900, 1901, *and the first Half-year of* 1902.

Year.	Quantity.	Value.
	Tons.	£
1897	894	812
1898	1598	1598
1899	3577	3474
1900	5375	5995
1901	612	417
1902, for the first Half-year	1642	725
	13,698	13,021

No. 9.

RETURN showing the Quantity and Value of Asbestos produced from Tasmania during the Years 1899, 1900, 1901, *and the first Half-year of* 1902.

Year.	Quantity.	Value.
	Tons.	£
1899	200	363
1900	128	113
1901	46½	45
1902, for first Half-year	—	—
	374½	521

No. 10.

RETURN showing the Quantity and Value of Wolfram produced from Tasmania during the Years 1899, 1900, 1901, *and the first Half-year of* 1902.

Year.	Quantity.	Value.
	Tons.	£
1899	3½	99
1900	53¾	2058
1901	—	—
1902, for first Half-year	—	—
	57¼	2157

No. 11.

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, 1901.

Year.	Ore Smelted.	Products.			Yield.		
		Lead.	Blister Copper.	Matte.	Copper.	Silver.	Gold.
	Tons.	Tons.	Tons.	Tons.	Tons.	Ozs.	Ozs.
1896	26,028$\frac{13}{20}$	—	—	2417$\frac{6}{20}$	1235$\frac{1}{20}$	76,951	4707
1897	90,773$\frac{1}{2}$	—	3476$\frac{12}{20}$	257$\frac{19}{20}$	3583$\frac{14}{20}$	334,349	16,485
1898	170,933	—	4992	—	4783	606,123	24,418
1899	275,239	2295	8463	89$\frac{8}{20}$	8362	1,089,657	27,615
1900	363,113	4817	9449	—	9341	1,215,036	26,252
1901	355,528	1839	9982	50	9880	800,317	21,717

No. 12.

RETURN showing the Average Number of Persons engaged in Mining during the Years 1880 to 1901 inclusive, and first Half-year of 1902.

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

No. 13.

RETURN showing the Number and Area of Leases held under "The Mining Act, 1900," in force on 30th June of each year since 1896.

Nature of Lease.	In force on 30th June, 1896.		In force on 30th June, 1897.		In force on 30th June, 1898.		In force on 30th June, 1899.		In force on 30th June, 1900.		In force on 30th June, 1901.		In force on 30th June, 1902.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.
		ACRES.		ACRES.		ACRES.		ACRES.		ACRES.		ACRES.		ACRES.
For Minerals, Silver, Tin, &c.	738	33,077	1150	56,493	1290	66,981	1207	64,339	1487	70,500	1388	60,865	1061	45,396
For Coal, Slate, Shale, &c.	37	5946	38	6105	41	5943	39	6002	52	7258	55	7566	52	6819
For Gold	602	5712½	615	5789	702	7190	652	6725	647	6623	566	6091	425	4166
Water Rights, Mineral and Gold	160	808 sluice-heads.	155	774 sluice-heads.	159	784 sluice-heads.	200	933 sluice-heads.	225	1004 sluice-heads.	267	1318 sluice-heads.	300	1691 sluice-heads.

No. 14.

RETURN of the Number and Area of Leases under "The Mining Act, 1900," *in force on the 1st July*, 1901, *issued during the Year ending 30th June*, 1902, *cancelled during the Year ending 30th June*, 1902, *and remaining in force on 30th June*, 1902.

Nature of Lease.	In force on 1st July, 1901.		Issued during Year ending 30th June, 1902.		Cancelled during Year ending 30th June, 1902.		In force on 30th June, 1902.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.
For Minerals, Silver, Tin, &c.	1388	Acres. 60,865	264	Acres. 10,202	591	Acres. 25,671	1061	Acres. 45,396
For Coal, Shale, Slate, &c.	55	7566	13	1770	16	1517	52	6819
For Gold	566	6091	96	903	237	2828	425	4166
Water Rights, Mineral and Gold..	267	1318 sluice-heads.	80	513 sluice-heads.	47	140 sluice-heads.	300	1691 sluice-heads.

No. 15.

COMPARATIVE Statement of Net Revenue from Mines, being Rents, Fees, &c., paid to the Treasury for the Years ending 30th June, from 1880 *to* 1902.

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

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.

TOTAL Number and Area of Leases in force on 30th June, 1902.

Minerals.	Number.	Area.
		Acres.
Gold	425	4166
Minerals	247	14,284
Silver	226	11,492
Copper	76	4462
Tin	487	13,858
Coal	29	4671
Limestone	14	1308
Iron	13	590
Slate	1	200
Wolfram	8	353
Asbestos	2	140
Precious Stones	1	80
Lithographic Stone	1	97
Marble	1	317
Graphite	1	20
Shale	6	1226
Bismuth	1	40
Monazite	1	80
Machinery Sites	20	78
Dredging Claims	27	629
Mining Easements (under "The Mining Act, 1900")	12	38
Dam Sites	31	783
Water Rights	300	1691 sluice-heads.

No. 17.

AVERAGE Number of Miners employed during the Year ending 30th June, 1902.

	Europeans.	Chinese.
Northern and Southern Division	749	...
North-Eastern Division	502	167
Eastern Division	814	84
North-Western Division	361	...
Western Division	3761	...
	6187	251

No. 18.

MINING Companies registered during the Year ending 30th June, 1902.

Number of Companies.	Capital.
13	£67,400

In addition to the above, 18 Agents for Foreign Companies, and 5 Syndicates, under 60 Vict. No. 51, were registered.

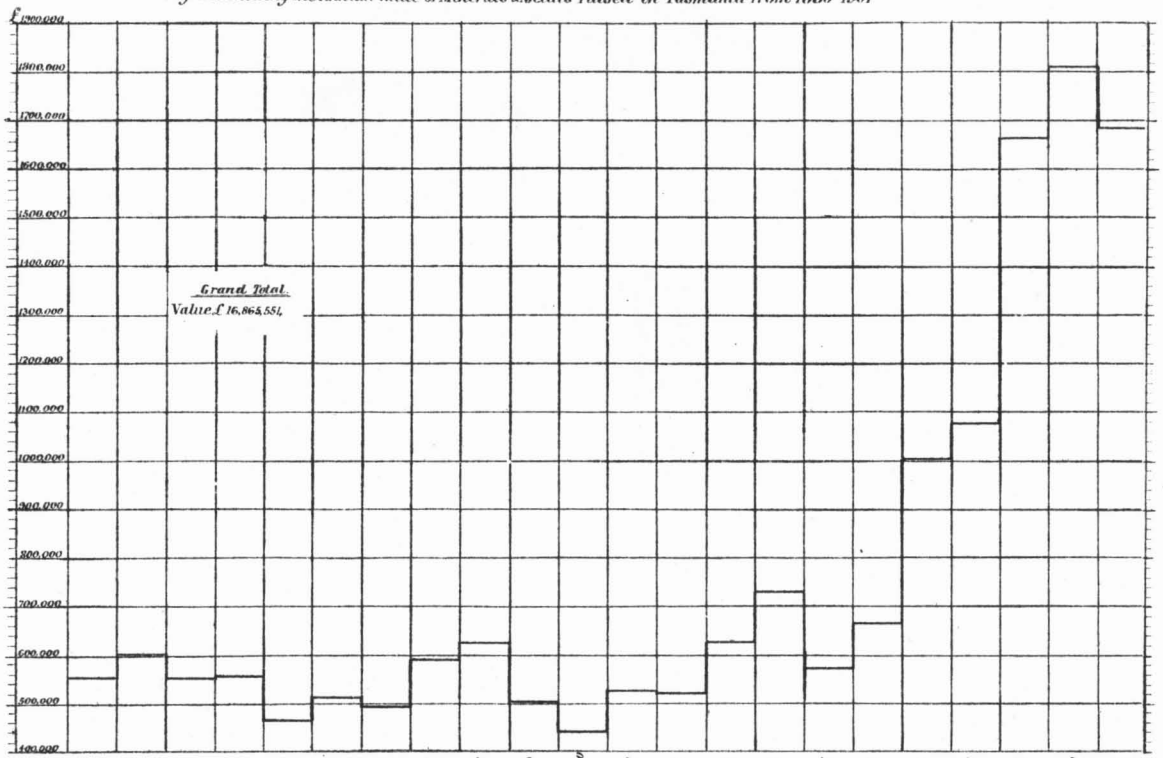
No. 19.

TOTAL Area of Land applied for during the Year ending 30th June, 1902.

Mineral.	No. of Applications.	Area.
		Acres.
Asbestos	1	40
Coal	23	5513
Copper	19	1047
Galena	3	200
Gold	134	1321
Iron	4	150
Limestone	1	40
Mineral	52	2533
Shale	14	2320
Silver	13	811
Tin	155	4781
Machinery Sites	6	33
Dredging Claims	20	351
TOTAL	445	19,140

In addition to the above, 13 applications for Mining Easements, and 88 applications for Water Rights (201 Sluice-heads and 239 acres Dam Sites) were received.

Diagram showing the Annual Value of Minerals & Metals raised in Tasmania from 1880-1901



JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

5 cm

No. 20.

TOTAL Amount of Rents, Fees, &c., received by the Mines Department during the Year ending 30th June, 1902.

Head of Revenue.	Amount.
	£ s. d.
Rent under "The Mining Act, 1900," for Gold ...	4146 16 3
" " " for Minerals	13,966 1 4
Fees " " for Gold ...	288 17 0
" " " for Minerals	1069 5 6
Survey Fees	2637 16 11
Rent of Diamond-drills	—
TOTAL	22,108 17 0

No. 21.

RETURN showing the Amounts paid in Dividends and Bonuses by Mining Companies during the Year ending 30th June, 1902.

Mines.	Dividends.	Bonuses.	Total.
	£ s. d.	£	£ s. d.
Copper	123,750 0 0	20,625	144,375 0 0
Gold	44,800 0 0	—	44,800 0 0
Tin	64,350 0 0	—	64,350 0 0
Silver	17,879 11 0	—	17,879 11 0
Coal	1359 9 9	—	1359 9 9
	252,139 0 9	20,625	272,764 0 9

REPORT OF THE MOUNT CAMERON WATER-RACE BOARD FOR THE YEAR ENDING 30TH JUNE, 1902.

24th July, 1902.

SIR,

WE have the honour to present the Report of the Board for the year ending 30th June, 1902.

The total receipts for the year amount to £1142 18*s.* 1*d.*, as against £1291 11*s.* 10*d.*, and the expenditure £701 10*s.* 5*d.*, as against £929 8*s.* during the preceding year.

Water.

The supply throughout the year was good, and, with the exception of one or two brief periods, was more than sufficient for all requirements. An unusually wet summer caused the supply to exceed the demand during the month of February by about 25 heads per week; this excess was nearly equal to the full supply of the corresponding period of 1901.

Race.

The chief cost was for repairs to the syphon pipes; no less than 75 bad breaks occurred, all of which had to be repaired with plate-iron bands. In addition to the cost of these repairs, there is the loss of water during the time the repairs were being carried on, amounting to, for 59 heads at 8*s.*, £23 12*s.*

In the early part of the year these pipes did not give much trouble. Since Christmas, however, some very bad breaks have occurred, notably in May, when no less than 22 breaks had to be mended, taking 24 bands, and loss of water amounting to £26 5*s.*

The flumings at the south are in a very bad state. A wet summer favoured these, as we did not have to overload them, half the supply coming from the Little Mussel Roe River. If the next summer happens to be a dry one, the supply of water will be very short, owing to the defective state of these flumings.

In view of the defective state of repair of the syphon and fluming of the race, as reported to this Board by the manager, and the liability of the supply of water being at any time cut off through breakage of the above portion of the race, and also taking into consideration the great loss that would be entailed through the abandonment of the work, the cost of which is £34,281, and the consequent stoppage of all mining enterprise in a large extent of mineral-bearing country, this Board, after mature consideration, is of opinion that, having in view the considerable extent of country that would be served by the reconstruction of a portion of the race on the north slope of Mt. Cameron, instead of its present course, starting from the junction of the Amber branch with the main race to Gladstone, and on by Scotia claim to the original race, a distance of about 12 miles, that the re-construction or renewal of works of race should be undertaken in the course as above indicated, as early as practicable, at a cost not exceeding £10,000, at which sum it is estimated by the manager the works could be constructed.



GALLOWAY'S CLAIM (SCOTIA), GLADSTONE.

The statistics for the year are as follow :—

Average per week of claims supplied, 10.

Greatest number supplied in any one week, 17.

Present number supplied, 10.

Total number of heads supplied, 2144⅓

Tin ore raised, 15 tons 2 cwts. 0 qr. 19 lbs., royalty scale; 49½ tons (approximately), fixed scale. Total, 64 tons 12 cwts. 0 qr. 19 lbs.

Average number of miners employed—European, 26; Chinese, 19. Total, 45.

Total receipts for the year, £1142 18*s.* 1*d.*

Cost of maintenance and management—Salary and wages, £597 8*s.*; repairs and management, £72 15*s.* 5*d.*; travelling expenses, £18 19*s.* 6*d.* Total, £701 10*s.* 8*d.*

Paid to Public Debts Sinking Fund, 1901 (including moiety of rents of mineral land served by the race, £26 7*s.* 6*d.*), £185 14*s.* 9*d.*

Total amount paid to Public Debts Sinking Fund on 31st December, 1901, £7171 7*s.* 9*d.*

Rate of interest for the year upon cost of purchase and construction, ·53 per cent.

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

W. H. Wallace, *Chairman of the Board.*

C. O'Reilly,
W. H. Twelvetrees,
S. Hawkes,
John Simpson,
} *Members of the Board.*

MINE MANAGERS' EXAMINATION.

MARCH 25TH, 1902.

Questions set.

SUBJECT A.—MINING.

1. Describe how you would proceed to place in position a 12-inch Cornish plunger pump bottom. Explain by sketch the following :—
   (*a*) Positions of foundation and cistern relative to the main level.
   (*b*) The position of main rod and H piece.
2. A rise is being put up on a lode to connect with a level 120 feet above, the object being ventilation. Explain and give sketches showing the following :—
   (*a*) How you would proceed with the work and secure ventilation.
   (*b*) How you would timber the rise in soft and hard ground respectively.
3. Show by sketch the various systems of timbering underground workings, with which you are acquainted, as applied to the following :—
   (*a*) Vertical lodes.
   (*b*) Inclined lodes.
   (*c*) Flat lodes.
4. Give sketch showing the several safety appliances which you know, as applied to the following :—
   (*a*) Safety appliances of cages.
   (*b*) ,, ,, to prevent over-winding.
   (*c*) ,, ,, of Cornish pumps.
5. To what depth would you recommend sinking with one draw-lift? Give your reasons for long and short lifts.
6. Describe how you would work a nearly vertical ore-chimney extending downwards from the surface. The ore is high grade, which makes it necessary to extract the whole. The country-rock of the adjoining strata is not wholly self-supporting, but has a tendency to break away in large pieces. The ore-chimney is elliptical in cross section, the small diameter averaging 30 feet, while the larger diameter averages 60 feet. Describe particularly the methods which you would adopt in extracting the ore and in timbering, to ensure the safe working of the ore-body, and to permit the extraction of the whole of the ore.
7. Describe how you would timber a shaft in swelling ground, to prevent or avoid future trouble.
8. Describe what, in your opinion, are the necessary supplies which should be always kept on a mine for the safe working of the same, as required by the mining laws of Tasmania.

9. What is the fundamental principle upon which the ventilation of mines is essentially based, irrespective of whether it be accomplished by ordinary or artificial means?
10. What precautions would you take when nearing old workings containing much water?

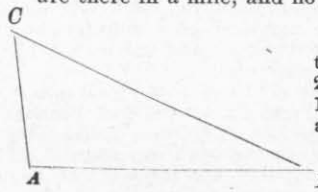
SUBJECT B.—ORE-DRESSING AND SAMPLING.

1. Enumerate the appliances which are used in a well-equipped ore-dressing establishment for the purpose of separating the ore particles from the reduced or crushed gangue.
2. How would you sample and put a value on a block of ground (stoping) between two levels and two rises connecting them?
3. How would you determine if an ore was suitable for concentration?
4. Give sketches of automatic ore-feeders.
5. How would you classify fine sand and slimes, and what advantage, if any, would you expect to obtain by doing so?

SUBJECT C.—MINING GEOLOGY.

1. Discuss the meaning of the terms sill, laccolite, contemporaneous lava-sheet, and their applicability to the greenstone rock (dolerite or diabase) which crowns the tiers and numerous mountains in Tasmania.
2. Name the principal ores of lead, copper, and iron, and state their composition.
3. Discuss the subject of faults. State what you understand to be their origin; describe the different kinds of faults, their effects upon mineral lodes, and the rules for dealing with them when met with underground.
4. Explain the difference between true dip and apparent dip. Describe a method by which the true dip of a stratum can be determined from observations made on its apparent dip.
5. Write a description of any ore deposit which may be known to you, giving its characteristic features in detail, and explaining your views of its origin.

SUBJECT D.—MINING SURVEYING.

1. State a rule for calculating the true thickness of an inclined stratum from its thickness proved in a boring. If a stratum be proved 1 fathom thick in a borehole, where the dip is 30°, what is its true thickness?
2. The outcrop of a vertical reef is seen on the side of a hill which rises at an angle of 30°. How far must a horizontal level be driven to intersect the reef at a depth of two hundred feet below its outcrop?
3. Give the length of a link and of a chain. How many chains are there in a mile, and how many acres in a square mile?
4. 

In the triangle ABC, given the two sides AB = 187 feet and BC = 242 feet; also, the angle at A = 107° 16′, find the angles at B and C and the third side of AC.

5. Describe the process of using the theodolite underground, enumerating any precautions which may be required to ensure accuracy.
6. Describe the method of connecting the surface with the underground survey through a vertical shaft.
7. Calculate latitudes and departures in the following traverse, and the direct bearing and distance of station 3 from 1 :—
   1. N. 32° 15′ E. 176 links distance,
   2. N. 72° 32′ E. 180 links distance,
   3. N. 28° 15′ W. 155 links distance.

SUBJECT E.—SURFACE WORK.

1. What would be the size of a pair of ordinary high-pressure engines, and what would be the horse-power, which would be required to hoist 120 tons per hour up an incline 1500 yards long with a gradient of 1 in 8, at a speed of four miles an hour. What proportion of gear would you recommend between the engine-shaft and the drums? Assume your own data.
2. In a set of 12-inch pumps with 11-inch pole, 200 feet effective depth, the pump-rod, straps, plunger, &c., weigh 3½ tons, and the effective weight of the column below the plunger is 3½ cwts.; stroke of pumps, 6 feet. What is the weight required in the balance box?
3. If the above pumps are worked at seven strokes per minute, what horse-power would be required, allowing 10 per cent. for friction?
4. A Cornish boiler is 24 feet long, 6 feet 6 inches diameter, and the flue is 3 feet 6 inches diameter. What is the nominal horse-power?
5. If the shell of the above boiler is made of ⅜-inch steel, lap jointed, and rivetted double, with ¾-inch rivets pitched at 2½ inches in the longitudinal seams, what will be the bursting pressure, and what the safe-working pressure, as regards the shell?
6. Write out a Specification for the construction of one mile of Light Tramway, and give its proposed carrying capacity and (if time permits) reasons for each clause in Specification.
7. Make Sketch for working drawing of set of Points for 2-feet gauge Tram-crossing, with detail measurements.
8. Give rough Drawings of Timber and Earthwork Dam, 20 feet deep at centre; detail estimate and instructions for building.
9. Give size and dimensions of Smith-building for one general and two tool-sharpeners' fires.

SUBJECT F.—BOOK-KEEPING AND MINE ACCOUNTS.

1. What is the tributors' part of £72 15*s.* 6*d.*, at 5*s.* 7*d.* per £1?
2. Required the square yards and cost of a rubble wall, the length of which is 53 feet 6 inches, and the height 12 feet 3 inches, at 4*s.* 3*d.* per square yard.
3. How many cubic feet of stone are there in a round pillar, the height of which is 16 feet, and diameter 2 feet 3 inches?
4. There are 265 props, 39 caps, and 642 slabs delivered at a mine. The contract price in the bush for props is £5 7*s.* per 100; for caps, £8 9*s.* per 100; and slabs, £1 4*s.* 6*d.* per 100. The price paid for carting is—for props, 8*s.* 4*d.* per

100; for caps, 9*s*. 5*d*. per 100; and slabs, 3*s*. 6*d*. per 100. Show by calculation the cost of the above timber delivered at the mine.

5. Draw up a specimen mine balance-sheet and working (or cost) account respectively.

SUBJECT G.—MINING LAW.

1. What quantity of detonators is allowed to be kept in any one level in a mine, and how should same be stored?
2. What weight or strain is required to be used when testing new ropes or chains to be used in the shaft of a mine?
3. What is the duty of an employé in a mine who may discover any appliance or part of the workings to be unsafe?
4. Frozen nitro-glycerine compounds are required to be thawed or softened previous to use. How should this be done?
5. How would you peg or mark-off an 80-acre mineral section before applying for a lease of the same?

ANNUAL REPORT OF THE GOVERNMENT GEOLOGIST.

Government Geologist's Office,
Launceston, 30th June, 1902.

SIR,

I HAVE the honour to present my Annual Report as Government Geologist for the year terminating 30th June instant. During this period I have reported upon the following districts and mines :—

1. On the coalfield of Llandaff, the Denison and Douglas Rivers, on deposits of tin ore on Schouten Main, and on outcrops of quartz near Buckland, 19th October, 1901.
2. On the tin mines of the Blue Tier, County of Dorset, 7th December, 1901.
3. On coal seams at Thornedale, near Thompson's Marshes and the Jubilee Colliery, near St. Mary's, 12th December, 1901.
4. On the occurrence of coal near Catamaran River, Recherche Bay, 20th February, 1902.
5. On country on the east shore of Lake Sorell, and on a discovery of coal near Oatlands, 17th March, 1902.
6. On the coalfield in the neighbourhood of Recherche Bay, 1st May, 1902.
7. On deposits of opal at Bothwell, and an alleged discovery of gold at Hunterston, on the Shannon, 26th May, 1902.
8. On gold and coal at Port Cygnet, 31st May, 1902.
9. On deep-sinking at the Moonlight-cum-Wonder Gold Mine, Beaconsfield, 30th June, 1902.

Mr. Geo. A. Waller, Assistant Government Geologist, has also submitted Reports, as follow :—

1. On some wolfram sections near Pieman Heads, 24th September, 1901.
2. On the recent discovery of Cannel coal in the Parish of Preolenna, and upon the New Victory Copper Mine, near the Arthur River, 9th November, 1901.
3. On the tin ore deposits of North Dundas, 8th March, 1902.
4. On the ore deposits (other than those of tin) of North Dundas, 30th April, 1902.
5. On some discoveries of copper ore in the vicinity of Point Hibbs, 30th June, 1902.

The inspections represented by the above reports have been directly related to the mineral industry of the State, and have exhibited as reliable an account as possible of the ore deposits in the respective districts. Some of these examinations deal with new discoveries; others, by special requests, with old fields viewed in the light of more recent knowledge. In all cases, the aim has been to diffuse a knowledge of our mineral resources in plain language, and with sober regard for facts, in order that the State's industry may be promoted, and investors guided on the

one hand to promising fields, as well as warned on the other hand from enterprises in which hopes of success are groundless. Those interested in the geology of the Island, and philosophical students of ore deposits, will find much interesting matter scattered through the reports.

There has not been time during the year to satisfy all applications for examinations and reports. Engagements standing over for the coming year are :—(1) The coal and iron ore deposits near Ilfracombe, (2) the Salisbury goldfield near Beaconsfield, (3) the Den goldfield near Lefroy, (4) gold mines near Fingal, (5) iron ore deposits at Riana (North-West Coast), with which will be associated those at the Penguin, (6) sections near Mt. Humboldt; and the Assistant Geologist has on his programme the following inspections :—(7) The mines at Zeehan, (8) mines in the vicinity of Mt. Farrell, (9) the Lyell field; the latter has not been examined since the opening of the district by the Lyell Company.

In addition to these, there are mineral fields which have never been reported upon yet, and which should be examined; as, for instance, the so-called Asbestos Range (with no asbestos, but with indications of copper), from Badger Head southwards; the country south of Smithton, Circular Head; Mt. Ramsay; and the huge iron ore deposits on the Meredith River. The Golconda goldfield, too, requires examination; and the Warrentinna field has also been neglected. The Latrobe dysodile area has not been reported upon since Mr. C. Gould's time. The freestone quarries and limestones of the State, which will now infallibly attract attention in connection with new industries, may be suggested as advantageous subjects for examination.

I beg to refer to the aims in view in the preparation of the several reports.

Llandaff and Schouten.

The Mesozoic coal measures and the outcropping seams were examined at Llandaff, the Denison and Douglas Rivers, with the result that several seams of variable quality and thickness were found to occur in the ranges. At Llandaff seams between 2 and 3 feet thick were observed at heights between 200 feet and 700 feet above sea-level. This coal would have to be conveyed 16 miles to Cole's Bay for shipment, as, although it is only six or seven miles from Bicheno, expensive harbour works would be necessary to convert the latter place into a port safe in all weathers. Most of the seams being high up the mountain, three deep bores have been put down with the diamond-drill this year, with a view of striking seams at a lower level, and in more convenient positions. Numerous thin seams were passed through, but the only one of workable size (3 feet 10 inches) was found to be of poor quality. The bores passed through the strata of the Mesozoic and Permo-Carboniferous divisions into granite rock, and show conclusively that the lower beds do not possess seams from which any substantial quantity of coal could be raised. The seams, too, in the upper part of the range, are not thick enough to work profitably with their present quality of coal Until they are opened out further their real capabilities cannot be stated.

The seams at the Denison River were also examined. Some of these are of good quality, but not quite thick enough to induce working them. At the Douglas River, too, there is a fair domestic coal nearly 5 feet thick. This is six miles from Seymour. Further work is necessary to see how it will open out.

The Schouten Main tinfield was inspected. Some leases on the Saltwater Creek offer a dredging proposition on a moderate scale. West of Bluestone Bay are tin sections in a belt of greisenised granite, similar to the stanniferous rock of the Blue Tier. It is a low-grade proposition. A certain extent of good alluvial ground, containing ore released from the above rock, has been worked. This district may, therefore, be looked upon as a stanniferous one, but the deposits do not appear to be extensive.

I examined a quartz outcrop at Cutting-Grass Marsh, near Buckland. This had been worked for gold unsuccessfully. It almost certainly results from the impact of diabase rock on the sedimentary strata, and is valueless from a gold-miner's point of view.

Blue Tier.

The mines at and near Lottah were visited, with a view of ascertaining the probable extent of the tin ore deposits in connection with Mr. K. L. Rahbek's scheme for the conservation of water on the Tier for the use of the mines. I formed a favourable opinion of the quantity of tin-bearing stone in this mountain range, but it is of low grade, and its exploitation cannot be conducted economically without an adequate supply of water for dressing and power purposes. The stone is not rich enough for selection, and any soberly-conceived scheme for working will require to be based on cheap treatment of large quantities.

Recherche.

Coal seams at Ida Bay and Recherche Bay were visited during the year. The most important developments are those at Recherche Bay. The Moss Glen Company is exploring seams between 4 and 5 feet thick at the northern part of the bay, and a Hobart syndicate is prospecting a 6-feet seam on the Catamaran, near the south end of the bay. The Government No. 1 diamond-drill is about to be employed in testing the measures of this district. The field, being near to deep water and a market for the output, will probably be one of some importance.

Lake Sorell and Oatlands.

I examined the country on the east shore of Lake Sorell, in order to ascertain the nature of the rock through which it may be expected that the proposed tunnel will have to be driven from the rim of the lake to the eastern face of the Tier. I found that the tunnel channel near the shore of the lake will be in sandstone, but that it will probably enter diabase rock at perhaps a quarter of a mile from the water's edge. The Lake Country is not promising for mineral; excepting a possible discovery of opal, coal is the only likely product.

I visited a coal outcrop at Mike Howe's Marsh, seven miles north-west of Oatlands. The seam is between 3 and 4 feet thick, but the locality is too remote for much to be done with the coal at present. The sandstone at Oatlands itself seems to occupy a position between our lower and upper measures, but the possibility always exists of coal seams being discovered in the vicinity.

Bothwell.

Reports of an extensive development of opal-bearing rock led to my being instructed to visit and report upon it. I found outcrops of opalised sandstone, veined with common opal, occurring on the plain 1½ mile north and north-west of the township

for a considerable distance. The veins are not continuous, but are in the form of irregular infiltrations. The stone has sometimes a pale bluish tinge, and gives occasional orange flashes of colour; but the gem opal has not been found yet. A few pits and trenches have been sunk, but without success. There is, however, no reason why the noble variety should not exist here.

Shannon.

Abortive mining for gold was carried on near Hunterston for a short time in 1897, and the locality was examined by me this year. The deposits proved to be merely Permo-Carboniferous mudstones, impregnated with pyrites, and worthless as a payable source of gold.

Port Cygnet.

I paid another visit this year to the old goldfield at Lymington, and the abandoned mines near Lovett. I am confirmed in my opinion that the gold won from the alluvium was originally seated in the silicified and brecciated rock which occurs at the contact of the porphyries with the sedimentary strata, and that these contacts are the only places where payable lode-mining may be hoped for. Looking at the alluvial gold obtained, it is reasonable to believe that future prospecting will reveal better stone than has been found yet.

The Mt. Cygnet Coal Mine, near Gardener's Bay, was inspected. The seam is from 3½ to 4 feet thick, and the coal finds a market in Hobart. During the past few years the output at this mine has increased.

Moonlight-cum-Wonder Mine.

The deep workings at this mine, carried on with the aid of the Government grant, having proved unsuccessful, I was instructed to examine the mine and report upon its prospects. My examination showed that a very thorough programme of exploration had been carried out to a depth of 800 feet, but without disclosing any payable reef. The mineralised formation upon which some work was done proved to be unremunerative, and is, in fact, merely a belt of shattered rock, between the loosened blocks of which small quantities of mineral have been introduced subsequently by descending percolating waters. There would seem to be more hope of success in prospecting the small quartz-veins on the company's Olive Branch section, and following them down when good stone is met with.

Progress Reports on the Mineral Industry.

I have issued four quarterly reports during the year. As usual, these present statistics of the mineral production of the State, and a brief statement of work done at the various mines. Inquiries for these reports are being increasingly received from abroad, and the information contained in them is, I notice, embodied in the statistical and industrial publications of other countries.

Assistant Government Geologist's Reports.

Mr. Waller refers to his inspections in his Annual Report forwarded herewith. They have covered a wide area of difficult West Coast country, and, as may be seen by their perusal, form

valuable contributions to our knowledge of the varied ore deposits in the districts which he has examined.

Examination of Minerals and Rocks.

Samples of these continue to be sent to me for determination and opinion as to their industrial value. Assays are not undertaken, but tests are applied, slices made for microscopical examination, and all possible information given to the senders. I annex a list of such examinations made during the past year.

Office.

The work in the office increases. The geological reports issued this year number 14, against 7 the previous year; three sets of Government drills have been working concurrently; and the correspondence has amounted to 2526 letters, &c., in and out, as against 1809 the previous year. I am glad to be able to acknowledge the efficient help of Mr. F. S. Grove in the preparation of maps, examination of plans, and charge of general work.

Geological Survey.

During the year I submitted an estimate for the initiation of a survey on modest lines as a beginning, but financial considerations compel this to remain in abeyance for the present. Meantime, the Assistant Government Geologist is preparing a geological sketch-map of a large part of the West Coast, which, it is hoped, will be of great use to prospectors and others.

Australasian Association for the Advancement of Science.

This association held its meeting in Hobart in January, when the Hon. the Minister of Mines placed the services of the Assistant Government Geologist and myself at its disposal. Papers on the geology and ore deposits of Tasmania were prepared for the association by both of us; and each of us conducted a geological excursion of members—one to Port Cygnet, the other to the mines on the West Coast. Various mining companies contributed specimens of their ores, which were exhibited to the members in Hobart, and every endeavour was made to aid visitors in taking away with them correct impressions of the mineral resources of the State.

Government Drills.

The two diamond-drills and a hand-boring plant have been employed throughout the year on Government account. I beg to append registers of the boring. All cores have been labelled, and are preserved at this office.

Mt. Cameron.

The hand-drill was in operation near Gladstone. In view of the precarious state of parts of the Government water-race at Mt. Cameron, and the impending necessity for serious renewals, several lines of bores were put down through the drift in places

where it was believed to conceal the ancient river channel in which tin ore may have been deposited. If this deep lead could be shown to harbour payable deposits of tin ore, renewals or extensions of the race would be justifiable. The lead crosses the present bed of the Mussel Roe River westwards, a little north of the Proprietary ground, and pursues a northerly direction to Watt's ground; it seems to reappear at the old Tamar, and crosses the Portland Road at the Lochaber, and trends north-west between the Stinking Springs and the Scotia. Across this course six lines of bores have been sunk to the bedrock. These have been on Crown land, the few leased sections having no practical bearing on the broad question, in addition to which the work done by leaseholders on their own leases supplies any information that may be needed.

No. 1 line (= A-B on map with report) of six bores was 10 chains in length across Carroll's Flat, on Section 3468-93M, defining the channel of the old Mussel Roe lead east of the present river. The deepest part of the gutter was struck in the second bore at a depth of 49 feet 6 inches from surface. At 7 feet 6 inches in the first bore, 3 inches of gravel with good tin, and 3 inches pug and drift, with a little tin, were met with, the whole being just payable for wages-men. This corresponds with the shallow layer of payable wash in the Proprietary workings further south. The second bore at 6 feet 7 inches passed through 3 inches of quartz wash, containing a little tin ore, not payable. This is the same layer as in the first bore. The third bore, at 9 feet 6 inches, passed through 18 inches of wash, with fairly good prospects of tin and much iron; and at 32 feet, 8 feet 4 inches of drift, carrying a little tin, lay on the granite bedrock. In the fourth bore the only tin found was in 8 inches of gravel, at a depth of 6 feet 8 inches, but only a little. No tin was met with in the fifth and sixth bores.

No. 2 line (= C-D on map) of 11 bores was 20 chains in length across the Crown land between the No. 5 syphon on Edina Flat and the Mussel Roe River. The line begins at the east boundary of Section 3568-93M, and crosses the old lead, proving at the same time the ground east of the Edina workings, which are in a belt of drift worked throughout a length of two miles west of this. The bottom of the gutter was struck in the sixth bore at a depth of 54 feet 6 inches. No tin was struck anywhere on this line.

No. 3 line (= G-H and E-F on map) of 32 bores was 108 chains in length. It begins with 11 bores in a northerly direction along the eastern boundary of Sections 3566 and 3567-93M, west of Watt's section, continues thence north-east, with 12 bores across and out of Section 1351, and finishes with 9 bores in an east line towards the Mussel Roe River. The information given by these is hardly what was expected. The deepest point of the G-H line is at No. 10 bore in the creek, quite close to the north-west angle of Watt's Section 4219-93M; but the bedrock is only 130 feet below datum, as against 209 feet in the sixth bore on the Edina line; consequently, the lead cannot pass to the north-west. The eleventh bore was in a new direction, viz., N. 30° E., which was continued to the twenty-second bore, when, failing to find any outlet towards the north-west, the remaining nine bores were put down in a line due east towards the river. The twenty-eighth bore touched granite in a gutter 84 feet from surface, or 187 feet below datum. This is the deepest channel found in this

line of bores, but it is still shallower by 22 feet than the gutter proved in the Edina bores. Hence there is no outlet for the lead to the north. If it did not run east, which, from the rock-bound channel of the modern river, is hardly likely, the only location open for it is somewhere south of the first bore on this line, and north-west from the Edina line. As the whole district has been raised subsequently, we cannot expect to be able to trace the old channel in a continuous line, but the various isolated deposits which survive at intervals along its course indicate its general direction. This line of bores was the best as regards indications of tin ore. In No. 1 bore, at 41½ feet from surface, 3 feet 6 inches of wash was passed through, showing ore worth about 1¾ lbs. to the cubic yard. In No. 2 bore, 4 feet 8 inches of pebble wash at 51½ feet contained ore, 3⅝ lbs. to the cubic yard, and below this was fine drift 16 feet 10 inches and pug 6 inches, containing a little tin. In No. 3 bore, below 18 inches of surface-soil, was drift 3 feet 11 inches, carrying a little tin. In No. 7 bore, at 4 feet 6 inches, was drift for 18½ feet, with a little tin. In No. 10 bore, at 20 feet, was fine drift for 2 feet on the bedrock carrying good tin, 29 lbs. per cubic yard. In No. 11 bore was 1¼ foot of wash, with a little tin, and the bottom wash 1 foot, at a depth of 12 feet 6 inches, also carried a little ore. In No. 19 bore, at 11 feet 3 inches, was pebbly wash for 2 feet 3 inches, with a little tin; and in bore No. 31, 3 feet 3 inches of wash, with a little ore, rested upon the granite, which was bottomed on at 21 feet 2 inches.

No. 4 line of bores (or I-J on the chart) was in a north-easterly direction from the Tamar workings, in order to see whether any deep ground extended towards the Empress dam. The result has been to show that the drift shallows in that direction; but no argument can be based on this, for the bedrock falls in the same direction. There has evidently been denudation of the gravels, which prevents us from now tracing the boundaries of any channel which may have existed. The deepest of the three bores put down here was No. 1, on the top of the hill east of the main face, which struck slate at 64 feet from surface, passing through 1¾ foot of wash at surface, with a little tin ore. No. 2 bore bottomed on the slate at 32 feet, and No. 3 at 4 feet 8 inches. It is noteworthy that the bedrock at 64 feet is only 42 feet below datum, or 145 feet higher than the deep gutter on the Edina line. This striking difference illustrates the rising movement of the land, and shows that we have to deal with broken and disturbed sections of the lead, and not an uninterrupted channel. The task of tracing its course is thus made more difficult, and the drawing of conclusions is more or less open to argument.

No. 5 line (M-N on map) comprises 32 bores from north-west of the Scotia to Stinking Springs, a distance of 91 chains. The first bore was at the south-west corner of Section 1858-8 M, and the last at the south-east corner of 172-87w. This important line crosses the assumed continuation of the lead from the Lochaber, as well as that of the lower part of the tributary lead of the Scotia. In No. 1 bore, at 34 feet 6 inches, a foot of sub-angular pebble wash, containing a little ore, was passed through. Slate was struck at 37 feet 6 inches from surface. In No. 4 bore, 10 chains from No. 1, 5 feet 9 inches of sub-angular pebbles, with a little ore, was passed through at 34 feet 3 inches from surface. No. 17 bore was quite close to the old 56-feet shaft, from which both tin and gold are alleged to have been obtained.

The interest attaching to this shaft leads me to reproduce Inspector Griffin's register of this bore, viz. :—

Fixed datum, 500 feet.

Depth bored. ft. in.	Total depth. ft. in.	Below datum. feet.	
—	—	78 ·40	Collar of bore.
0 9	0 9	79 ·15	Fine sand.
1 9	2 6	80 ·90	Wash.
2 6	5 0	83 ·40	Yellow pug.
8 6	13 6	91 ·90	Fine sand.
63 6	77 0	155 ·40	Alternate layers of pug and drift.
3 6	80 6	158 ·90	Angular wash.
2 6	83 0	161 ·40	Fine drift.
1 0	84 0	162 ·40	Carbonaceous silt.
1 6	85 6	163 ·90	Soft slate bored into 18 inches.

Total depth of bore to bedrock 84 feet.

The deepest bedrock along this line was reached in No. 27 bore, 76 chains from No. 1, and nearly, if not quite, as deep as the present bed of the Ringarooma at its nearest point to the bore, a distance of 1¼ mile. The register of the bore is as follows :—

Depth bored. ft. in.	Total depth. ft. in.	Below datum. feet.	
—	—	128 ·37	Collar of bore.
0 9	0 9	129 ·12	Turf.
1 9	2 6	130 ·87	Fine sand.
1 6	4 0	132 ·37	Brown cement.
30 0	34 0	162 ·37	Alternate layers of drift and pug.
1 0	35 0	163 ·37	Angular wash.
4 0	43 0	171 ·37	Coarse drift.
3 6	46 6	174 ·87	Grey pug.
4 0	50 6	178 ·87	Carbonaceous silt.
6 6	57 0	185 ·37	Angular wash.
4 0	61 0	189 ·37	Carbonaceous silt.
1 0	62 0	190 ·37	Fine sand.
13 0	75 0	203 ·37	Angular wash.
17 0	92 0	220 ·37	Carbonaceous silt.
4 0	96 0	224 ·37	Brown sand.
2 0	98 0	226 ·37	Carbonaceous silt and lignite.
1 0	99 0	227 ·37	Fine sand.
13 6	112 6	240 ·87	Carbonaceous silt and lignite.
2 0	114 6	242 ·87	Brown sand.
0 6	115 0	243 ·37	Hard slate.

In bore No. 28, 79 chains from No. 1, 6½ feet of wash, with a little tin, was passed through at 34 feet 6 inches, and 3½ feet of wash, also with a little ore, at 43 feet 6 inches, and 2 feet of angular wash, with a little ore, at 83 feet. This bore bottomed on slate at 91 feet. A foot of angular wash with a little tin ore was passed through at 8 feet in bore No. 29. The 12 feet of sub-angular wash overlying the slate in this bore at 82 feet is similar to that of the Lochaber, except that it carries no tin. The section of the drift presented by this line shows great irregularity of bottom, but discloses a deep rock-channel between bores 23 and 30, 21 chains wide, with a bank on the north side 84 feet high. The gutter at the bottom of this channel is 245

feet below datum, or 35 feet below the channel on the Edina line. The whole section suggests that the high drift, which now covers the country, has been spread by the sea. The Scotia lead, as it comes north, will evidently widen out and merge into the barren marine drift.

The last line of bores (No. 6 O-P on map) consists of four bores 3 chains apart, south-east to north-west, in the old workings on McGregor's Section 2089 in the Aberfoyle country. These workings never bottomed, and payable tin ore has been obtained over a considerable area. The deepest bore was 58 feet below the surface (358 feet below datum), when it struck granite. In the No. 2 bore 2½ feet of wash, with a little ore, not payable, lay upon the bedrock at 42 feet 6 inches.

The drill has done useful work in demonstrating the real nature of the Mussel Roe buried lead, in which many believed considerable stores of tin ore were concentrated. It has now been shown that, from a tin-bearing point of view, this old channel is unimportant; and we can easily see two reasons why it is so. In the first place, it is here too far from the source of the ore in the Tier to the south; in the second place, it has in all probability been scoured and re-filled by the sea in later times. Without the boring trials, this question would never have been set at rest. Now that it has been disposed of, the future of the tinfield is seen to be dependent upon (1) the terraces and short leads at the base of Mt. Cameron, (2) the greisen belt of contact of the granite with the slates. The latter work cannot be undertaken while the Government race is in its present position; and it is useless to disguise that it involves mining risks. It is hoped that parts of the ground would prove remunerative, but not enough work has been done to assure that the formation will pay for mining it. The geological indications are favourable. As regards alluvial deposits, the best terraces are too high to be commanded by any disposition of the race, and would require the employment of a pumping plant. Many of these have been worked, but they are not exhausted yet, and some of them would doubtless be worked again if a water supply were forthcoming. In this event, the gravel terraces at Gladstone itself would also probably be reworked, and the output of the district maintained at its present average level. The Scotia is now the mainstay of the district, but, should anything happen to interrupt the prosperous career of that mine, it would, with the facts now before us, be impossible to predict for Gladstone anything more than a struggling and precarious existence, even if the renewals of the Government race are undertaken, while the abandonment of the latter will practically put an end to the district as a tin-producer at once.

The annexed diagram shows the sections of the drift as disclosed by the bores.

No. 1 Diamond-drill at Llandaff.

I append copies of registers of the three bores put down at Llandaff during the past year.

No. 1 bore, 90 chains west from the Llandaff Road to Bicheno, in the northern part of Lot 369, was 120 feet above the road and 150 feet above sea-level. This was carried down 475 feet and into the underlying granite rock, which it struck at 465 feet. The upper part of the bore was in Mesozoic sandstones and shales, and the lower part in Permo-Carboniferous sandstone and shale, with occasional beds of limestone. It is impossible to point out the boundary between the two systems. As the lime-

stone certainly belongs to the lower one, the highest calcareous band may be provisionally taken as the upper limit of the Permo-Carboniferous, if we understand that the beds above it may also belong to the same system, but cannot at present be recognised as doing so. Thus the Mesozoic strata descend to 299 feet in the bore, and the Permo-Carboniferous thence to the granite, a further vertical distance of 166 feet. The first seam of coal struck was only 9 inches thick, at a depth of 236 feet 8 inches, and was of poor quality. Its analysis by the Government Analyst was—

Fixed Carbon.	Gases.	Ash.	Water.	Coke.
35 · 2	20 ·1	43 ·0	1 ·7	Rather powdery.

A seam 3 feet 10 inches of poor friable coal was passed through at 251 feet 2 inches, but the analysis in the Government Laboratories showed it to consist of—

Fixed Carbon.	Gases.	Ash.	Water.	Coke.
43 ·7	24 ·6	29 ·3	2 ·4	Powdery.

In the Permo-Carboniferous strata the bore passed through four thin seams from 5 inches to 1 foot thick, all with excessive proportions of ash (34 per cent. and upwards).

No. 2 bore was situate 105 chains a little west of south from No. 1, on Hume's boundary, 20 feet above the road and 50 feet above sea-level. This was carried to a depth of 718 feet and into cemented granitic rock, which it penetrated for 60 feet. The limestone in this bore is first met with at a depth of 417 feet, and it is impossible to fix the lower limit of the Mesozoic beds. According to the reading in No. 1 bore, they ought to descend to 194 feet. Four small seams of coal were intersected in this part of the bore, varying from 2 inches to 6 inches in thickness. In the Permo-Carboniferous portion three seams were passed through, ranging from 6 inches to 1 foot 8 inches in thickness, and coaly shale at several horizons down to 477 feet. The 1 foot 8 inches seam at 477 feet 4 inches was of inferior quality, containing 35 per cent. ash.

No 3 bore is 70 chains north-west from No. 2, on the boundary between Lot 410B and Lot 369, about one mile north of the north boundary of Llandaff Township, and 380 feet above sea-level (350 feet above the road). This was sunk to a depth of 751 feet, entering granite at 726 feet. The limestone here was met with at 324 feet 8 inches in the bore. The varying depths at which this rock occurs in the different bores may point to faulting, but I am inclined to think it is principally due to inconstancy of the beds; and the same applies to the coal seams, which apparently cannot be depended upon as being continuous for any distance. Seams varying from 6 inches to 1 foot in thickness were intersected between 153 feet and 543 feet. Coal markings were observed in this bore to a depth of 688 feet.

It is remarkable that none of the bores struck any underground continuation of the diabase (greenstone) which crowns the range.

The bores seem to show that the lower beds of the Mesozoic as well as the Permo-Carboniferous strata are devoid of any important seams. Prospecting for the more powerfully developed seams will have to be confined to the upper part of the range. So far, seams which would support a tramway to Cole's Bay

have not been found, but the measures for such seams exist here, and there is a chance that some day a profitable discovery will be made. Though the boring trials and other prospecting works in the neighbourhood have been disappointing, I do not despair of either this field in particular or the East Coast range generally.

Eden Bore with No. 2 Diamond-drill.

Permo-Carboniferous beds, with coal-measure plants, have been known for several years to occur near the Henty River, between Strahan and Zeehan, and a few years ago a little coal was discovered near Eden. It having been decided to test these strata, the No. 2 diamond-drill has been engaged lately on that work. The first bore has been put down on the north side of the Strahan-Zeehan Railway line, at about 15½ miles from Strahan.

The bore was put down to 456 feet 8 inches through sandstone, conglomerate, and calcareous mudstone, or clay, without meeting with anything beyond carbonaceous markings. The strata in this bore do not resemble those of the system on the east side of the Island, and are, therefore, difficult to interpret. There is some reason for believing that the coal in this district may exist at two horizons, the upper one being the greenish sandstone seen at surface on the Eden Coal Company's Reward section, and the lower one being that of the shales seen below the limestone.

The bore was stopped on the 4th June, as the rock had become difficult, owing to joints and increasing water, and the drill has been removed to a site on the Eden Company's section 1¼ mile further north-east.

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

W. H. WALLACE, ESQ.,
Secretary for Mines, Hobart.

5 cm

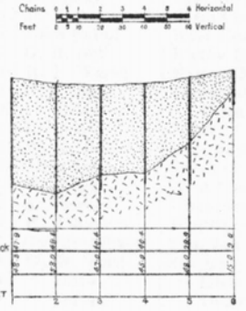
GLADSTONE

SECTIONS ALONG LINES OF BORES

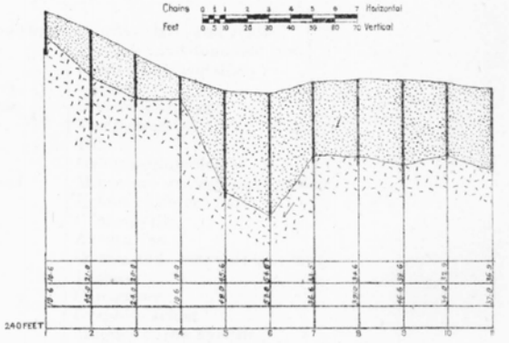
sands and gravels slate granite

W. H. Twelvetrees
Government Geologist.
30 June 1902.

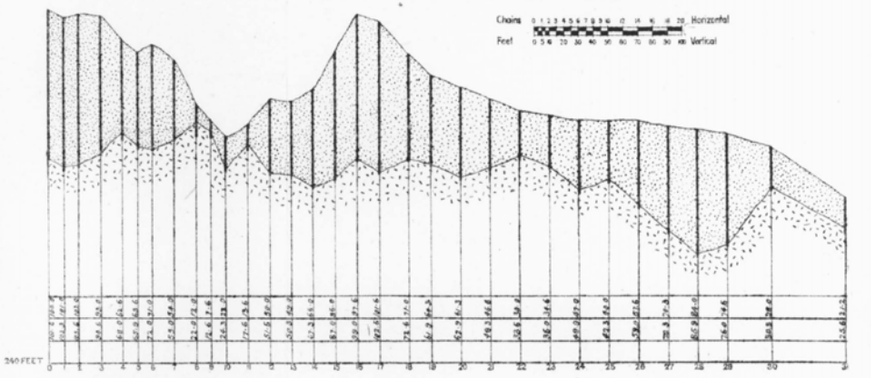
Nº1 LINE



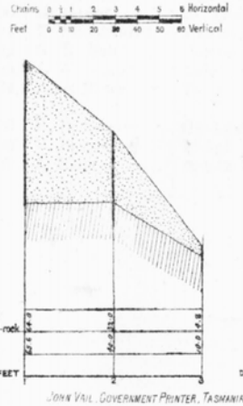
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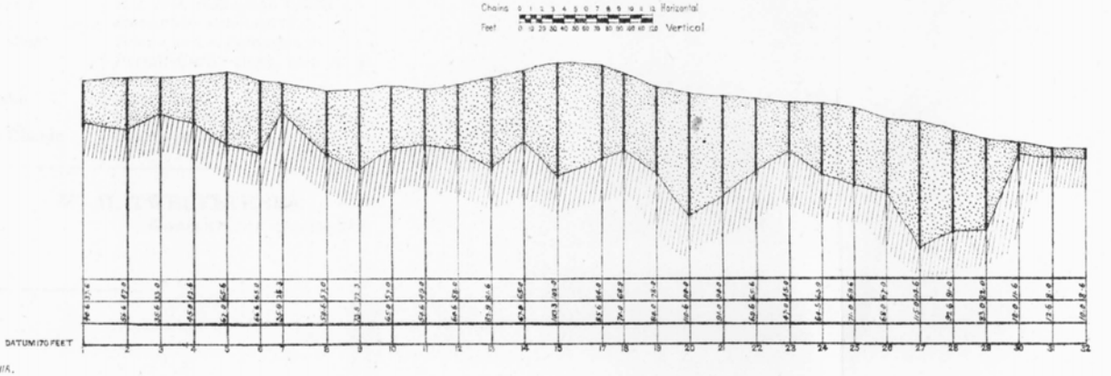
Nº3 LINE



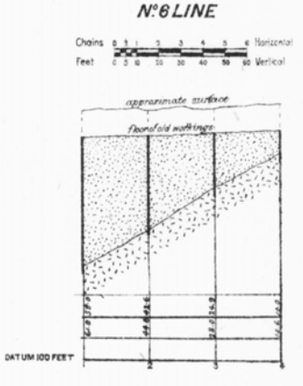
Nº4 LINE



Nº5 LINE



Nº6 LINE



JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

GOVERNMENT GEOLOGIST'S OFFICE.

Report upon mineral determinations made for the public during the year ending 30th June, 1902.

No.	Sender.	Locality.	Substance examined.
74	D. Finlay	Tasman-Comstock	Quartz-felsite and schist.
75	P. V. Ashworth	Farm Cove	Tertiary sandstone and coal
76	John Cahill	West Coast	Fossil resin (copalite)
77	G. R. Bell	Blythe River	Gabbro
78	R. F. Waller	Magnet Mine	Diabase porphyrite
79	G. R. Bell	Table Cape	Trachydolerite
80	Ditto	Ditto	Talc
81	L. Smith	Forth	Gabbro-amphibolite
82	W. R. Bell	Corinna Road	Micaceous segregation in granite
83	Allan Innes	Smithton	Epidotic contact rock
84	W. Hogg	West Coast	Chalcopyrite
85	A. Peoples	Unknown	Aventurine
86	W. Johnston	Westbury	Quartz and brecciated vein-stone
87	George Allison	Shannon	Diabase
88	W. W. Ford	Stanley	Copper ore
89	Ditto	Ditto	Graphite schist
90	Ditto	Ditto	Magnetic iron pyrites
91	E. J. Pitchford	Mount Cameron	Cassiterite and iron sand
92	G. R. Bell	Franklin River	Amphibolite
93	Ditto	Ditto	Artificial slag
94	Ditto	Ditto	Fossil shell (*Spirifera vespertilio*)
95	F. Thorne	Frogmore	Fossil oak or beech leaf (*quercus* or *fagus*)
96	T. Everett	Tongataboo	Blue quartz grit (Permo-Carb.)
97	Ditto	Ditto	Sandstone
98	Ditto	Ditto	Non-bituminous shale
99	G. R. Bell	Latrobe	Calcareous cemented grit
100	H. Grant	St. Helens	Several rock specimens
101	K. Shoobridge	Devonport	Minerals, rocks, and fossils
102	G R. Bell	Corinna	Spherulitic siliceous rock
103	J. W. Plant	Lake Jukes	Felsite and conglomerate
104	John Rowe	Dover	Permo-Carb. clays and mudstones
105	E. R. Groves	Gladstone	Dolerite
106	F. Bottomley	Liffey	Permo-Carb. fossils and rocks
107	J. Hope	Mount Claude	Quartz-porphyry

W. H. TWELVETREES,
Government Geologist.

GOVERNMENT DRILLS.

Statement of work done during the year ending 30th June, 1902.

Locality.	Direction of Bore.	Number of Bores.	Total Distance Bored.	Average cost per foot, inclusive of labour and fuel.
			ft. in.	£ s. d.
No. 1 *Diamond Drill.* Llandaff—For Coal.....	Vertical	3	1944 0	0 7 4
No. 2 *Diamond Drill.* Eden—For Coal.....	Vertical	1	456 8	0 18 3
Hand Drill. Mount Cameron—For Tin Ore.....	Vertical	88	4889 5	0 1 6
Total.....	..	92	7290 1	

Note.—The above cost is calculated upon the running time only, and the diamonds are reckoned at £10 per carat.

W. H. TWELVETREES,
Government Geologist.

No. 1 Diamond Drill.

LLANDAFF BORE No. 1.

Height above main road, 120 feet = 150 feet above sea-level. Bore commenced 24th August, 1901; finished 18th October, 1901. Total depth of bore, 475 feet.

Nature of Strata bored through.	Thickness of Strata.		Total Depth.	
	ft.	in.	ft.	in.
Stiff clay and hard broken sandstone	7	0	7	0
Soft sandstone	3	0	10	0
Broken sandstone	6	0	16	0
Solid sandstone	9	0	25	0
Broken sandstone	30	0	55	0
Sandstone, intermixed with decomposed vegetable matter	27	0	82	0
Solid sandstone	30	0	112	0
Sandstone	10	0	122	0
Blue shale	1	4	123	4
Sandstone	2	2	125	6
Sandstone, intermixed with decomposed vegetable matter	54	6	180	0
Solid sandstone	28	0	208	0
Sandstone, intermixed with decomposed vegetable matter	12	0	220	0
Broken sandstone	13	0	233	0
Sandstone	3	8	236	8
COAL	0	9	237	5
Blue shale	3	7	241	0
Blue shale, intermixed with decomposed vegetable matter	10	2	251	2
COAL, friable	3	10	255	0
Shale and sandstone	5	0	260	0
Blue shale and sandstone	8	6	268	6
Broken shale and sandstone	6	3	274	9
Clayey blue shale	12	3	287	0
Clayey shale and sandstone	7	0	294	0
Clayey shale	5	0	299	0
Limestone	1	6	300	6
Clayey shale	6	6	307	0
Shale and sandstone	4	0	311	0
Sandstone and decomposed vegetable matter.	7	6	318	6
COAL	0	6	319	0
Shale and sandstone	5	0	324	0
Dark clayey shale	11	0	335	0
COAL	1	0	336	0
Clayey blue shale	5	0	341	0
Sandstone	25	10	366	10
COAL	0	5	367	3
Dark clayey shale	5	3	372	6
COAL	0	9	373	3
Dark clayey shale	7	3	380	6
Clayey shale	5	6	386	0
Dark clayey shale	6	5	392	5

Nature of Strata bored through.	Thickness of Strata. ft.	in.	Total Depth. ft.	in.
Sandstone	0	7	393	0
Sandstone and decomposed vegetable matter.	12	0	405	0
Sandstone	0	9	405	9
Clayey shale	15	3	421	0
Clayey shale and limestone	4	0	425	0
Sandstone	2	7	427	7
Clayey shale	1	5	429	0
Dark clayey shale	6	6	435	6
Sandy shale	10	6	446	0
Hard cemented white sandstone	0	6	446	6
Broken sandstone and shale	9	0	455	6
Broken sandstone and shale, giving place to granite	8	3	463	9
Granite, enclosing fragments of shale	1	3	465	0
Granite	6	0	471	0
Granite	4	0	475	0
Sandstone and shale	21	0	503	0
Sandstone	17	0	520	0
Clayey shale	6	0	526	0
Shale	1	0	527	0
Limestone with carbonate of iron	0	10	527	10
Blue and dark-coloured shale	6	2	534	0
Dark-coloured shale	8	6	542	6
Shale and sandstone	1	0	543	6
Coarse grey sandstone	5	0	548	6
Sandstone and shale	11	0	559	6
Clayey and sandy shale	11	6	571	0
Clayey shale	3	3	574	3
Shale and sandstone	5	2	579	5
Sandstone	12	7	592	0
Sandstone	8	0	600	0
White cement and quartzite	5	0	605	0
Sandstone and shale	4	0	609	0
Sandstone	5	0	614	0
Broken sandstone and shale	9	5	623	5
Blue clayey shale	6	7	630	0
Shale and limestone	1	9	631	9
Broken conglomerate	11	6	643	3
Conglomerate and sandy shale	6	6	649	9
Granitic conglomerate	3	8	653	5
Fine-grained granitic conglomerate	1	10	655	3
Coarse sandstone and granitic cement	29	11	685	2
Granitic cement	32	10	718	0

No. 1 Diamond Drill.

Llandaff Bore No. 2.

Height above main road, 20 feet = 50 feet above sea-level. Bore commenced 14th November, 1901; finished 24th February, 1902. Total depth bored, 718 feet.

Nature of Strata bored through.	Thickness of Strata.		Total Depth	
	ft.	in.	ft.	in.
Surface clay	2	6	2	6
Sandstone	13	6	16	0
Blue shale	2	0	18	0
Sandstone	3	6	21	6
Dark shale and coal	1	3	22	9
Blue shale	1	0	23	9
Coal	0	3	24	0
Blue and dark shale	4	0	28	0
Blue shale	5	0	33	0
Dark shale	1	0	34	0
Coal	0	2	34	2
Dark shale	0	10	35	0
Coal	0	4	35	4
Dark shale	0	8	36	0
Coal	0	6	36	6
Blue shale	2	6	39	0
Dark shale (small veins of coal)	3	0	42	0
Shale and sandstone	14	0	56	0
Sandstone intermixed with small veins of coal	33	0	89	0
Sandstone	19	0	108	0
Broken sandstone	13	0	121	0
Sandstone	10	0	131	0
Sandstone and shale	1	0	132	0
Sandstone	18	0	150	0
Sandstone intermixed with decomposed vegetable matter	15	6	165	6
Sandstone	46	6	212	0
Sandstone with small veins of coal	42	0	254	0
Sandstone	21	0	275	0
Sandstone	9	8	284	8
Blue shale with coaly matter	5	7	290	3
Sandstone	1	3	291	6
Black shale with veins of coal	1	2	292	8
Sandstone	0	2	292	10
Black shale	1	0	293	10
Sandstone	12	8	306	6
Sandstone	34	6	341	0
Sandstone and shale	5	0	346	0
Coal	1	8	347	8
Sandstone and shale	0	2	347	10
Coal	0	7	348	5
Blue and dark-coloured shale	3	7	352	0
Coal	0	6	352	6
Blue and dark clayey shale	10	0	362	6
Clayey shale	10	6	373	0

Nature of Strata bored through.	Thickness of Strata. ft.	in.	Total Depth. ft.	in
Dark and blue clayey shale	6	6	379	6
Shale and sandstone	9	6	389	0
Black shale and coal	0	10	389	10
Blue clayey shale	1	2	391	0
Sandstone with layers of shale	13	0	404	0
Solid sandstone	13	0	417	0
Limestone	0	10	417	10
Dark-coloured shale	1	2	419	0
Sandstone	11	9	430	9
Clayey shale	10	5	441	2
Black clayey shale	2	4	443	6
Sandstone intermixed with decomposed vegetable matter	27	6	471	0
Sandstone and shale	6	4	477	4
Shale and coal	0	8	478	0
Sandy shale	4	0	482	0

No. 1 Diamond Drill.

LLANDAFF BORE No. 3.

Height above main road, 350 feet = 380 feet above sea-level.
Bore commenced 1st March, 1902; finished 14th May, 1902.
Total depth bored, 751 feet.

Nature of Strata bored through.	Thickness of Strata. ft.	in.	Total Depth. ft.	in.
Surface soil	12	0	12	0
Boulders of diabase (greenstone)	13	0	25	0
Loose ironstone detritus	15	6	40	6
Shale detritus and loose stones	15	6	56	0
Dark and blue shale with veins of coal	6	0	62	0
Broken blue shale	4	6	66	6
Blue and dark clayey shale	5	6	72	0
Shale with small veins of coal	9	0	81	0
COAL and bands	0	8	81	8
Blue and dark shale	16	6	98	2
Sandstone	2	6	100	8
Dark brown and blue shale	14	6	115	2
Blue clayey shale	11	10	127	0
Sandstone	2	10	129	10
Clayey shale	20	2	150	0
Grey sandstone	3	0	153	0
Dark shale	0	4	153	4
COAL	0	8	154	0
Dark and blue clayey shale	9	6	163	6
Dark and blue broken shale with small veins of coal	34	6	198	0
Sandstone	2	0	200	0
Sandstone with coal-markings	27	0	227	0
Dark and blue shale with small veins of coal.	4	0	231	0

Nature of Strata bored through.	Thickness of Strata.		Total Depth.	
	ft.	in.	ft.	in.
Blue and dark shale	4	2	235	2
Coal and bands	1	3	236	5
Sandstone with coal-markings	48	1	284	6
Shale and sandstone	2	6	287	0
Sandstone with coal markings	37	8	324	8
Limestone and shale	0	4	325	0
Sandstone with coal-markings	24	0	349	0
Dark shale with coal veins	0	9	349	9
Sandstone	8	3	358	0
Sandstone with coal-markings	81	0	439	0
Sandstone and shale with coal-markings	11	0	450	0
Sandstone with coal-markings	82	6	532	6
Blue and dark shale	7	0	539	6
Coal	0	8	540	2
Shale with seams of coal	3	6	543	8
Coal	0	6	544	2
Band	0	4	544	6
Coal	1	0	545	6
Band	0	6	546	0
Coal	0	9	546	9
Shale and sandstone	3	3	550	0
Dark and blue broken shale	13	0	563	0
Dark shale	1	6	564	6
Rotten shale	8	0	572	6
Broken shale and sandstone	16	6	589	0
Dark and blue broken shale	12	0	601	0
Broken shale and sandstone	10	0	611	0
Broken sandstone	11	0	622	0
Green sandstone	29	0	651	0
Sandstone and shale with coal-markings	27	6	678	6
Broken sandstone and shale with coal-markings	9	6	688	0
Shale and sandstone	25	0	713	0
Hard white sandstone	11	0	724	0
Sandstone	2	0	726	0
Fine-grained granite	11	0	737	0
Granite	14	0	751	0

No. 2 Diamond Drill.

EDEN BORE No. 1.

Commenced 10th March, 1902; finished 4th June, 1902. Total depth bored, 456 feet 8 inches.

Nature of Strata bored through.	Thickness of Strata.			Total Depth.	
	ft.	in.		ft.	in.
Dark sandy shale	4	0	...	4	0
Dark sandy shale	1	0	...	5	0
Dark sandstone	4	0	...	9	0
White crystalline sandstone, much jointed	20	0	...	29	0
Dark sandy shale	1	0	...	30	0
White crystalline sandstone, broken and jointed	31	0	...	61	0
Dark micaceous sandstone	25	6	...	86	6
White crystalline sandstone with coal-markings	15	6	...	102	0
Dark micaceous and arenaceous clay with iron pyrites	13	0	...	115	0
Dark pebbly sandstone	4	0	...	119	0
Fine-grained dark grit	9	4	...	128	4
Dark clayey sandstone	5	9	...	134	1
Dark calcareous clay with marcasite and calcite in joints	155	11	...	290	0
Dark micaceous mudstone grit with pebbles.	1	0	...	291	0
Conglomerate	18	1	...	309	1
Grey pebbly mudstone	21	0	...	330	1
Clay or mudstone with calcite and marcasite and pebbles	62	2	...	392	3
Grey calcareous grit	46	2	...	438	5
Grey pebbly mudstone with calcite and marcasite	18	3	...	456	8

W. H. TWELVETREES,
Government Geologist.

Launceston, 30th June, 1902.

ANNUAL REPORT OF THE ASSISTANT GOVERNMENT GEOLOGIST.

Zeehan, 30th June, 1902.

SIR,

I HAVE the honour to submit the following Report on the work done by me during the year ending 30th of June, 1902 :—

Up till the 14th of August, 1901, I was engaged in Launceston in completing my report on the tin-mining district of Ben Lomond, which appeared in last year's Annual Report of the Mines Department.

Since then I have been engaged, almost exclusively, in geological work on the West Coast of Tasmania.

My programme, as laid out at the beginning of the period under review, was as follows :—To visit the several mining districts on the West Coast in rotation, examining the mines and roughly mapping the main geological features of the country, forwarding to you, at the conclusion of my examination of each district, a report on the mines of that district, and reserving my observations on the general geology for a future report on the geology of the West Coast.

A portion of the programme has already been carried out, but it has proved a much heavier task than I had at first anticipated. The mining work is so extensive, the nature of the ore deposits so varied, the country in parts so rugged and so heavily timbered, and the weather is so unfavourable, that a great deal of time is required to make an effectual examination of the mines alone, apart from mapping and general geological work.

The greater portion of my time has been spent in the North Dundas district on the ore deposits, of which I have forwarded you two reports, namely—

(1) Report on the tin ore deposits of North Dundas (8th March, 1902); and

(2) Report on the ore deposits (other than those of tin) of North Dundas (30th April, 1902).

In this district I found that there was an unusual amount of variation in the types of ore deposits represented, and I have attempted to classify them according to their mineralogical composition and geological occurrence. This classification I hope to be able to extend to include all the deposits on the West Coast of Tasmania.

Besides the information contained in these reports, I have also succeeded in obtaining data for a fairly complete geological and topographical sketch-map of the greater part of the North Dundas district.

During the year I have also forwarded you the following additional reports :—

(3) Report on some wolfram sections near Pieman Heads (24th September, 1901).

(4) Report on the recent discovery of Cannel coal in the Parish of Preolenna and upon the New Victory Copper Mine, near Arthur River (9th November, 1901).

(5) Report on some discoveries of copper ore in the vicinity of Point Hibbs (30th June, 1902).

Besides my work in the above districts, I have also made an exhaustive examination of the underground workings of the Western Mine at Zeehan. This work was necessitated by the closing down of the latter, as it was thought desirable that, before such should take place, an examination should be made with the object of ascertaining as far as possible the factors which determine the distribution of the shoots of ore in the various lodes. My report on this mine will be reserved until the other mines of the Zeehan district have been examined.

I have also commenced an examination of the tin ore deposits of the Mt. Heemskirk district. My report on this district will not, however, be ready for publication in the present Annual Report.

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

GEORGE A. WALLER,
Assistant Government Geologist.

W. H. WALLACE, ESQ.,
Secretary for Mines, Hobart.

ANNUAL REPORT OF THE CHIEF INSPECTOR OF MINES.

Inspector of Mines Office,
Launceston, 30th June, 1902.

SIR,

I HAVE the honour to present my Annual Report on the inspection of mines for the year ending 30th June instant.

I append the reports of Mr. M. J. Griffin, Inspector of Mines for the Northern, 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 men employed this year in and about the mines of the State was 6438, against 7017 the previous year; the fatal accidents were 7, against 8 in the preceding year; and 35 persons were otherwise injured, against 23 the year before. The death-rate from accidents per 1000 persons was 1 ·088, compared with 1 ·140 the preceding year. The comparative table annexed hereto presents the statistics from 1892 to the present date. I also add a classified tabular statement of the accidents and fatalities which occurred during the past year.

Comparisons of the statistics of other States and countries are useful, as showing the position which this State occupies with regard to mining accidents. In the Victorian gold mines the fatal accidents were 1 ·19 per 1000 in 1900, and 1 ·02 in 1901. In New South Wales the rate was 1 ·509 per 1000 for all mines in 1900. In Western Australia it was 2 ·68 per 1000 in 1900. The returns for the United Kingdom in 1901 show a death-rate from accidents in all mines of 1 ·35 per 1000 (or 1 ·36 in coal mines and 0 ·92 in metalliferous mines).

Proceedings were taken in two instances for breaches of the Mining Act. In one case a verdict was obtained against an engine-driver for absenting himself from his engine without being relieved; the other case (against a mining manager for neglect to report an accident) was dismissed on a point of law.

I inspected the Mt. Cygnet Coal Mine during the year, but other engagements have prevented me from visiting the York Plains and Colebrook collieries.

Legislation during the year for further assuring the safety of miners in metalliferous mines and open-cut workings is comprised in the new Regulations 178, 179, 180.

Regulation 178 enacts that places of refuge shall be provided on all open cuts or surface works, and provides for danger and safety signals with bell and flag. Regulation 179 provides for giving and acknowledging signals at surface works on contiguous mines. Regulation 180 forbids anyone to work by himself in heavy or dangerous ground, either underground or at the surface.

With regard to underground surveys, the new Regulation 183 provides that all traverses must be reduced, and the calculations forwarded with the field-notes.

A Regulation (177) has been issued referring to the timbering of coal mines, and controlling the size of the pillars to be left in the first working of the coal.

In the absence of a Factories Act in this State, and in view of the fact that the Mining Act defines mines and mining as meaning and including smelting works and smelting, I take leave to ask whether Regulations could not be issued, providing for the safety of persons employed at such smelting works as are situate on land leased under the Mining Act, and Inspectors of Mines be instructed to include the inspection of such works in their duties.

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.

COMPARATIVE Table of Statistics of Accidents in and about the Mines of Tasmania from 1892 *to* 1902.

1st July to 30th June.	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.
1892 - 1893	3295	28	4	25	29	8·8001	1·214	7·586
1893 - 1894	3403	25	7	20	27	7·934	2·075	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

TABLE showing the Number of Persons killed and injured in and about the Mines of Tasmania during the Year 1901-1902.

Place or Cause of Accident.	Inspection District.													
	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	...	...	...	...	...	...	...	1	...	7	1	1	1	9
Shaft accidents—														
Suffocation by natural gases	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Overwinding	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ropes or chains breaking	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Machinery	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Falling in or into shafts	...	...	...	...	...	...	...	1	...	5	...	...	...	6
Things falling into shafts	...	1	...	...	...	...	...	...	...	...	...	...	...	1
Explosives	...	...	...	...	...	...	...	...	...	...	2	1	2	1
Miscellaneous	...	...	...	...	...	...	...	...	...	1	...	...	...	1
Total	...	1	...	...	...	...	...	1	...	6	2	1	2	9

Miscellaneous (underground).														
Explosives	...	1	...	...	...	...	...	...	...	...	...	...	...	1
Suffocation by natural gases	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Haulage :—														
On inclined planes	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ropes or chains breaking	...	...	...	...	...	...	...	...	...	...	...	...	...	...
By trams and tubs	...	1	...	...	1	...	...	...	...	...	...	...	1	1
Machinery	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sundries	...	...	...	..	...	...	...	...	...	...	...	...	...	...
Total.....	...	2	...	...	1	...	...	...	...	...	...	...	1	2
Total underground	...	3	...	...	1	...	...	2	...	13	3	2	4	20
ON SURFACE—														
Machinery	...	1	...	...	...	...	...	...	...	...	...	...	...	1
Boiler explosions	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tramways	...	...	...	1	...	1	...	...	...	2	...	3	...	7
Explosives	...	...	...	...	...	...	...	...	...	...	1	...	1	...
Falls of ground.....	...	...	1	1	1	...	...	...	...	...	...	1	2	2
Miscellaneous	...	1	...	1	...	1	...	...	...	1	...	1	...	5
Total on Surface	...	2	1	3	1	2	...	...	...	3	1	5	3	15
GROSS TOTAL, 1901-1902	...	5	1	3	2	2	...	2	...	16	4	7	7	35
TOTAL, 1900-1901.....	1	1	...	2	2	7	...	...	3	3	2	10	8	23

ANNUAL REPORTS OF THE INSPECTORS OF MINES.

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

In submitting my Annual Report, I am pleased to be in a position to state that we have been free from fatal accidents during the term. The accident list is as follows :—Serious, 6; not serious, 12. Many of the latter were of a very trivial nature.

Ropes and Cages.—Ropes and cages have been inspected and tested as required, and two of the former condemned.

Ventilation.—Ventilation of the various mines is good, and there has been no complaint to the contrary

Magazines.—Magazines are clean and in good order, but they are situated inside the town boundary, and too near dwelling-houses.

Future Prospects of the District.—The output from the field has been well maintained, and there is every prospect of my next report showing a considerable increase.

Mt. Zeehan (Tas.).—The Mt. Zeehan (Tas.), better known as the Argent, neved looked as well as it does at present. The Spray section, especially, is turning out a large quantity of rich ore, both by the company and tributors.

Montana.—The Montana is keeping up its usual output, with large reserves on hand.

Comet.—The Comet Mine is looking well; the large shoot of ore worked to such advantage at No. 2 level is being followed down to No. 3 level, with every appearance of living down to a considerable depth. Large quantities of gossan flux are also sent from the mine to the local smelters.

Silver Queen.—Several tribute parties have been doing very well on this property, which has lately changed hands, and now belongs to the Argent and Montana. I understand that preparations are about to be made for mining on an extensive scale.

Silver King.—The western drive is now nearly out to where the manager expects to cut the western run of iode; a few weeks more should settle this question. The country, at present, in face of drive, is favourable for minerals. South end of sections still remain idle.

Colonel North.—At the main workings it has been considered advisable to cease work for a time, but the prospects of the Silver Foam section, adjoining the Silver Spray, are very good.

Oonah.—This valuable property still continues idle, except above water-level, where several parties of tributors are working.

Western.—Still idle; a small party of tributors are working on the gossan near the surface.

Florence (late Smith's section).—On this property, which has been worked to considerable benefit by tributors, Mr. Quiggin, the proprietor, has put down a splendid main shaft, and is now busy erecting powerful pumping and winding machinery. A start will be made to unwater the mine in about a fortnight's time.

New Mt. Zeehan.—Only a few small tribute parties are at work on this property.

Local smelters are doing good work under the Huntingdon-Heberlein process, and are, in my opinion, the mainstay of the field.

Heemskirk.—This district will come to the front again as a tin-producing field as soon as the several companies settle their difficulties in Court, and settle down to work.

Stanley River.—The Stanley River tinfield is being again taken up, but I do not expect much result until the summer sets in.

Mt. Farrell.—At Mount Farrell mining is looking up. The North Mount Farrell Mine has a large stock of ore ready for market. Good progress is being made with the construction of a wooden tram into the district; but, in my opinion, the field fully warrants the necessary expenditure for a good steel tramway.

Comstock.—This field, I regret to say, is very quiet; the only mine doing any work of importance is the South Comstock, which, under the management of Mr. A. M. Reid, is working the large zinc-blende lode.

General.—We have numerous small parties at work all over the district, most of them adding to the output of the field. In conclusion, I am pleased to say it has not been necessary to take legal proceedings against any person during the year.

LIST of Accidents in Inspector Harrison's District, 1st July, 1901, to 30th June, 1902.

Date.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1901.							
3 July	Western S.M.	Zeehan	Fall of *débris*	Allen, John	Married	Slight injuries to leg	Was putting in sets, when a slight fall of *débris* took place, jamming his leg against the set.
16 Aug.	Hercules S.M.	Mt. Read	Fall of rock	Gillespie —	—	Bruised hip	Was retimbering a stope, a slight fall of stone occurred, some of it striking him on the hip
28 Sept.	Comet S.M.	Dundas	Fall in pass	Johnston, Thos.	—	Bruised ribs and cut elbow	Was timbering a pass; he slipped and fell about 7 feet.
17 Oct	Ditto	Ditto	Fall in shaft	Baker, Thomas Samuel	Married	Broken collar bone	Was descending manway, and stepped off ladder about 14 feet from the bottom, which he thought he had reached.
3 Dec.	Mount Zeehan (Tas.) S.L.M.	Zeehan	Truck bolted	Burke, Patrick	Ditto	3 broken ribs	Burke and his mate were braking a truck down incline, truck bolted, and Burke was thrown over tip.
1902.							
16 Jan.	South Silver King Tribute	Ditto	Fall of stone	Turley, John	Ditto	Scalp wound	Stone fell from roof after a shot had been fired.
27 „	Ditto	Ditto	Scalded by molten lead	Crompton, Jas.	Widower	Left eye badly hurt	Was pouring molten lead into a casting, some of the lead flew, a portion striking him on the eye.

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3 Feb.	Ditto	Ditto	Fall of stone	Lynch, Richard	Married	Scalp wound	Sending timber up manway, loose stone fell and struck him.
22 „	Magnet S.M.	Magnet Range	Ditto	Bell, Thomas	Single	Broken ankle	Bringing loose stone down with pick, in standing away he stumbled, and was struck by some stone.
22 Mar.	Mount Zeehan (Fas.) S.L.M.	Zeehan	Fall in pass	Mayne, Arthur	Married	Bruised side	
28 „	Smith's Section	Ditto	Fall down shaft	Judd, Harry	Ditto	Broken jaw and sprained wrist	Was looking down shaft, his foot slipped and he fell down the shaft.
7 Apr.	Oonah S.M.	Ditto	Fall of rock	Webb, George	Ditto	Cut head	Piece of slate from face fell and struck him on head.
18 „	Zeehan Montana	Ditto	Fall of timber	Delbridge, Geo.	Ditto	Compound fracture both legs	Cap piece came down after a shot and fell on his legs.
28 „	Magnet S.M.	Magnet Range	Fall off ladder	Watson, Albert	Ditto	Bruised hip	
29 „	Oonah S.M.	Zeehan	Crushed between trucks	Mancey John	Ditto	Broken collar bone	
2 May	Zeehan Montana	Ditto	Fall of rock	Rushton, Joseph	Ditto	Left leg broken	
21 „	Watt & McAuliffe's	Ditto	Fall down pass	Watt, Jabez	Ditto	Broken leg and injured back	
18 June	Silver Spray	Ditto	Fall of rock	Hodgetts, R.	—	Dislocated hip	

Fatal accidents, 0; Serious, 6; Non-serious, 12; Total, 18.

Mr. Inspector CURTAIN (stationed at Queenstown) reports :—For the twelve months ending the 30th of June the following casualties have taken place in my district, viz. :—Mount Lyell Mining and Railway Company, Limited—(1) Michael Contini, surface hand, aged 40 years; bruised ankle and calf of leg, caused by piece of spoil rolling over in one of the open-cut benches; his recovery was speedy, and he resumed his usual work. (2) Frederick Ganter, repairer, aged 42 years, married; jammed the fleshy part of his thigh between two waggons, one of which he was repairing; the accident was attributable to the man's thoughtlessness in not providing for the constantly-returning empty waggon that had to be shunted on to the line upon which he was working; he was incapacitated for six weeks. (3) Arthur McGlade, horse-driver, aged 23 years; contused wounds to calves of legs, caused by being run over by front truck in a rake of ore of which he had charge; he made a quick recovery, and resumed his usual calling. (4) Patrick O'Malley, quarryman, aged 31 years, single; scalp wound and concussion of brain, caused by flying stone from a shot. O'Malley, in company with others, and contrary to the general instructions of the mine, was having his crib in the blacksmith's shop, 460 feet away from the scene of operation, when a flying piece of rock from a late or emergency blast penetrated the building, and, striking him on the side of the head, produced the aforementioned injuries; pneumonia supervening possibly accelerated his death, which took place six weeks later. At the Coroner's inquiry the jury pointed to the fact that the powder-monkey, who had temporary charge of the work at the mine, was, in their opinion, culpable for not having given the customary bell-warning before lighting the fuse. (5) Joseph Dougherty, machine-man, aged 33 years, married. (6) James Patrick Kelly, assistant machine-man, aged 39 years, married. Both of these men were fatally injured by a premature explosion on the No. 5 stopes of the main workings. Kelly's death was almost instantaneous, Dougherty's taking place 15 days afterwards. The men were engaged charging a hole with, it is believed, rack-a-rock—Kelly putting in the ammunition, and Dougherty ramming it home with a wooden tamping-rod—but beyond this little was elicited at the inquest which would lead to a positive explanation of the actual cause of the disaster. On the day following the accident I visited the casualty ward, and, through the wardsman, learned from Dougherty the class of tamping-rod which he was using. I further desired to obtain from him his account of the occurrence; but, in his interest, the medical officer prevented me, which is now to be regretted, as Mr. Batchelor, the engineer in charge of the mine, has since obtained a statement from three persons to the effect that Dougherty told them "that two plugs of rack-a-rock had been placed in the hole, and he was hurriedly ramming home *a plug of gelignite* with something more than ordinary force, when the explosion took place." Should this be true, it illustrates the necessity of taking great care when using any of these highly-explosive compounds. (7) John O'Shea, miner, aged 24 years, married; nervous shock, sustained while working in the stope in which the explosion previously described took place; a week's attention and rest completed his recovery. North Mount Lyell Mining and Railway Company, Limited—(1) John Breen, miner, aged 54 years, widower; crushed chest, and hole in side from which his intestines protruded, causing death instantaneously. Deceased, with a

man named Pinkerton, and another, was engaged turning a piece of ore over in the stope, when a large slab of ore slipped from the side, and pinned him against the piece with which he was occupied. A careful examination of the surroundings disclosed the fact that all reasonable precautions had been taken, and that the cause and circumstances could only be attributed to accident. (2) William Pinkerton, miner, aged 46 years, married; bruised about body. Pinkerton was assisting Breen, but being, fortunately, on the side of the stone, was simply pushed forward into the stope, and escaped with the injuries aforesaid. He made a complete recovery, and is still employed on the mine. (3) Edward Oliver, surface hand, aged 43 years, married; bruises to head and body, caused by being taken over the mullock-dump with a truck which he was assisting to empty. This accident was occasioned by the sticky nature of the spoil, and the men's want of thought in selecting a short lever to hold the load. Oliver resumed work, but has now left the district. Mount Lyell Blocks Copper Corporation, Limited—(1) Frank Taylor, assisting timber-man, aged 20 years, single; a gash wound above ankle, caused by losing control of an adze. Taylor was engaged levelling the bed-logs that were required to seat a steam winch. He was removed to the hospital, where it was found necessary to perform an operation. While still suffering, he left for Victoria. Owing to this accident not being reported in pursuance of Section 89 of the Mining Act, proceedings were taken against the mining manager, but the case was dismissed on a law point.

Ropes and Cages.—These have been periodically tested, and replaced and repaired where necessary. Dealing with the latter, two mounted with Cowling's appliances in no instance came up to our requirements, and for the transit of men were in one compartment replaced by those of another maker. Cowling's cage, however, has one most valuable essential, viz., a lever which can be used by those travelling in it. This accessory should be fixed to all cages, and those without it can scarcely be considered up-to-date.

Ventilation.—The mines in operation are, so far, satisfactory. However, not only for ventilation, but also for the safety of those engaged in the Lyell Blocks Mine, other connections will have to be made with the higher or surface workings, whereby an exit apart from the shaft may be afforded.

Open Cuts and Quarries.—These having assumed huge dimensions, which will increase as work proceeds, I am of opinion that more definite legislation is necessary for regulating their height and angle of safety. The regulations would have to be such as would satisfy mine-owners and at the same time assure the safety of workmen. For this and other purposes, I should be pleased to hear that the Mining Board had decided to hold a meeting on the West Coast.

LIST of Accidents in Inspector Curtain's District, 1st July, 1901, to 30th June, 1902.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1901.							
25 July	Mount Lyell M. & R.	Mt. Lyell	Rock rolled on leg	Contini, Michael	Married	Bruised ankle & calf of leg	Landing stones by means of a crane, in open-cut, when one of the stones rolled, and crushed his leg against a truck
6 Aug.	Ditto	Ditto	Caught between two dobbies	Ganter, Frederick	Ditto	Contused wound on thigh	Mending a dobbie on dead end of line; another dobbie was run into the end, crushing Ganter between the two.
4 Oct.	Ditto	Ditto	Run over by truck	M'Glade, Arthur	Single	Deep gashes on legs	Was horse driver; was stepping into front truck, when he slipped and fell in front of it, the truck passing over his legs.
6 Nov.	North Mt. Lyell	Ditto	Fall of rock	Breen, John	Widower	Killed	Breen and Pinkerton were working in a stope, and a slide took place.
,,	Ditto	Ditto	Ditto	Pinkerton, Wm.	Married	Bruised side	
1902.							
10 Feb.	Mt. Lyell Blocks	Ditto	Cut with adze	Taylor, Frank	Single	Cut above ankle	Was using an adze, and it slipped.

26 Mar.	Mt. Lyell M. & R.	Ditto	Truck ran off line	Oliver, Edward	Married	Bruises to head & body	Was trucking, and got carried over tip with the truck.
„	Mt. Lyell (South Tharsis)	Ditto	Explosion	O'Malley, Patrick [rick	Single	Concussion of brain	Struck by flying stone from blast ; died 7th May.
26 April	Mt. Lyell M. & R.	Ditto	Ditto	Kelly, Jas. Pat-	Married	Killed	Kelly & O'Dougherty were charging a hole, and it prematurely exploded ; Kelly was killed, and O'Dougherty received such injuries that he succumbed, on the 12th May. O'Shea was working near, and suffered from shock due to concussion.
„	Ditto	Ditto	Ditto	O'Dougherty, Joseph	Ditto	Severe injuries, face, neck, arms	
„	Ditto	Ditto	Ditto	O'Shea, John	Ditto	Concussion	

Total accidents, 4 ; Serious, 7 ; Total, 11.

Mr. Inspector GRIFFIN (stationed at Gladstone) reports :—

I have the honour to submit my Report on mines inspected in the Northern, Eastern, and North-Eastern divisions for the year ending 30th June, 1902.

Accidents :—Fatal, 3; serious, 8; non-serious, 2; total, 13.

Of the fatal accidents, Carl Rudolph Anderson, a married man, aged 47 years, who was employed in the open-cut workings of the New Hope Tin Mine, went, of his own accord, after his day's work was done, to examine the face-prospects, and, while standing with his back towards the face, was struck from behind by a large lump of earth that toppled from a heavy slip in the face. This forced him on to the pick-handle, the hand end of which was resting against the lower part of his body in front. Death was almost instantaneous. No person is to blame for this accident. Arthur Broomhall, a single man, aged 20 years, was employed by the contractor for the construction of the Anchor Tin Company's water-race at a place about 12 miles from the mine. While engaged in excavating the race-channel, he was caught and fatally injured by a fall of rock from the side of the channel, death ensuing in a few hours. Deceased and his mates—a party of six men—were sub-contractors, and no one in particular was supervising the work; otherwise, more care would have been taken to see that the loose rock was trimmed down before proceeding to remove the portion lying in the channel. It is difficult to make mine managers understand that they are responsible for the supervision and safe working of contracts let by them for the construction of water-race channels, whether such channels are beyond the boundary of the mine proper or not. Thomas Parsons, a married man, aged 36 years, was employed as deputy-overman in the Mount Nicholas Colliery. When assisting the set-wheelers to couple and send off a set of loaded coal-skips from the flat or siding in the main tunnel (engine-hauling line), he was jammed against the wall by an empty skip, forced on to him by contact with the moving set of loaded skips, and received severe internal injuries, from which he died five hours later. This accident was mainly caused through crowding too many empty skips on to the siding, and thus narrowing the clearance space between the loaded and empty sets. It was the duty of deceased, as deputy overman, to see that sufficient space was allowed; and his incautiousness and want of judgment in this direction cost him his life.

Of the serious accidents :—John Barrett was working down the batter of an open-cut deep tail-race at Scotia Tin Mine, and was caught and jammed against the side of the race by a large lump of pug and grit that slid from the batter. He received severe contusions about the back and hips, and was laid up for a fortnight. William Huxley, engine-driver, was cleaning compressor-engine when in motion, at Tasmania Gold Mine; he got his hand caught between connecting-rod and bed-plate, which caused severe laceration of the hand. Joseph Hearps, tram-horse driver at the New Brothers' Home No. 1 Tin Mine, was struck by the axle-pedestal of a truck from which he had just detached the horse, and received a nasty flesh wound on the outside of left thigh, also bruises and scalp-wound. It was a long time before he was fit for work again. Frank Holland, trucker at the open-cut workings of the Australian Tin Mine (Lottah), while running trucks to the foot of the engine hauling-line, got his foot caught in a crevice at turning-table, and was

thrown down by the truck, which he was in front of at the time, steadying it on to the table, and had his thigh-bone fractured. It was not really necessary for him to go in front of the truck, and he has mainly himself to blame for the accident. J. Trezise, platman at Tasmania Gold Mine, was taking a piece of timber along the level on a trolly; the trolly came off the line and jammed his foot, causing severe pain. Frederick Wagner, general hand, was employed by a contractor erecting trestle work at the Pioneer Tin Mine, and the structure, for want of fore-and-aft bracing, collapsed in line; Wagner, who was on top at the time, went down with the falling timbers, and had to be extricated from beneath its mass. He received a nasty scalp-wound, also contusions and cuts about the face and eyes, and was insensible for a short time, but soon rallied, and within a fortnight was well enough to go to work again. On 19th November, 1901, Hugh Parish, a married man, age 34 years, was employed winze-sinking in the Tasmania Gold Mine at Beaconsfield. The winze was only down about 3 feet. Two shallow holes were charged; Parish spit the fuse in the first of these, but failed, as he thought, to get the second fuse lighted; and, being warned by his mate (William Cornelius) not to remain any longer, left for a time. Ten minutes after the explosion from the first hole, he returned, and was just about to descend into the pit, when the second charge exploded. He received a very severe peppering about the face and eyes from the dust and small fragments of stone; the injuries received, although painful, were not of a permanent nature. On 11th June, 1902, J. Burt, married, age 35 years, was working in a winze 12 feet in depth at the Tasmania Gold Mine, Beaconsfield. His mate at the windlass failed to hook on the empty bucket properly; it fell away, striking Burt on the back, and causing injuries, which, however, were not of a very serious nature. He was at work again within a fortnight.

Of the non-serious accidents :—John Mullins was assisting to roll a log at the Mt. Rex Tin Mine, and he received painful contusions to his foot by being jammed by the log he was assisting to remove. John McKercher, carpenter at the Tasmania Gold Mine, received bruises about the body through a suspended log swinging against him. The cause of the majority of the foregoing accidents may be traced to the incautiousness, and, in some cases, to the inexperience, of the injured men themselves; some were unavoidable; and only in two cases could it be said that any blame whatever was attachable to the mine-owners or management. At the Mt. Nicholas Colliery it was wrong to appoint an inexperienced man like Thomas Parsons to the responsible position of deputy overman during the temporary absence of the underground manager; and his inexperience in the handling of skips on the haulage-line cost him his life.

Legal Proceedings.—Only in one case was it necessary to take proceedings against any person for a breach of the Rules. An engine-driver at the Moonlight-cum-Wonder Gold Mine was proceeded against for having absented himself from charge of steam machinery, in use for the working of the mine, without being relieved by a competent person for that purpose. A verdict was obtained, and defendant fined £2 and costs. It is to be hoped that the result of the proceedings taken in this case will prove a warning to all persons in charge of steam machinery. Had the offender remained at his post, a fatal accident in the mine would in all probability have been averted. The stopping of the

blower engine, for even so short a time as elapsed between the departure of one driver and the arrival of another, was sufficient to allow of the accumulation of foul natural gas at the bottom of the shaft in such quantity as to cause the death of a miner who incautiously descended into it.

Observance of Rules and Regulations.—On the whole, it may be said that an improvement is noticeable in this direction; more care is taken in the handling of explosives for one thing; and, again, miners appear to be more alive to the responsibility of the part they are required to take for the safety of all concerned.

Ventilation.—This is generally good in the small mines; in the large mines, however, the use of the anemometer in measuring air-currents shows defective distribution. The quantity of fresh air passing into the mine by the natural down-cast is in nearly every case adequate, and if properly regulated would effect its purpose. It is, however, sometimes dispersed to such an extent at the lower level of a mine as to be ineffective at the next level above. At the Tasmanian Gold Mine much is being done to improve the ventilation; regulating doors have been fixed in some of the main crosscuts; a drive is being extended from the 718-feet level to connect with Phœnix shaft; a connection is also being made directly with the old Lefroy shaft from the same level. The two main shafts, old and new, will be connected by a drive from the 718-feet level in the former to the Riedler pump-chamber at the 600-feet level in the latter; this work is now in hand, and, as driving from both ends is carried on simultaneously, should soon be finished. In addition to the foregoing, as a means of improving the ventilation of the mine, a Root's blower, capable of supplying 10,000 cubic feet of air per minute, has been procured from a Liverpool company of engineers, and is now being placed in position near the Florence shaft. Down this shaft the air will be carried in pipes of 22 inches diameter; thence, along the levels, in wooden boxes of equal sectional area. So much acid in the mine water debars the use of iron pipes in the western division of the mine. The Riedler pump, at the 600-feet level in the new main shaft, is worked by steam carried down from the surface; a condenser is used, but this does not prevent overheating of the shaft and chamber. Steam escapes from pipe-joints and engine, thus creating a moist atmosphere, the temperature of which is not less than 110 degrees Fahr. The Riedler is a highly-efficient pump, and if worked by electricity or compressed air would not interfere with the ventilation of the mine. Worked as it is, by steam, it does interfere by overheating, apart from which there is always the danger of the bursting of a steam pipe, and its consequent effects by filling the shaft and level with scalding steam. I consider the use of this steam pump in a shaft or level where men are employed at ordinary mining work, and where such shaft is the only means of exit, to be unsafe; and have notified the general manager that great care must be exercised until such time as this shaft and the main shaft are connected by the drive already referred to.

Safety Cages, Ropes, Chains, &c.—Inspection and testing of these have been regularly attended to. In the smaller mines several ropes have been condemned. The practice of weekly careful inspection and periodical cleaning of ropes in the big mines, and where haulage is from a considerable depth, is found

to be safer than testing by loading to twice the ordinary weight carried; this latter test is only applied when a new rope or new shoe on old rope is put on.

Outlying Mines Inspected.—During the month of February of this year I inspected the following mines :—Tasmanian Iron Company Mine, at Penguin; Barnes' Iron Mine, at same place; the coal mines at Dulverton and Spreyton, near Latrobe; also the mines in the Middlesex district; but I did not go to Barn Bluff, as the time at my disposal was too limited, owing to having river-snagging work, as well as alluvial boring operations, to supervise. The new track from Gad's Hill to the "Bluff," now finished, will shorten the distance, as compared with the old route, by about half.

Mine Equipment and Development.—The Tasmania Gold Mine has the new main shaft down to the 1100-feet level; a crosscut from the 1000-feet level in this shaft cut the main lode within 300 feet of the plat. An increase in the flow of water necessitated the bringing into use of one of a pair of Riedler pumps, which had been already provided and fixed in a large chamber at the 600-feet level. Three new boilers at the surface supply steam to these pumps. The old 14-inch draw-lift, used for sinking the shaft, is still in use. At the old shaft the hydraulic machinery is used to take the place of the 14 and 18 inch draw-lifts between the 718-feet and 818-feet levels. The Riedler pump in this shaft is not now used. The hydraulic pump is working efficiently. A new 40-head battery has been added to the crushing plant, bringing the number of stamps up to 103 heads.

Mathinna.—The New Golden Gate shaft has been sunk to a further depth of 200 feet; the total depth from the surface is now 1600 feet. Cross-cutting from the 1500-feet and 1600-feet levels is about to be commenced.

The *Volunteer Gold Mining Company* has removed its 10-head battery from Lefroy, and erected it on the freehold portion of their property at Mathinna. At the New Golden King Mine a steam winding plant has been erected.

Tin Mines.

The *Mt. Rex Mine*, after a few months' run, shut down towards the end of last year, the difficulty of treating the ore, which is of a complex nature, rendering this course necessary, pending a solution of the difficulty. Work has now been resumed, and the main shaft will be sunk another 100 feet.

At the *Stonyford Tin Mine* (*St. Helens*) a new plant, comprising a five-head battery, stone-crusher, jigs, vanners, and buddle, has been erected. The buildings erected are of a roomy and substantial nature, providing space for an additional five heads, and dressing plant. The machinery, including a portable boiler and engine, was procured from the Gates Company of Engineers, America. Very little has been done to prove the value of the lode; about 200 tons of stone taken from an open cut and shallow shaft are stacked on the surface; an assay of this is said to give highly payable results.

The *Anchor Company* has finished the construction of its new water-race to the North George River. It is expected that the supply from this source will be sufficient, in addition to the water already in use from the local races, to keep the 100-head battery running for nearly the whole year.

Liberator.—This mine is shut down.

Crystal Hill.—Great results were expected from this mine when the plant was erected. It is disappointing to find it a failure; but it is, however, doubtful if the tests made were exhaustive enough to prove the value of the mine.

Briseis Mines.—The new water scheme—the Briseis-Ringarooma-Maurice race—was completed and opened on the 16th April, 1902, since which date the water supply of the mines has been slowly increased, until the full supply of 100 sluice-heads (for which it was designed) was delivered hourly; and this has easily been maintained. It is not expected by the management that the supply from this race will even in the driest summer fall short of 60 heads. This race covers in all 30 miles of difficult country, including four syphon columns of 38 and 40 inches diameter steel pipes, measuring upwards of two miles. A telephone line has been constructed throughout the whole length of race. The company now owns 40 miles of head-races, supplying a maximum of 232 sluice-heads, equal to 2,088,000 gallons of water per hour, the average being something less than two-thirds this quantity. At the mines, work has been confined almost entirely to removal of overburden, which, since the advent of the new water supply, has been got rid of at the rate of 10,000 cubic yards per week. The output of tin ore has averaged for the year ending 30th June, 1902, about 15 tons per month, equal to about 11 tons metallic tin per month. It is intended to pursue the policy of removal of overburden, until the tin-bearing drifts can be attacked on a large scale without fear of serious stoppage. Large quantities of tailings have been disposed of on the company's dumping-area, the Ringarooma River having been already saved in this way over 150,000 cubic yards. A new and powerful electric plant is under erection, driven by a 3-feet diameter Pelton water-wheel, for lighting purposes. The ground below sluicing level will be elevated by hydraulic pressure; one elevator is already in use for this purpose.

New Brothers' Home No. 1 Company.—Work at this mine for the past year has been confined to removal of overburden, the upper portion of which, consisting of columnar basalt and soil, was trucked out dry and dumped. The quantity removed from the A face in this way was 47,679 cubic yards. Cost per yard, as follows :—Labour, breaking, trucking, and tipping, 6½*d.*; driving headings, laying trams, making waggons, lighting, explosives, stones, supervision, &c., 2¾*d.* Total, 9¼*d.*, all charges included. At the B and C faces the full depth of basaltic overburden, as well as a portion of the drift beneath it, was removed by sluicing and trucking, as follows :—Sluiced out 59,203 cubic yards; cost, all charges included, 4½*d.* per cubic yard. Stone taken from sluices at same levels and trucked out, 35,310 cubic yards; cost per cubic yard, 10*d.* The cost of sluicing off the overburden is not high, considering the restriction of not being allowed to put solid matter of a size exceeding 2¼ inches diameter into the Ringarooma River. This company has made very good progress with the removal of overburden during the year. It is estimated that they have now 80,000 cubic yards of tin drift uncovered, and 120,000 half uncovered. The only tin obtained during the year was 3 tons 4 cwts., sluiced from a portion of the drift removed with overburden.

Arba Tin Mine.—For the past six months or so developmental work has been going on; a drainage tunnel is being driven, and it will soon be through into the main face. The object of this is

to carry off the overflow water from the sandbins, into which the tin, sand, and gravel are pumped by the centrifugal sand-pump, from the bottom level. The total height from the bedrock in the deepest part of the mine to the surface of the ground is 120 feet; for the first 25 feet from the bottom, the sand-pump, fixed on a large pontoon, will be used for elevating the tin drift into the bins already referred to; the second lift, of 95 feet, will be accomplished by means of an inclined tramway, on which cylindrical tanks fixed on wheels run. These tanks pass beneath the sandbins, and are easily filled, and quickly hauled to the surface and automatically tipped into the sluice-race. By this means some 850 cubic yards of stuff can be elevated to a height of 100 feet in every 24 hours. The proportion of water to sand lifted by the centrifugal pump is said to be 30 of the former to one of the latter, the proportion for the tanks being four of sand to one of water. In these deep open-cut drift workings, where the natural drainage water, as well as the water from the breaking-down nozzle, has to be lifted with the gravels, the use of the sand-pump is indispensable for the first lift, or to such a height as, in the case of this mine, the surplus water can be got rid of. After this is obtained, it would appear that the tanks as described worked on an inclined tram, and self-tipping would give a higher percentage of efficiency. It will take another three months to complete all preliminaries, after which time the company will be able to commence tin-getting on an extensive scale.

Ringarooma Tin Mine (Derby).—Removal of the overburden has been persistently carried on for several months past, a continuous and efficient supply of water for nozzles and sluices being obtained by a powerful pumping plant erected on the river bank, close to the sluicing faces. The average number of sluice-heads pumped to a foot head-pressure of 250 feet was 16 ·5, equal to 149,111 gallons per hour. The average cost per 1000 gallons pumped was 1 ·183*d.*, equal to 10 ·7*d.* per head per hour. The average cost per cubic yard for removing the overburden during the past six months was 4 ·35*d.* The greater portion of the overburden removed during the past year has been dumped on the company's lease.

Pioneer Tin Mine.—Since the completion of this company's new centrifugal sand-pumping plant, a description of which was given in last year's report, good progress has been made, as the following statistical information, furnished by the mine manager (Mr. Cecil G. Ryan) will show :—

For year ending 30th June, 1902—

Number of cubic yards of drift sluiced, 227,900.
Yield in tons of stream tin, 217 ·4.
Average recovery of stream tin in lbs. per cubic yard, 2 ·136.
Yield in tons of metallic tin, 157 tons 19 cwts. 0 qr. 19 lbs.
Average percentage of metal per cubic yard, ·044%.

To date, 349,300 yards of drift, carrying 1 ·9 lbs. of stream tin per cubic yard, have been pumped and sluiced for a yield of 299 tons of stream tin, and during the last six months three dividends, amounting to 7*s.* per share, have been paid. The drift is pumped from the working face into the tail-race, a vertical height of 70 feet. The tail-race is 8 chains long and 10 feet wide, having a fall of 20 inches per chain. Sluicing to date has proved the accuracy of the bores put down previous to equipping the mine. The lead has not yet been bottomed right across. To lift this bottom ground to the level of the suction-pipe of pump

an elevator will shortly be installed; this will greatly increase the radius of action for the pumping plant, so that it will seldom require removing. The average number of men employed is 33, not including wood-cutters and carters, amounting to another 20.

Ringarooma River Snagging.—During the year the seven-mile stretch of river between the Townships of Derby and Moorina has been snagged, and improved, for the better get-away of tailings, the accumulation of which was seriously interfering with the sluicing operations of the three big companies at the former place. Of the £1000 obtained for this work, £500 was paid by the Government and £500 contributed by the three Derby companies—Briseis, New Brothers' Home No. 1, and Ringarooma; £925 of this sum has been expended in snagging and removing the network of timber lying in the natural channel, in constructing timber-groins to confine the stream to this channel, and in a cut through and retaining wall at Mutual Flat. The improvement effected is as yet only noticeable in the first few miles above Moorina; the immense deposit in the river between Mutual Flat and Derby is now, however, beginning to cut down; a good flood is required to cause a scour in this portion of the river.

LIST of Accidents in Inspector Griffin's District, from 1st July, 1901, to 30th June, 1902.

Date.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1901.							
5 July	New Hope T. M.	Branx-holm	Fall of earth	Anderson, Carl R.	Married	Killed	Was leaning on his pick handle with his back to the face; a mass of earth fell from the face, striking him on the back, causing fracture of pelvis bone and rupture of the intestines.
6 July	Mount Rex T. M.	Avoca	Log rolled on foot	Mullins, John	Ditto	Bruised foot	Was helping to roll a log, and his foot got caught by it.
5 Sept.	Scotia T.M.	N. Mount Cameron	Slip of earth	Barrett, John	Single	Bruised thigh and hips	Was battering down a tail-race; the race choked. and in attempting to clear it he was crushed by a lump of cement
5 Sept.	Pioneer T.M.	Bradshaw's Creek	Collapse of trestle work	Wagner, Frank	Ditto	Contused head and face	E ecting fluming trestles 12 to 15 feet high; several collapsed, and Wagner was carried with them.
26 Oct.	Tasmania G.M.	Beacons-field	Crushed by timber	McKercher, John	Married	Crushed and bruised	Was lifting piece of timber, and it came back and crushed him.
19 Nov.	Ditto	Ditto	Explosion, gelignite	Parish, Hugh	Ditto	Cut face	Shot missed; after waiting some time Parish returned; as he was decending, the shot exploded.
20 Nov.	Anchor T.M.	Blue Tier	Fall of rock	Broomhall, Arthur	Single	Injured back and loins, causing death in 4 hours	Was removing stone shot down, and a large lump slipped from side and struck him. Died 4 hours afterwards.

List of Accidents in Inspector Griffin's District—continued.

Date.	Name of Mine	Locality.	Cause of Accident	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1901.							
31 Dec.	Tasmania G.M.	Beaconsfield	Machinery	Huxley, W.	Married	Lacerated hand	Cleaning air-compressor, and his hand was caught between connecting-rod and bed-plate.
1902.							
4 Feb.	New Brothers' Home T.M.	Derby	Knocked down by truck	Hearps, Joseph	Single	Lacerated thigh and scalp wound	Was horse-driver on low-level dump line. Detached horses from trucks, but failed to get clear, and was knocked down.
28 Feb.	Australian T. M.	Lottah	Run over by truck	Holland, Frank	Ditto	Left leg broken above knee	Was trucking; he slipped, and was run over by truck.
9 May	Mt. Nicholas Coal	Mt. Nicholas	Jammed by truck	Parsons, Thos.	Married	Internal injuries, causing death in 5 hours	Was helping to send off a full set of skips; these collided with empties, and jammed Parsons against side of tunnel.
11 June	Tasmania G.M.	Beaconsfield	Fall of bucket in winze	Burt, J.	Ditto	Bruised back and shoulders	Working in winze; bucket became detached from hook whilst being lowered, and fell on him.
15 April	Ditto	Ditto	Jammed by trolly	Trezise J.	Married	Bruised foot	Was trollying piece of timber along drive; trolly ran off line and jammed his foot.

Fatal accidents, 3; serious, 8; non-serious, 2; total, 13.

REPORTS OF THE COMMISSIONERS.

Mr. Commissioner FOWELL (St. Helens) reports :—

I have the honour to submit my Report for the year ending 30th June, 1902, upon the mining industry in the Eastern Mining District :—

Gold.

Mathinna and vicinity.—The New Golden Gate.—I visited this mine on the 16th instant, and found, as usual, thorough work going on, with satisfactory results. The main shaft is being carried down, and whilst I was there some stone from the 1400-feet bearing gold visible to the naked eye was brought to the surface. This mine during the last quarter has produced 2677 ozs. from 5180 tons quartz, and 621 ozs. by cyanide process, employing 166 men.

On the *Volunteer Mine* a considerable amount of work has been done during the last four months. A battery has been erected, and is now in full work; a crushing of 500 tons yielded 144 ozs. gold; 30 men employed.

The other properties working are :—

The *Golden King*, 96 tons treated, 251 ozs. won, and 26 men employed.

The *East Volunteer, Revenue Prospecting Association, Douglas Prospecting Association, Golden Princess Prospecting Association, Loans Prospecting Association*—are all prospecting.

The claim known originally as the *Tasmanian New Golden Gate Extended,* has recently been taken up by a new company, called "The Tasmanian Consols, Limited." The legal manager is advised that the mining director is shortly to arrive, and mining operations will be started. The company has a working capital of £15,000. As the stone in the New Golden Gate has been followed to the boundary of this property, there should be good results. A firm of underwriters have offered to send an expert to report upon the mines in the vicinity of Mathinna, and, if favourable, are prepared to underwrite £2500 for the purpose of re-opening the City of Hobart Mine, the property of the Tasmanian Exploration Company, Limited.

Mangana and vicinity.—Mangana Reefs.—121 tons of quartz have yielded 92 ozs. of gold, and 16 men have been employed on tribute. The other properties in this neighbourhood are prospecting. Abbotsford employs 30 men; Miami, 4; Golden Entrance, 5; Hit-or-Miss, 3. So much of the land in this portion of the district being private property very much retards its progress. Several good shows are known to exist.

Tin.

Avoca and vicinity.—Mt. Rex Mine.—During the quarter ending 30th June last 30 men have been employed, and one ton of tin

has been raised. The difficulty of finding a market for the complex ore has retarded progress on this mine. The company is about to sink a shaft from 50 to 100 feet, to prove the ore at a depth. The only other company working in this neighbourhood is the South Esk, which, during the past quarter, has raised 12 tons 5 cwts. of tin, and employed 12 men. Prospecting is being carried on at Aberfoyle, and also prospecting under licence, five claims being held.

St. Helens and vicinity.—The Royal Ruby Company is bringing in water a distance of 12 miles from the Groom River; the race is anticipated to be completed in about six weeks. At the Stony Ford a very complete and up-to-date plant is being erected, consisting of a battery of five head of stampers, with dressing machines. It is intended to start work during the present week. On Thureau's Deep Lead four men are working; during the last quarter they have raised 1 ton 6 cwts. of tin. On Patterson Brothers' lease two men have raised 9 cwt. There are also 23 men working on miners' claims, who have raised 6 tons of tin.

Lottah and Blue Tier.—At the Anchor Mine 31 tons 10 cwts. have been raised during the last quarter, and 77 men employed. The race from the George River has been completed; but in all probability it will be found necessary to extend it, so as to tap the second branch of the river to secure a sufficient supply during the summer months. On the Australian Mine 11 tons 18 cwts. have been raised by 28 men during the quarter. On the Blue Tier eight Europeans and six Chinese are working miners' claims, and have raised 1 ton 18 cwts. of tin.

Weldborough and vicinity.—The Weldborough Company has raised 1 ton 8 cwts. with nine men. The Weldbrook Company has done a considerable amount of work during the past year. Its tunnel is nearly completed, but, unfortunately, in rising it has come across soft country, which has caused considerable trouble. It is to be hoped it will soon be overcome. A good and substantial dam has been constructed to conserve its water. Besides these companies' workings, there are eight Europeans and 49 Chinese on miners' claims, who have raised during the quarter about 8 tons 9 cwts. of tin.

Coal.

The miners' strike has seriously affected the output of coal during the year, which is very much to be regretted, especially in the instance of the Cornwall Company, which, by a recent strike, has been obliged to relinquish a contract; and all this trouble caused by the action of two or three men acting upon purely selfish views.

Mt. Nicholas Mine.—During the past quarter 7117 tons have been raised, and 61 men employed.

Cornwall Company (now on strike).—1739 tons raised; 76 men employed.

Cardiff.—Twelve tons raised; 14 men employed.

Jubilee.—Three tons raised.

Coal has also been discovered at St. Paul's River, about 14 miles from Avoca. The seam is reported to be 10 feet in thickness.

Mr. Commissioner O'Reilly (Scottsdale) reports :—

I have the honour to submit my Report for the year ending 30th June, 1902, upon the state of mining in the North-Eastern Mining District.

Gold.

I cannot report any marked improvement in the state of the gold mining industry since my last Annual Report.

At Mt. Victoria mining operations are carried on by small parties of working miners, principally on tribute; very payable returns have been won. The prospects of the several claims worked are considered very good, the stone being rich. The last crushing at the Ringarooma Gold Mining Company's claim, The Mercury, yielded 281 ozs. 5 dwts. from 56 tons of quartz, five men being employed on tribute. Sewell and party, on their claim, Long Struggle, obtained at their last crushing 59 ozs. of gold from 28 tons of quartz. The Ringarooma Gold Mining Company has not resumed mining operations since its battery was burnt (about two years ago), but has let its mine, situate upon freehold property, at New River to a party of tributors. I am informed that the prospects of this mine are very good. The richness of the yields obtained by small parties of co-operative miners during the past year should be sufficient inducement for the introduction of capital to test the lodes to a good depth. Until capital is available for this purpose, there is not much prospect of this promising goldfield making any material progress.

Mining operations at Warrentinna have been suspended, work being confined to prospecting, principally.

At the *Portland Mine*, near Gladstone, mining operations have been resumed by the lessee, who is about to treat the lode at the mine, and thus save the expense incurred by the former company in forwarding it to New South Wales for treatment. He looks forward to obtaining very satisfactory returns. The tailings from the original workings at the Royal Tasman Mine at Gladstone have been treated by cyanide process by the lessee, and very satisfactory returns of gold won, six men being employed during the summer and autumn months at this work. No mining operations have been carried on at the Waterhouse goldfield during the past year. For the twelve months ending 30th June last, 1030 ozs. of gold have been won from quartz, as against 935 ozs. for the previous year.

Tin.

In the localities of Ringarooma, Mt. Maurice, and Upper Cascade River, there are a considerable number of small claims, principally held as miners' claims, worked with satisfactory results, about 60 Europeans and 10 Chinese being thus employed.

The lessees of the Star of Peace Mine at Belmont are erecting a ten-head battery, which will shortly be completed. I am informed that the tin lode on this claim, so far as it has been prospected, appears very rich, and the prospects of the mine are considered very encouraging.

In the locality of Branxholm, the Arba Tin Mining Company is taking vigorous proceedings towards the development of its mine, and has provided a more powerful plant, to enable the tin-bearing deposits to be elevated from the lowest levels, where it is said they have been found to be very rich in tin ore. These

necessarily to temporarily suspend mining operations, as it was impossible to cope with the drainage water without constructing a drainage tunnel of some 1133 feet to connect with the tunnel formerly constructed. After overcoming some difficulties, this work will be shortly completed, when mining operations will be resumed on a much more extensive scale than heretofore. So far as I can learn, the prospects of this mine are very good, and large yields may soon be expected. In the near locality of Ruby Flat there are a few leases (mined by Chinese) yielding satisfactory returns.

In the vicinity of Derby, the Ringarooma Tin Mining Company is confining its mining operations principally to removing the heavy overburden above the tin-wash, and this work will be continued for several months, so as to enable the mine to be worked in a safe and systematic manner. When this work is completed, it is expected that large quantities of tin will be won. The pumping plant, provided at considerable cost, answered very fully all that was required of it, sending the water with great force and evenness from the river through the nozzles. A very convenient dumping-ground has been provided on the flat fronting on the river, which affords ample space for deposit of tailings, and also gives great facilities for the working of the mine. A tramroad has been constructed into a forest of timber, from which an ample supply of firewood will be cheaply obtained. Electric light is provided for carrying on mining operations during night time.

At the *Briseis Tin Mines Limited Mine* very active and extensive mining operations have been carried on under new management, principally in removing the heavy overburden above the tin-wash.

The new Briseis-Ringarooma-Maurice head-race has been completed, at a cost, as I am informed, of £67,000, and is, as stated, capable of conveying to the mine over 100 sluice-heads of water, and works satisfactorily, affording very enlarged facilities for the removal of the overburden in the mine, and also for the working of the hydraulic elevators used for raising the tin-wash from the low levels of the mine. A dumping-area has been provided on the flat fronting on the river, and is largely used for the sluicing of tailings and débris thereon, thus relieving the river of a large quantity of stuff being deposited in it. A large dump-site will also be provided on the worked-out portion of the former Krushka Bros.' Mine, which will retain a very large quantity of stuff. A large stone weir or dam, to be about 60 or 70 feet in height, is now being constructed across the Cascade River, near to its mouth, or point of discharge into the Ringarooma River, with the view of retaining the débris discharged into the stream by the nozzles at work on the Briseis Hill, removing the overburden, and thus making a "dump" in the bed of the river. At this period of the year there is an abundant supply of water, and I presume that the principal mining operations will be confined to the removal of heavy overburden so long as a bountiful supply lasts. It would be unreasonable to look for a large output of tin ore until a considerable extent of work of this character had been effected. Seventy men are employed at the mine.

The *New Brothers' Home No. 1 Company* is carrying on the removal of overburden by "dry-stripping," and trucking the stuff on to a dump-site in a very systematic manner, 44 men being employed. When this work is completed operations for the

raising of tin ore will be commenced. The limited supply of water available retards mining operations being carried on on an extensive scale, but I understand it is contemplated to make provision for obtaining an additional supply to develop the rich deposit of tin which intersects these claims, being a continuation from the Krushka Mine lead. The works in the mine appear to proceed, under capable and careful management, in a satisfactory manner.

The Ringarooma River at Derby, as may be expected from the large quantity of stuff sluiced into it from the mines, continues to silt up considerably, especially at the bend of the river and near thereto, where the above three companies' tail-races empty into it, causing the water to back up to a height previously unknown when the river flow is at normal state, or not in flood. There does not appear to me any practical remedy to obviate this blocking of the river by tailings (by constructing works in the stream) that could be carried out at a moderate cost. It remains for the mine-owners to dump all their tailings on their claims, and prevent as far as possible their flow into the river; otherwise, the effect would be to cause a block in flow of stream that would cause serious injury to property in one of the mines, and also to Derby town property.

In the vicinity of Moorina, very satisfactory mining progress has been made, and the yields from the claims are considered payable. The old Weld claim continues to maintain its reputation as a steady and profitable tin-producer.

On the *Moorina Mine* it is reported that a rich deep lead of tin-wash has been struck in carrying on mining operations, supposed to be a lead from the Frome and Weld Rivers, the localities of which have in past years produced very large quantities of tin. Reports from other smaller claims in this locality are favourable, and I look forward to a considerable advancement of the industry here in a short time.

At Bradshaw's Creek the Pioneer Tin Mining Company continues to carry on mining operations at its mine, under very able and careful management, with much energy and marked success. The new powerful plant, referred to in my last report, has been at work for several months, and acts smoothly and effectively in pumping the tin-wash to the higher elevations; consequently, the output of tin has been considerably increased, the quantity raised during the year ending 30th June last being 218 tons, of which 154 tons were raised during the last six months, the average number of men employed being 34. Since the commencement of mining operations, 349,300 cubic yards of drift have been pumped and sluiced for 300 tons of tin ore. The drift and sluicing water is being pumped to a vertical height of 70 feet, the ground not yet being bottomed. Since April last three dividends have been paid of 7*s.* per share, amounting to nearly £9000. There appears to be a very prosperous future before this company, as it possesses a very large extent of similar tin-bearing ground, which has been proved, through careful boring prospecting operations, under an expert foreman at boring operations engaged in Victoria for that purpose. This work has been done in so careful and reliable a manner that the manager can pretty correctly estimate the yields of tin per cubic yard of stuff ahead of the ground being now mined, and those estimates have been fully realised by actual mining operations. In some instances, the ground has proved richer in tin than anticipated.

Electric light is provided for night work at the mine. There is evidence of signs of prosperity in the locality, and a number of cottages have recently been erected to provide accommodation for increased population.

In the localities of Wyniford River and South Mt. Cameron there are several small claims being mined, giving satisfactory returns.

At Gladstone, Mr. Galloway carries on mining operations on his claim, called the "Scotia," with much enterprise in developing the deep lead of tin found to exist thereon. A deep tail-race is being constructed, so as to enable the lower deposits of tin-wash to be sluiced with greater advantage. I understand that the prospects of this mine are considered very good.

In the vicinity of Boobyalla River, mining operations are carried on on a few claims; but, so far, the yields are not large. A Wilberforce pump has been provided for mining one of the principal claims there, but I have not yet heard the result of operations.

Considering the extent of the deep leads of tin ore which are reasonably believed to exist from the known deposits at the Arba, Brothers' Home, Frome and Weld Rivers, and also the Pioneer, it is to be regretted that prospecting operations have not been extensively undertaken to ascertain their course and their value. The future continuity and prosperity of tin mining in this district largely depends upon the successful development of deep leads, and also tin lodes. It appears to me that reasonable and legitimate inducement is offered for prospecting for the continuation of the deep leads known to exist, and I have no doubt that ere long efforts will be made in this direction. The quantity of tin ore raised during the twelve months ending 30th June, 1892, is 963 tons 16 cwts.; the quantity for the preceding year, 683 tons 4 cwts.; being an increase of 280 tons 12 cwts. for last year. I look forward to a much larger increase for the coming year. An average of 465 European and 166 Chinese miners have been employed during the year ending 30th June, 1902. On the whole, taking into consideration the many drawbacks through the scarcity of water during the dry seasons, and the difficulties to be contended with in removing the heavy overburden on deep leads of tin, as at Derby, the tin mining industry appears to be in a very progressive state in this district, and I look forward to more extensive development and largely increased production during the coming year.

Mr. Commissioner CHAMBERS (Queenstown) reports :—

I have the honour to submit my Report on the mining industry in the Lyell Division of the Western Mining District for the year ending 30th June, 1902.

I entered upon my duties as Commissioner of Mines for this division on 1st August, 1901.

Notwithstanding the somewhat serious decline in the market value of copper, the principal item of production in this division, which has naturally caused considerable depression upon the field, necessitating the temporary closing down of many of the mines in which fair deposits of low-grade ore and promising indications of the presence of richer ores had been met with, extensive work has, on the whole, been performed. It is hoped that the return of payable prices is not far distant, when a large number of properties not now working would quickly become

scenes of renewed activity, and when the output from the Lyell field would probably exceed by far the previous records.

At the *Mt. Lyell Mine*, generally known as "The Iron Blow," work has been proceeding steadily and energetically during the year, and the continued success of the Mt. Lyell (the parent) Company is so well known that comment upon the value of this property is unnecessary. An average daily output of 1000 tons of ore per working day has been maintained. The company has been industriously working its South Tharsis and Royal Tharsis Flux Mines, in conjunction with the "Big Mine," during the period under review, and the returns obtained (see below) speak for themselves. At the company's reduction works 296,056 tons of pyritic ore from "The Iron Blow," 28,047 tons of metal-bearing fluxes, and 58,509 tons of purchased ores have been treated, the whole containing 9716 tons of blister copper. The latter, in turn, has produced, approximately, as follows :—

GOLD, FINE.		SILVER, FINE.		COPPER.	
ozs.	Approximate Value.	ozs.	Approximate Value.	tons.	Approximate Value.
	£		£ s. d.		£
21,462	91,171	678,654	79,753 2 2	9608	594,660

or a total value of £765,584 2*s*. 2*d*. For the year ending 30th June, 1902, the company has paid in dividends the sum of £144,375, and, at and in conjunction with its mines and reduction works, it has provided daily employment for, on an average, 1925 men. The company has been for some time past diligently prospecting various portions of the large adjoining property—now in its hands—known as the Lyell Reserve. On one section, 4691-93M, ore was obtained, giving an average daily assay of—Copper, 6 ·96 per cent.; silver, 0 ·36 ozs.; gold, 0 ·008 ozs.

The *North Mt. Lyell Mine*, already abundantly proved to contain very extensive deposits of high-grade ore, produced during the past year 61,728 tons of ore, of which 50,164 tons, in wet weights, valued at £188,620, were sold to the Mt. Lyell Mining and Railway Company, Limited, and 11,564 tons, valued at £99,968, were transferred upon the North Mt. Lyell Company's railway, partly to the company's smelting works at Crotty and partly to Pillinger, for shipment. Considerable progress had been made with the erection of the company's smelting works, and preliminary smelting tests were being made when a change in the local management occurred, Mr. L. C. Trent retiring, and Mr. F. D. Mitchell assuming general supervision of the company's affairs. Additions deemed to be necessary to the works, in the nature of cold-blast furnaces, were then undertaken, and the completion of the whole plant at an early date is expected. The company's branch railway-line to the Comstock, to facilitate access to the ore-bodies located in that vicinity, is still in the construction-stage, but is likely to be completed towards the close of the current year. The average number of men daily employed in connection with the company's operations in this division is returned at 700.

At the *Mt. Lyell Blocks Mine* the shaft has been extended to 475 feet, and at 450 feet driving operations have been carried out in a south-easterly direction for 240 feet, where the working of the cupriferous clay-body there found is proceeding. The

company's puddling machinery has been working successfully since April last, and the average daily employment of men at the mine has been 65. Five thousand and sixty-six tons of ore raised, valued at £21,200, have been disposed of to the Mt. Lyell Mining and Railway Company, and 4313 tons of clay puddled have produced 145 tons of concentrates, 30 tons of slimes, and 39 tons of gossan, containing a fair percentage of copper. A change in the mine management has recently taken place, Mr. T. Taylor, the former manager, having been succeeded by Mr. J. H. Crittenden.

The *Lyell Tharsis Mine* during the year produced 13,197 tons of ore, worth 4·40 per cent. copper, and, for the first six months of the year, provided daily employment for, on an average, 44 men. The management decided, in view of the low price of metal, to close down about the end of 1901, and for some months afterwards only prospecting with the diamond-drill was carried on. After boring for a little beyond 1000 feet, the operations were temporarily suspended. The mine is not yet working again, and Mr. W. H. Vale has relinquished his position as mine manager.

At the *Tasman Lyell Mine* prospecting has been continued on the sections adjoining the North Mt. Lyell and Mt. Lyell Comstock properties, and promising indications have been met with. Average number of men daily employed, 30.

The branch railway to the *Mt. Lyell Comstock Mine* being near completion, considerable necessary and useful work in the direction of cleaning, driving exploratory tunnels, rising, and making connections between the tunnels, to facilitate mining operations and for purposes of ventilation, have been in progress. Average number of men employed, 25.

At the mines known as the *Copper Mines of Mt. Lyell West*, *Crown Lyell*, *South Mt. Lyell*, *North Mt. Lyell Consolidated*, *Mt. Lyell Anaconda*, and *Western Tharsis*, practically no work has been carried out during the year; but, as regards the Crown Lyell property, intimation has been received that mining operations will shortly be resumed.

Upon the property of the *Tasman and Crown Lyell Company* the main adit has been advanced to 1130 feet, in the expectation of cutting the lode, and six men have been constantly employed. The indications met with have been of considerable promise.

At the *Great Mt. Lyell Mine*, a property of some 640 acres, mining operations on various sections (employing about 16 men) were carried on until the end of last June, when temporary exemption from performance of the labour covenants of the company's leases was sought. Some excellent prospects have been obtained by the mine manager, Mr. S. W. Haynes, but nothing sufficiently extensive, so far, as to justify the erection of machinery and appliances for further developing the property.

Intermittent prospecting has taken place upon the sections known as the *Tasman Comstock*, *North Crown Lyell*, *Mt. Lyell Consols Extended*, *Lyell Pioneer Consolidated*, and *Mt. Lyell Peaks*, but without any developments calling for especial mention.

At the *Duke Lyell Mine* no work has been carried out during the year, and the proprietors are endeavouring to arrange for the introduction of capital to further test the value of the property.

As regards the Jukes and Darwin field, mining operations have been hitherto somewhat retarded by the difficulties of access to many of the properties, and by the late depressed state of the

metal market. At one mine, however, the *King Jukes*, work has been carried on throughout the past year, and the management have driven 225 feet. The indications met with have been distinctly favourable, but thus far no ore is in sight. Number of men employed at this mine, 3.

The *Jukes Proprietary*, *Lake Jukes*, *Comstock Jukes*, *Jukes Consols*, and *Darwin Proprietary Mines* temporarily suspended work towards the end of 1901.

This district is regarded as possessing great possibilities, and in the event of the North Mt. Lyell Company's Smelting Works at Crotty proving a success, considerable advantage to the mines in the vicinity must ensue.

The *King River Tribute*, near Lynchford, has been carrying on hydraulic sluicing on the company's gold claim during the whole year, employing three men. The results are not yet obtainable.

At the *Lady Havill Mine*, a property being worked for gold at Mt. Huxley, the face has been opened out, and 43 chains of race have been cut. The proprietors have now a five-head battery on the ground, and are working energetically.

On *May's Prosp cting Claim*, at Harvey's Creek, beyond Lynchford, the proprietors have during the past six months driven 75 feet, and have sunk winze 15 feet; a road to the claim has also been constructed.

The measure of success striven for by the owners of the *Queen River Dredging Claim* has not been attained, though dredging operations were continued during the greater portion of the year. The quantity of gold won not proving sufficient to enable the proprietors to continue to work profitably, the plant is at present idle.

Prospecting work by small parties has been proceeding at *Woody Hill*, but without any important results.

Some additional prospecting work has been done on the coal leases of the *Farm Cove Coal Company*, at Pillinger, but no satisfactory development of the mine can be said to have taken place, notwithstanding the encouraging nature of the prospects originally obtained. Pending further tests with the aid of the diamond-drill, for the use of which, I am informed, application has been made, the sections are not being actively worked.

In the early part of the present year, upon my suggestion, the boundaries of the Lyell and Zeehan Mining Divisions were redefined. The alteration has effected a considerable improvement, and has been found more convenient, both by the public and by the departmental officers.

Mr. Commissioner GILMORE (Zeehan) reports :—

It cannot be denied that the past year has been one of depression. It must not, however, on that account be assumed that the field has seen its best days, and is drifting to nothingness, and the silent machinery and gaunt poppet-heads on some of the temporarily idle mines are monuments of past prosperity. The recent rich finds on the Spray alone would belie such an idea, and give grounds for hope in the future. Moreover, "when night is darkest dawn is nearest," and so, when we were at the bedrock of our depression, the tin-finds of Heemskirk and Mt. Agnew districts lit again the lamp of hope, and it seems probable that the predictions of Mr. Thureau, at one time Government Geologist of Tasmania, in relation to these districts, are

likely to be fulfilled. Two of the principal factors in the depression have been the continued low prices of metal, especially lead, and the closing down of the Western Mine. The latter occurrence was little short of a calamity for Zeehan, a calamity which the Government, by a generous offer of assistance, tried in vain to avert. The stoppage of this mine meant the throwing out of employment of some 300 men, and the withdrawal from circulation of about £500 per week. The mines in the Rosebery district are wearily waiting the solving of the problem of how to treat zinciferous ores. On the 9th of August, the foundation-stone of the new Zeehan School of Mines and Metallurgy was laid by the indefatigable chairman, Mr. A. D. Sligo. The school continues to be well attended, notwithstanding the fact that a number of former students, owing to the closing of some of the mines, have found it necessary to seek employment elsewhere. The present number of students is 47. The affiliation which has recently been arranged for between the University and the school should prove advantageous to both institutions; and it is to be hoped the Council of the University will endeavour to forward the interests of the school, and bring it into the closest possible relation with that seat of learning. There can be no doubt that the West Coast mineral fields possess facilities for the thorough training of mining students unsurpassed by any field in the Commonwealth; and, with the necessary financial assistance (the people locally have raised some £500), there is no reason why the Zeehan School of Mines and Metallurgy should not become one of the foremost and most useful institutions of the kind in Australia. Good progress is being made with the erection of the new school buildings, and when completed they should prove a great convenience to the students after the unsuitable premises with which they have had to make shift for some years past. An up-to-date School of Mines, with a wide curriculum, and located in the centre of the extensive mining districts of the West Coast, must prove of great value to the industry generally, affording, as it does, advantages to the youth of the State to gain practical experience and theoretical knowledge which will fit them for positions of trust when fighting the battle of life.

To the courtesy of Mr. Kapp, manager of the Tasmanian Smelting Company, Limited, I am indebted for the following return of metals purchased by the company for the twelve months ending 30th June, 1902 :—

Lead.	Silver.	Gold.
5123 tons	518,285 ozs.	980 ozs.

Total value of these minerals at the mines from which they were obtained, £63,229.

The amount of bullion shipped by the company for the period was—

Lead.	Silver.	Gold.
6486 tons	666,189 ozs.	1506 ozs.

Silver King Mine.—One hundred and forty-eight men were employed in this mine during the year; they have raised 2673 tons of metal, valued at £13,571. There has been no ore won for the past few months, and all previously was taken from the South King Tribute, which is now shut down. The west crosscut has been driven 749 feet; at 638 feet it passed through a

lode 6 feet wide, chiefly carbonate of iron; the crosscut is now being extended to cut No. 3 west lode, which should be met with at about 890 feet. The west lode has been sunk on for about 15 feet, and is 2 feet 6 inches in width, giving good seconds, from which some marketable ore can be won. The prospects of this mine show a slight improvement.

Watts and McAuliffe's Mine employs 12 men, who have raised some 1362 tons of ore, valued at £982 18*s*. On this property two shafts have been sunk; one 60 feet, and the other 40 feet. Thirteen chains of water-race have been built, and a large water-wheel erected. Unfortunately, the prospects of this mine are poor, the lode being small and patchy.

The *Western Mine* has been closed since October, 1901.

The *Montana Mine* employs 178 men, and has raised during the year 4020 tons of ore, valued at £48,419 15*s*. 11*d*. The improvements here include the construction of a dam, the erection of a new boiler and shed for the engine, and the construction of 36 chains of new tramway; in addition, considerable improvements have been made to the concentrating plant. The prospects of this mine are excellent, good metal being obtained at all the levels.

The *British Zeehan Mine* employs 140 men, and for the year has raised 3570 tons of ore, valued at £45,555. The chief improvement for the last twelve months on this property consists of the construction of 30 chains of new and the re-laying of 140 chains of old tramway. A crosscut has been driven 700 feet to cut a new lode that has proved very rich near the surface; if it proves as rich at the lower levels as at present, it will undoubtedly make this property the best silver-lead mine on the West Coast. The prospects are better than they have ever been since work was commenced, and there is every indication of still greater improvement.

Silver Queen Mine.—On this property 51 men are employed, and for the past year they have obtained 2·270 tons of ore, of the market value of £10,873. This property has for some time past been worked by small parties of tributors, who have confined their attention to the not too large lodes near the surface. It has lately changed hands, and been refloated as the Zeehan Queen Silver Mining Company, Limited, with a working capital of £25,000. The company intend refixing machinery, and working the lower levels, and there seems little doubt that within the next year this property will again be one of the largest ore-producing mines on the field.

At the *Florence Mine*, better known as Smith's Section, 20 men are employed now, though the property has been idle for two years. Quiggin and party, having obtained a lease of the section, have started to thoroughly test the mine. They have erected a new set of poppet-legs, sunk a shaft 13 feet by 6 feet to a depth of 150 feet, erected a new boiler, winding-engines, and pumping-engine, with 14-inch draw-lift. In addition, they have built a large engine-house, blacksmith's shop, and storeroom.

The *Oonah* has 30 men working on the stannite lode, and they have raised 422 tons, of the value of £2964. From the proceeds of the tribute, the company erroneously, in the opinion of many, paid one or two threepenny dividends.

The *Silver Bell* has eleven men at work. For the past year it has driven some 700 feet, raised 244 tons of silver-lead, of the

value of £1220. Concerning the smaller mines there is nothing of importance to report.

In the Mt. Read district, the Hercules Gold and Silver Mining Company has 90 men employed. It has raised for the past year—Gossan ore, 8057 tons, at a value of £24,978; sulphide ore, 2464 tons, valued at £6422. The chief improvement at this mine comprises the extension of the drying plant, giving it a drying capacity of from 15 tons to 32 tons per eight hours. The sinking of a winze on No. 5 level to a depth of 45 feet on a copper formation, with favourable results, proves that the ore is growing richer in copper as it attains a depth. On the haulage the 3-inch wire-rope has been replaced by a 4-inch, giving it greater hauling capacity. A new wheel-house had to be erected, with improved brakes, in connection with the heavier rope. The prospects of this mine are very bright, all levels looking well, and there is not the least doubt that the output for 1901-1902 will be considerably increased.

The *Ring Valley Silver Mining Company* employ 16 men, and has raised 48 tons of Fahl-ore, valued at £520. The only notable improvement at this mine is that a wooden tram has been constructed from the mine to connect with the North-East Dundas tram. The manager has cut a nice lode at the 100-feet level, with indications that it will prove richer at a greater depth. This company has taken over the Fahl-ore property, and is driving on No. 2 lode.

Curtin and Davis Silver Mining Company.—Through the courtesy of the stationmaster at Williamsford, I am able to give this return. Ten men are employed; 91 tons of Fahl-ore have been raised, valued at £728. This mine has been worked by various parties of tributors.

At the *Mt. Farrell Mine* six men are engaged driving a tunnel to cut the lode that extends on to their property from the North Mt. Farrell.

At the *North Mt. Farrell Mine* 44 men are employed, and on this property there has been a wonderful improvement since the resumption of work, on the 1st October, 1901. The buildings consist of two new ore-sheds, capable of holding 500 tons of ore. At present there is a tramway in course of construction to connect the mine with the Emu Bay Railway. The manager is developing the mine in a thoroughly systematic manner, and has about 750 tons of first-grade galena bagged, but, owing to the great expense of having the ore packed from the mine to the Pieman Bridge, the company has decided to stack it till the tram is constructed. The prospects of this mine are excellent, and there is every indication of its being one of the biggest galena mines on the West Coast when fully developed.

The *Comet Mine* at Dundas has 66 men employed. They have raised for the past year 1675 tons of silver-lead, market value £8119 11*s.* 6*d.*; and 2332 tons of gossan flux, value £1576 9*s.* 3*d.* The other mines in this neighbourhood have done little worth reporting.

The tin mines in the vicinity of Heemskirk and Mt. Agnew promise great things, John Mayne having come successfully through a law-suit, and appeal has, so it is rumoured, disposed of the property on terms satisfactory to himself; the details have, however, not yet transpired.

The Darby and Connor claim is a good show, but has been the subject of litigation; perhaps this is an additional tribute to its

worth. Darby claims to be a partner with Connor—Connor claims that the claim is his alone. After a lengthy trial of eight days, I decided in Darby's favour, and an appeal to the Full Court from my decision is to be heard on 12th September. This case shows the desirability of Parliament re-enacting with as little delay as possible Section 20 of "The Mining Act, 1893."

The *Federation Tin Mine* at Mt. Agnew possesses the best natural water supply, perhaps, of any mine in the Commonwealth, a watershed forming a lake over three miles in circumference and very deep, an excellent timber reserve, and good communication with Zeehan. As regards its productiveness, a large amount of prospecting and exploring work has been done, with most encouraging results. In May last, on the most eastern section of the claim where grey tin ore was found to exist in payable quantities, a tunnel, which was driven in the early days of the field, has been re-opened and cleaned out. The grey tin ore lives down in this tunnel, which is a depth of 60 feet from the highest point, where the ore is found on the surface. The tunnel has not been driven through the lode, therefore its width at this level is not yet known. Munro's shaft on Section 3919 has been cleaned out, and ladders securely placed in same; it is 51 feet deep. There is a drive put off from the eastward from this shaft for a distance of 16 feet through a strong body of stone. The tin-bearing stone here shows a width of 20 feet, including the width of the shaft, with no western wall showing. On Section No. 3688 the prospects have been most encouraging. In the open-cut known as Dunn's old workings the lode has been picked up in a cuddy put in to the west of the cut, and at present, with indications of an increase, has a width of 3 feet, carrying payable tin ore. About 12 chains to the north-west of this open-cut some rich tin-bearing stone has been discovered. The tin ore occurs in a porphyritic formation associated with green tourmaline, and is a big formation. Mr. J. S. Munro, the energetic and systematic owner of this mine, is determined that only a strong corporation, capable of handling the proposition in a proper manner, shall take it in hand. When this is done, and a company formed with a good working capital, it means the employment of much labour, the advantage of the State, and the success of individuals. After a personal inspection of this mine, I hazard the opinion that in a few years it will be one of the biggest tin-producers in the State, not even excepting the famous Bischoff, whose natural richness made the reputation of more than one man.

In conclusion, I think the outlook for the future of the Zeehan division of the Western Mining District is most promising, and that a proper expenditure of capital and competent mining managers will soon restore the fortunes of the field.

Mr. Registrar DONOHUE (Waratah) reports :—

I have the honour to report on the progress of the Mining Industry in the Waratah Division during the year ended 30th June, 1902.

The *Mt. Bischoff Tin Mine* still continues to keep up a good output of ore. During the year 1291 tons of ore have been sent away from the mine. The only new development that has taken place is a rich deposit of alluvial tin discovered on the northern slope of the Mount, from which a good deal of tin ore is now

being won. The average number of men employed on this mine is 220.

West Bischoff Tin Mine.—A self-acting tram has been constructed. Alterations have been made to the sheds, and additions to the machinery; everything now is completed, and a start has been made to crush the lode-matter from the mine. At present there are 16 men employed at the mine.

Waratah Alluvial Tin.—This mine continues to send out a ton of ore regularly every month. Two men are employed.

The *Stanhope Alluvial Tin Mine* also maintains an output of nearly a ton of ore each month, with two men working.

Magnet Silver Mine.—For the past year 2239 tons of ore have been sent away, valued at £12,271. The construction of the 2-feet gauge tramline, connecting the mine with the V.D.L. Railway, Waratah, has been completed, at a cost of £19,250. It is fully equipped with rolling-stock, &c., and is now in regular operation, carrying about 300 tons of ore weekly to the market. At the mine a fine revolving drying plant has been erected, with stone-crusher, &c., operated by water-power derived from the Magnet Creek, with commodious ore-bins, all of which has been carried out under the supervision of the mine manager, Mr. R. F. Waller. The mine is in steady work, and the manager expects to ship ore at the rate of about 300 tons weekly for a considerable time. An underlay shaft is to be sunk from the lowest present level to exploit the lode at a further depth. One hundred men are employed.

Washington Hay Silver Mine, Whyte River.—Tributors have taken about 20 tons of metal from this mine during the year, assaying 100 ozs. of silver and 65 ozs. of lead to the ton. The mine is now idle.

Confidence Silver Mine, Whyte River.—This section has been taken up by a syndicate, and four men have started work on it to drive the lower tunnel about 300 feet to get beneath the body of ore known to exist in the upper workings.

Godkin Silver Mine.—Six men are employed on this mine in driving a drainage tunnel to drain the two shafts. They have driven 700 feet, and have about another 100 feet to drive.

Bell's Reward Silver Mine, Heazlewood.—Several tons of ore have been sent from this mine lately, but of very low grade—not sufficient to pay; still, Mr. Bell keeps working on, with four men.

Long Tunnel Prospecting Syndicate (formerly Mt. Stewart).—Six men have been employed on this mine for some considerable time, and have been sending about six tons of ore away weekly; but, owing to the bad state of the track leading to the mine, an exorbitant price has to be paid for packing, and, unless something is done to remedy this, they certainly cannot go on.

There are at present several prospectors out in the Heazlewood district prospecting, but nothing fresh has been discovered yet.

Mr. Leslie J. Smith has a party of men with him prospecting his different sections in the district.

The *Rocky River Mine* has been idle for some time past, but the former manager, Mr. Blaney, has had instructions to hold himself in readiness to resume operations again.

THE MAGNET TRAMWAY.

By R. F. Waller, Assoc. M. Inst., C.E.

Perhaps the most important problem in the development of many of our Tasmanian mines, and more especially in the case of those on the West Coast, is that of transit. So many of our mines are situated in inaccessible locations that, before economic development becomes a possibility, the problem of getting plant to the mine, and ore to market, becomes of vital importance, and in many cases must be either boldly attacked by shareholders themselves, or all hope of remunerative operations abandoned. This was notably the case at Mt. Lyell and Mt. Read, and some note of the solution arrived at in the case of the Magnet Mine may be of interest.

The Magnet Mine is situated some four miles south-west of Mt. Bischoff, on a spur of the Magnet Range, and is separated from Mt. Bischoff by the deep gorge of the Arthur River. The Corinna Road passes within two miles of the mine to the south, and avoids the Arthur Gorge by crossing that river near its source at an altitude higher than the mine.

When mining operations were commenced, the obvious route to market lay in a connection with this road, which is well constructed, and with fairly easy gradients. This was first accomplished by means of a pack-track along the leading spur between the mine and the road. With further development at the mine this proved quite inadequate, and was replaced by a tramway for horse-traffic of $2\frac{3}{4}$ miles in length. This tramway took about £28,000 worth of ore to market, and enabled the company to open up their mine in a systematic manner, which thoroughly demonstrated the fact that such a means of transport was utterly incompetent to deal with the ore available, and that, unless better facilities were provided, only the richest portions of the ore-body could be dealt with, and very large masses of moderate-grade ore would have to be left in the mine.

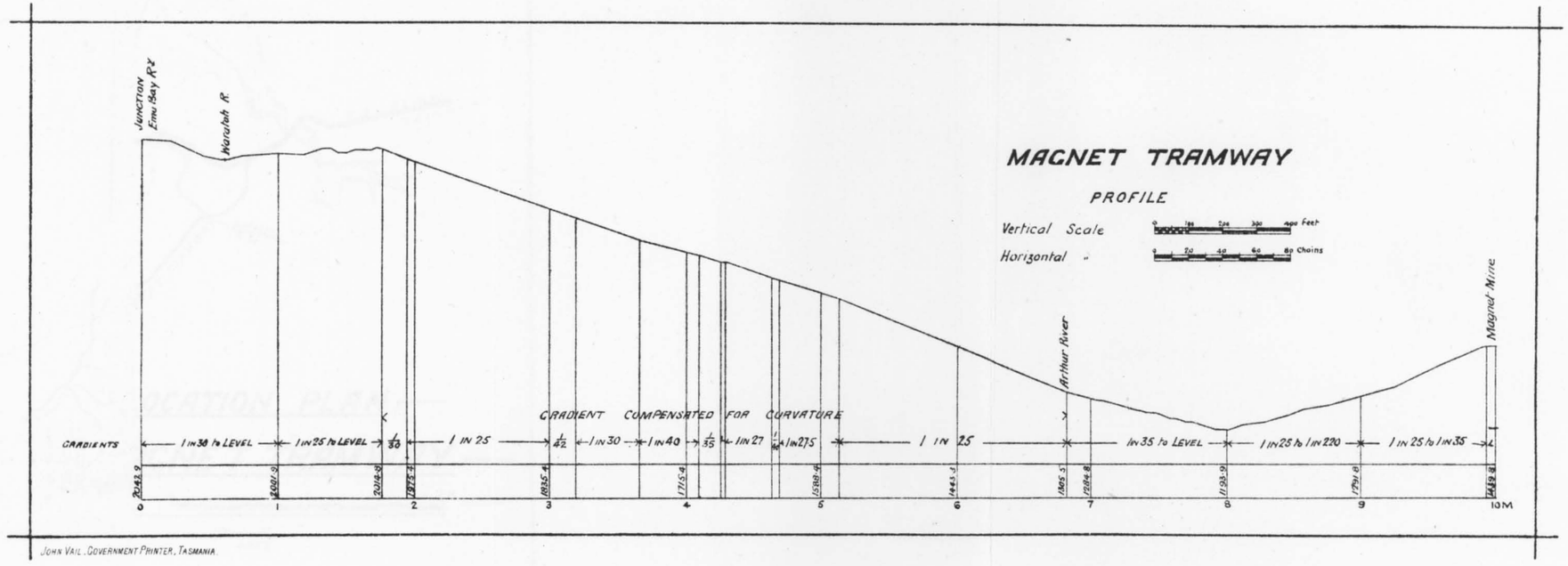
The Magnet Mine contains some very fine bodies of first-class gossan and sulphide ores, which in themselves would be payable under very adverse circumstances; but alongside of these ores lie very large bodies of lower-grade gossan ores, of excellent quality for fluxing purposes, containing, as they do, some 35 to 40 per cent. of iron and manganese, and about 6 to 10 per cent. of silica, and of values in lead and silver ranging from very little up to 30, 40, and 50 ozs. of silver per ton, with 7 to 15 per cent. lead. The amount of these ores has been variously estimated from 40,000 to 200,000 tons, according to the grades of ore included in the estimate. The lower figure may be taken as a conservative estimate of the quantity of ore now awaiting shipment. With present facilities and prices of metals, any improvement in metal prices, and a demand from Smelting Works for iron flux, will largely increase the amount available for export.

Surveys were accordingly put in hand, for the purpose of finding a route for a steam tramway of 2 feet gauge, to put the mine in direct communication with the Emu Bay Company's railway at or near Waratah. The principal obstacle is the gorge of the Arthur River. To head this gorge would mean a line of certainly over 15 miles in length, though construction would be easy; and many other routes, varying in distance and gradients, might be chosen, crossing the gorge lower down at various points. When the author was asked to undertake the construction of the tramway, one route had been partly surveyed, crossing the Arthur River near the top of the gorge; its length was about 13½ miles, and it had to negotiate some exteremely heavy country. Another route, over which a flying survey had been run, had a length of 9½ miles, and passed through easier country throughout; the grades, however, being heavier. This route was finally adopted, and lengthened to ten miles to avoid a short piece of very heavy work.

Permanent survey was started on 22nd January, 1901, by the author and Mr. F. K. Pitt, Authorised Surveyor. A party of about ten men was employed, as it was an object to get as good a start as possible during the summer months. The system adopted was to run a carefully-levelled and traversed trial line, with frequent cross-sections, plotting to a scale of 1 inch to the chain, and putting 10 feet contours to aid in the location of the line. By this method it is possible to draw a very closely approximate trial section before the centre line is laid down, and to locate the line to the best advantage. This procedure gives accurate data of a narrow strip of country, say 100 feet wide, within which limits it is possible to locate a line with a reasonable certainty that the best, and cheapest, location, as far as earthworks are concerned, has been secured. The best proof of this is in the fact that usually very trifling deviations indeed are found necessary during construction; it is, however, most desirable that the cross-sections be taken frequently, carefully, and with judgment. A careful system such as this is especially essential where it is attempted to compensate the gradient for curvature, which was done throughout on all grades against the load.

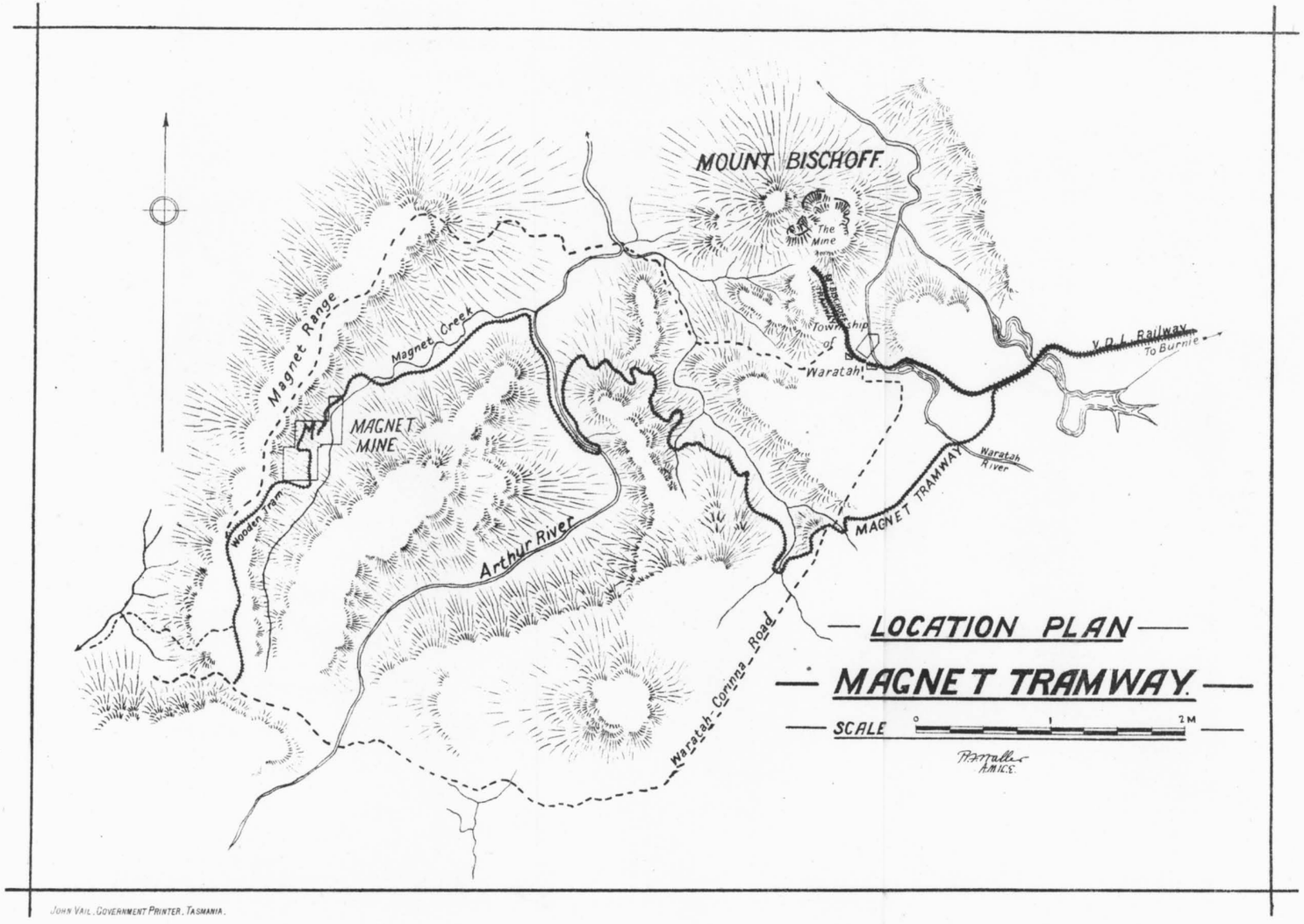
This matter of curve-compensation is a most important one in laying out any railway with heavy grades, as the maximum grade (of any length) limits the train-load, and therefore fixes the minimum carriage-cost. As a rule, on the West Coast, the grades must generally be long, and, with a view to shortening the length of line, it is usually desirable to make them as steep as practicable. The idea of curve-compensation is to make the total train resistance, uphill, approximately equal on curves and on the straight. To give some idea of the importance of the point, I may note that train resistance is approximately equal on a straight grade of 1 in 25, and on a combination of a curve of 1½ chains radius with a grade of 1 in 42·5.

The formula used in this computation was that given in Molesworth's Pocket-book, page 236. The train resistance on curves (for trains of normal length) is a junction of the radius of curve, gauge of line, and wheel-base of stock. In the present case the gauge is 2 feet, and the wheel-base was taken as 4 feet 6 inches. This value is rather in excess of the length of wheel-base subsequently employed, and as a matter of fact I find that traction on curves is generally rather easier than on straight road.



JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

5 cm



JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

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MAGNET SILVER MINE, NEAR WARATAH.

The ruling gradient was fixed at 1 in 25, and the grade on curves works out as follows, the total resistance for each combination being approximately 1 in 25, or 4 per cent. :—

Combinations of curvature and gradient equivalent to straight road, 1 in 25 grade.

Radius of Curve. Links.	Gradient.	Feet rise per chain.
1000	1 in 25 ·	2 ·64
500	28 ·5	2 ·32
400	30 ·	2 ·20
300	31 ·5	2 ·10
250	33 ·	2 ·
225	35 ·	1 ·88
200	36 ·	1 ·83
175	38 ·	1 ·74
150	42 ·5	1 ·55

A similar calculation was made and tabulated for all the grades likely to be used. In actually grading the section these tables were adhered to as closely as possible, making the change of gradient at the nearest chain, or sometimes half-chain, to the end of the curves. In practice, I find that, as stated above, the curves are slightly over-compensated, the engine travelling over curves rather more easily than on straight road; this is particularly noticeable in wet weather, but on the whole the result is extremely satisfactory, and the engine takes its maximum load up the grades and curves at a steady uniform pace.

As to curvature, the sharpest curve was originally fixed at 150 links, or 99 feet radius; but after the type of locomotive was decided on, I determined to try the effect of a curve of even sharper radius, with its due compensation in the gradient. This was only done in a very few places, where there was a very large saving in first cost by sharpening the curves, and where altering the line afterwards would not entail much additional expense. The rolling-stock works round these curves of 125 links (82 feet 6 inches) radius quite easily; but, except in positions where the saving in first cost is exceptional, I cannot recommend the adoption of curves sharper than 150 links radius. The objection to them is solely on the score of increased wear and tear to rails and stock. I hope to be able to alter these curves to a wider radius during the course of next summer, at small cost, by the employment of the line-repairing gangs, who by that time will have the line in good solid running order, and will be able to effect the necessary alterations without the employment of any extra hands.

I think, however, that their introduction here has demonstrated the fact that, under suitable conditions, the employment of such sharp curves is a perfectly justifiable practice, and that where trouble is experienced with sharp curves on a 2-feet line it is not due to the curves themselves, but to a selection of rolling-stock which is not suitable for working such a line.

All curves of 150 links radius (and under) are transition curves; that is, they are put in with a length of 50 links at each end, with radii gradually increasing from the minimum to infinity, the curve at each end being a cubic parabola. The train enters and leaves the curves without the jerk usually felt in negotiating such sharp curves.

Speed of travelling on the curved sections of the line is limited to eight miles per hour, but during construction we frequently travel the worst parts of the line at a speed of over twelve miles per hour; and, except for the danger of encountering a fallen tree, the practice was absolutely safe, and the travelling was smooth and easy. This, I think, is impossible except on a line with compensated gradients and transition curves.

Transition curves present no difficulties in setting out, and when platelayers are used to them the extra trouble in construction is trifling; speed of platelaying is necessarily somewhat reduced, as the rails at ends of curves have to be curved on the ground by a "Jim-crow," but the slight extra trouble and still slighter extra expense is more than repaid by the smoothness of the road when built.

Survey work was started on 22nd January, 1901, the first clearing contracts were let in the middle of February, and earthworks were put in hand on 4th March; platelaying was started on 8th August, finished on 5th December, and ballasting was finished and construction hands paid off on 23rd January, 1902.

The line junctions with the V.D.L. Company's line to Waratah, now leased to the Emu Bay Railway Company, just outside the township of Waratah, and about 1¼ mile from the terminus of that line. Here a running-shed for two locomotives is erected, with goods-shed, platform, coal-stage, shelter-shed for transhipping ore to Emu Bay Company's trucks, houses for engine-driver, stationmaster, &c. From this point the line traverses very easy country to the crossing of the Corinna Road, at 1m. 70c. The Waratah River is crossed at 0m. 46c., and on this section earthworks are easy, and grades, though stiff in places, are short. From 1m. 70c. to 6m. 70c. may be called the "mountain section" of the line. The grade is heavy and continuous, and the route is along steep and broken sidelings. The Arthur River is crossed at 6m. 65c., and from there to 8m. the line runs down the flats of the Arthur River to its junction with the Magnet Creek, thence up the flats of the Magnet Creek to 9m. 30c. This section is the easiest on the route; straights are long, curves are easy, and earthworks very light. The last 50 chains is another stretch of steep sidelings, with heavy grade and sharp curves.

The attached profile shows pretty clearly the nature of gradients on the line. The curvature works out as follows:— Taking first the portions 0m. to 1m. 70c., and from 6m. 70c. to 10m., which amounts to just half the total length of line, we find that these sections contain 53 curves, totalling 1m. 36c., leaving 3m. 44c. of straight road. On the "mountain section," from 1m. 70c. to 6m. 70c., on the contrary, we find 142 curves, totalling 3m. 21c., with only 1m. 59c. of straights. It must also be noted that the vast majority of sharp curves occur on this section; in fact, there are but five curves of under two chains radius on the other parts of the line. On the "mountain section" there are 71 curves with radius less than two chains.

The whole of the line is through heavy myrtle forest; indeed, on the first two miles the myrtles are the largest I have seen, running up to 5 and 6 feet in diameter. Clearing was done by contract, and was let in lengths of about 40 chains, as fast as the survey was completed. The line was only cleared to a width of 20 feet, except under seats of banks, which were fully cleared

out. Culverts were let to the clearing contractors, and fixed and put in well in advance of the earthwork-gangs. Clearing cost about 16*s.* 6*d.* per chain, on an average; this includes grubbing all stumps over 12 inches diameter, except where covered by over 2 feet of embankment. Log culverts were used throughout, and in all steeply-inclined gullies were put in near formation level, with contour drains cut to intercept the water.

The formation width originally proposed was 8 feet; this was found to be rather too narrow. Eventually cuttings were taken out to a base of 8 feet 6 inches, to allow of a drain, and banks were made not less than 9 feet. This is quite narrow enough, and with banks any narrower the loss of ballast is serious.

Earthworks were almost entirely done by day labour; an attempt was made early in the job to sub-let some cuttings, but the prices demanded were in all cases much higher than the work was subsequently done for.

I regret that I am unable to give figures for the quantities of earthworks, as the staff available had no time to devote to earthwork measurements. Although it is most desirable, as a rule, that the work of the various gangs be checked by the cost per cubic yard of the work done fortnightly, I think that, if reliable gangers be employed, as good results may be got by cultivating a spirit of emulation between the respective gangs, and comparisons of the length of line formed fortnightly.

As the country was rough, it was decided to employ no construction trams for earthworks, as carrying the plant along is a serious matter where no road or track exists; besides this, on a 2-feet line the leads are generally so short that the work can be done almost as cheaply with barrows.

There are four small bridges on the line, the largest (seven spans) being over the Waratah River. Simple beam-bridges of 16-feet span were adopted, with skeleton road. The timber was all hewn locally, and is myrtle, gum, and leatherwood, all of excellent quality.

The question of sleepers received early attention. An attempt was made to procure them hewn alongside the line, of myrtle, which here is of unusually good quality, but it failed. Subsequently a careful examination of the district resulted in the discovery of a belt of gum country, from which nearly all the sleepers were drawn. It was, however, necessary to construct a mile of wooden tramway to connect with the Corinna road, along which the sleepers had then to be carted to the line. Sleepers were cut 5 feet by 8 inches by 4 inches, and cost 1*s.* each on the line. About 2200 sleepers to the mile were used; they were spaced 12 to the rail-length of 30 feet on straights, and 13 on curves of two chains radius and under. Sleepers were adzed by hand, a contract being let for adzing and boring for one rail only, which reduces the boring to be done while platelaying materially.

The rails employed were of American manufacture, supplied by Orenstein and Koppel, of Berlin; they weighed 30 lbs. to the yard, and were in 30-feet lengths; rails slightly shorter, to allow for lead on curves, could not be procured, so to keep square joints in platelaying necessitated cutting and re-punching rails by hand, which should have been unnecessary.

Rails were all curved in the yard, in a hand-press designed on the job, and made in Launceston. The press works with a screw, and is practically an enlarged "Jim-crow" made of cast-iron, and bolted to a stump. The screw acts horizontally, on

the web of the rail, and the clips for holding the rail are so arranged that the rail may be put in the press with its head either up or down, so that either right or left hand curves may be pressed without the necessity of turning the rail end for end. I prefer this press to a roller-press, and think that both cheaper and better work may be done in it. Our rails were pressed by two men, at the rate of about 18 pairs per day, or at the cost of about 1s. per pair, and the results left nothing to be desired; the crow was never used on the road, except at the ends of curves, and more particularly of transition curves. I may mention here a new type of fishing-up spanner that was used throughout, made after the idea of the alligator-wrench; but as it was only required to take one size of nut, only one tooth was put in the jaw. These proved very fast and efficient.

The road was ballasted from two pits, the first situated at 2m. 42c., so that no ballast could be put on the road until this was reached. As much of the road was soft, and the work was done in the winter months, this was a troublesome piece of work, rails and sleepers disappearing under the weight of the engine in soft spots. The greater portion of the ballast came from the second pit at 3m. 70c., and was of excellent quality—a decomposed igneous rock, soft, but which never turns to mud. This ballast was taken right through to the mine, a distance of over six miles. About 900 cubic yards were put on to the mile, at an approximate cost of 3s. per yard laid and packed in the road.

The rolling-stock at present in use consists of two locomotives, both by Orenstein and Koppel, of Berlin; two 15-ton double-bogie ore-trucks, built in the Government Railway workshops in Launceston; a guard's van, and a rail and timber waggon, built on the job. Two 15-ton trucks of similar type are under order in America, and shortly expected.

Of the locomotives, No. 1 is a compound-engine, with articulated under-frame, on the Mallet system; attached is a diagram showing the leading features. It will be seen that, while the total wheel-base is 10 feet, the greatest rigid wheel-base is only 4 feet 3 inches. The long total wheel-base ensures steady running, and the short rigid base enables the engine to traverse sharp curves with great facility. The following are the leading dimensions :—

Cylinders, 8 inches and 12 inches diameter x 12-inch stroke.
Wheels (8 four-coupled), 25 inches diameter.
Rigid wheel-base, 4 feet 3 inches.
Total, 10 feet.
Boiler pressure, 170 lbs.
Heating surface, 418 square feet.
Grate area, 9 square feet.
Water-tanks (side), 500 gallons.
Weight in steam, 18 tons.
Approximate tractive force at 65 per cent. steam pressure in h.p. cylinders, 5940 lbs.
Adhesion ($\frac{1}{6}$), 6720 lbs.

The engine will take a load of 30 tons of ore and two trucks, which tare four tons each, up the 1 in 25 grade, and practically it takes a daily load of 35 tons (gross) up that gradient quite comfortably. This is its regular working load, and is taken daily up the six-mile stretch of heavy grade in all weathers without the slightest hitch or trouble. The engine is very economical in fuel. I think that a fair average of fuel used per trip of 20 miles is from 50 to 80 cubic feet of wood, and about 1¼ cwt. of

coal. The firewood used is myrtle, cut in 2 feet 6 inch lengths, and a little coal is used to fill up the spaces at the ends of the wood, the firebox being a little over 3 feet long.

Wood is very much cheaper than coal here, costing about 5*s.* per ton of 80 cubic feet. The best determination of the relative values of wood and Newcastle coal I know of is the result of observations at Mt. Lyell, which gives a ratio of 1 ton coal to 2·4 tons wood. This makes wood equal to coal at 12*s.* per ton, whereas it costs about 40*s.* per ton here. However, if it is necessary to get the best work out of a locomotive, and more particularly the fastest work, coal must be used; and, having regard to wages cost, as well as fuel cost, I think that, provided the traffic is heavy enough to warrant it, it would pay to use coal exclusively.

The only other point I need allude to in regard to this locomotive is that of repairs. The engine has now made some 5000 miles of running, and the repair bill has hitherto been almost nil, with the exception that we have had some trouble with the tubes. These were rather too light in metal, and we have now replaced some three dozen of them with a stouter make; the rest will be renewed as necessity arises.

The general question of selection of a locomotive for narrow-gauge, and lines with sharp curves, seems to me to very largely depend on wheel-base. A long wheel-base is very desirable to give steady running, and a short rigid wheel-base is a necessity where sharp curves have to be negotiated. For light locomotives the four-coupled engines with a base of about 3 feet 3 inches to 4 feet, such as our No. 2 engine (6¾ tons) and the well-known Krauss engines (7½ tons), are excellent; and it is still a moot point whether such engines are not the most economical generally for 2-feet lines.

Engines a size larger are usually built six-coupled, and can be got up to about 14 or 15 tons, and with a wheel-base of about 5 feet 6 inches. This is a type I do not much care about, as the length of base is hardly long enough to give steady running; while it is decidedly too long to give the best results on curves of less than two chains radius. The addition of a bogie, or, worse still, of a pony-truck, or two-wheeled bogie, certainly helps as far as steadiness on the road is concerned, but is open to the serious objection that some of the weight which it is so important to utilise for adhesion is carried on idle wheels. The pony-truck is all right if the engine can be turned at each end of the journey, but runs so badly backwards that turn-tables or Ys are a necessity at terminal stations. The 20-ton engines in use on the North-East Dundas tram are of this type, though with four-coupled driving-wheels.

Of engines of a heavier type, I think the Mallet system compound locomotive that we have at present in use is about the best now in the market. The wheel-base is satisfactory, and if coal were burnt in a shorter firebox, the maximum rigid wheel-base of 4 feet 3 inches might be still further reduced. The only previous engine with a flexible wheel-base, and all the weight on driving-wheels, that I know anything about is the double Fairlie engine. This engine was troublesome, on account of the difficulty of keeping the steam connections tight. The trouble arose from the fact that there was a high-pressure connection, and also an exhaust, to each bogie, all of which had to be flexible. These flexible joints were made with ball-and-socket joints and a sliding gland. It was found exceedingly troublesome to keep

these joints good, the difficulty being much accentuated with the high-pressure joints. I believe that later types of these engines have largely overcome the trouble by the use of flexible metallic tubing for steam connections. These troubles are largely overcome in the Mallet system by the adoption of compound working and its arrangement. The boiler is rigidly attached to the frame at the firebox end, and the high-pressure cylinders are situated under the footplate. This gives a rigid connection for the high-pressure steam. The pipe connecting high and low pressure cylinders is a large one, lying under the firebox, along the centre of the frame, and acts as an intermediate receiver. The frame is articulated, as shown in plan, but the amount of angular motion is small, and in the pipe is amply and efficiently allowed for by a short length of flexible metallic tubing. The whole pipe is well logged, and supplied with steam-traps, and a re-heating arrangement with live steam, which, however, we use very little. Condensation in this intermediate pipe is very insignificant. The low-pressure cylinders are on the leading bogie, directly under the smoke-box, into which they exhaust through a pipe with a ball-and-socket on the upper end, and a ball-and-socket combined with a sliding gland with packing rings at the lower end. It will be noticed that by this arrangement we have a rigid connection for high-pressure steam, a very simple flexible joint, with a small amount of motion for the steam after its first expansion; and the only joint of a character at all likely to give trouble is the exhaust, where it can do least harm. There has certainly been no trouble hitherto, nor do I anticipate any.

The advantages of the compound system are, therefore, I think, much as follows :—

1. Long total and short rigid wheel-base.
2. Simplicity in steam connections as compared with non-compound engines with flexible frames.
3. The engine runs equally well forward and backward.
4. Economy in fuel.

The disadvantage, as far as I can at present see, is that the repair-bill must necessarily be higher in the long run, as many parts are duplicated.

Our No. 2 locomotive is a small four-coupled engine, weight in steam 6¾ tons. This engine is a good and efficient machine, and does excellent work for its size. At the worst of times it pulls comfortably a gross load of 15 tons up the five-mile stretch of heavy gradient.

The following are the leading dimensions, with those of the well-known similar engines by Krauss, of Munich, for comparison :—

	Orenstein and Koppel.	Krauss.
Cylinders, diameter.....	6½ inches	7⅛ inches
„ stroke.....	12 „	12 „
Wheels, diameter.....	22¾ „	24⅜ „
Wheel-base	3 ft. 3⅜ in.	3 ft. 7¼ in.
Boiler pressure	170 lbs.	170 lbs.
Heating surface.....	155 sq. ft.	166½ sq. ft.
Grate area	3·8 „	3·25 „
Tank capacity	108 gallons	107 gallons
Bunker „	24¾ cub. ft.	18 cub. ft.
Weight in steam	6¾ tons	7¼ tons
Adhesion (1/6)	2520 lbs.	2800 lbs.
Tractive force (at 65 %)..	2480 „	2780 „

A comparison of the work done by these engines respectively shows that, weight for weight, there is little to choose between them. Our engine will take a load of 18 tons of ore easily up the 1 in 25 grade, but cannot make steam fast enough to keep this up for a long distance; indeed, while steam holds, it can manage 19 tons gross load up a 1 in 25 grade. As a regular load it takes 15 tons easily up the six miles of gradient, and loses no pressure in the boiler.

At Mt. Lyell the Krauss engines take a gross load of 23 tons up one mile of 1 in 30 gradient, or 13¾ tons up half a mile of 1 in 16. The first performance is just about equivalent to our engine with 18 tons on a 1 in 25 grade, but the second, on the 1 in 16 gradient, is better than we can show; but our six-mile length of stiff gradients is quite on a different footing.

In calculating the adhesion and tractive force of locomotives, I find that taking the adhesion at one-sixth of the weight, and the tractive force at 65 per cent. of the boiler pressure, gives results that should be attained by an engine under good working conditions, and for runs of reasonable length. The load hauled up any given gradient may then be arrived at pretty closely, the weight of engine being included in the load so found. This will be found to apply closely in the case of the two smaller engines, and also in the case of the 20-ton engines on the North-East Dundas tram. Their weight available for adhesion is about 18 tons, giving the same adhesion as our No. 1 engine. The tractive force at 65 per cent. works out to about 7000 lbs., and the best work that I know they do under favourable circumstances is to haul a gross load of 60 tons, including their own weight, up a 1 in 30 grade with 1½-chain curves, equivalent to a resistance of 7500 lbs.

According to above method of calculation, I should expect these engines to pull a train-load of 36 tons without trouble up the grade mentioned, in good ordinary circumstances. They have ample cylinder-content, but hardly sufficient steaming power. I may note also that, as they burn coal exclusively, on a fire-grate larger than ours, that their fuel consumption must be considerably higher; this obviously follows from a consideration of the types of engines.

Going back to our compound engine, it may be noted that the tractive force at 65 per cent. is lower than the available adhesion; this points out the fact that the engine is under-cylindered, and experience on the road fully bears this out. An increase in the cylinder-diameters to 8½ and 12¾ inches respectively would bring this proportion about right, and the engine would certainly do better work. In ordering another engine, I should increase these diameters to 9 and 13½ inches; the engine would then have ample power for an emergency, a point in which it is deficient at present.

The last point to which I wish to draw attention is the best economic size of engines to use. At Mt. Lyell, after much experience of the Krauss engines, they have come to the conclusion that engines of about this weight (7½ tons) are the most economical that they can use, when running cost, repairs, &c., are included. I have not been working long enough here to pretend to estimate my repair-bill: but I do know this—that, under my conditions, the saving I effect by running the engine we have adopted will pay very heavy repair-bills indeed. My daily running costs, including interest, depreciation, &c., for one engine only on the road amounts to about £3 8*s*. 6*d*. per day.

To do the same work, two engines of 7½ tons would be required, which would cost me at the lowest £4 18*s.* per day. I believe that the cost at Mt. Lyell is considerably higher. This represents a difference of £1 9*s.* 6*d.* per day, or over £440 per year. I hardly think my repair-bill will amount to this, and the small engines will certainly not run without any.

One point in favour of lighter engines is that a lighter rail may be used; 7½-ton engines will run nicely on a 20-lb. rail, and this would diminish construction costs by, roughly, about £200 per mile.

The conclusion that I have come to, and which seems pretty obvious to me, is that, up to the limit that is fixed by another factor, it pays to use the heaviest engines that traffic on the line will keep fully at work.

The factor which, in my opinion, limits the economic size of engines on any road is the train length, taken in conjunction with the nature of curvature of the line. The effect of long trains is not usually felt on 3 feet 6 inches lines, though, even then, where curves are long and sharp, I have heard of several instances where a long light train offered a resistance apparently altogether disproportionate to its weight. The fact is that a considerable proportion of the curve resistance is strictly analogous to the frictional resistance of a flexible string wound round a post, and this may be proved to be proportional to the power of the number representing in circular measure the arc embraced—for example, assuming that this particular portion of the curve resistance amounts to 5 lbs. for a single truck, then for two trucks the resistance will be 5^2, or 25 lbs.; for three trucks, the resistance will be 5^3, or 125 lbs.; and for five trucks, it will be 5^5, or 3125 lbs.; and so on. Thus, if any material portion of train-resistance varies in this manner, as must evidently be the case, it is obviously most desirable to keep train lengths as short as possible, and most particularly so on lines of narrow gauge, almost the only excuse for whose existence is economy of construction due to the possibility of using sharp curves. The employment of trucks carrying as heavy loads as possible is evidently a move in the right direction.

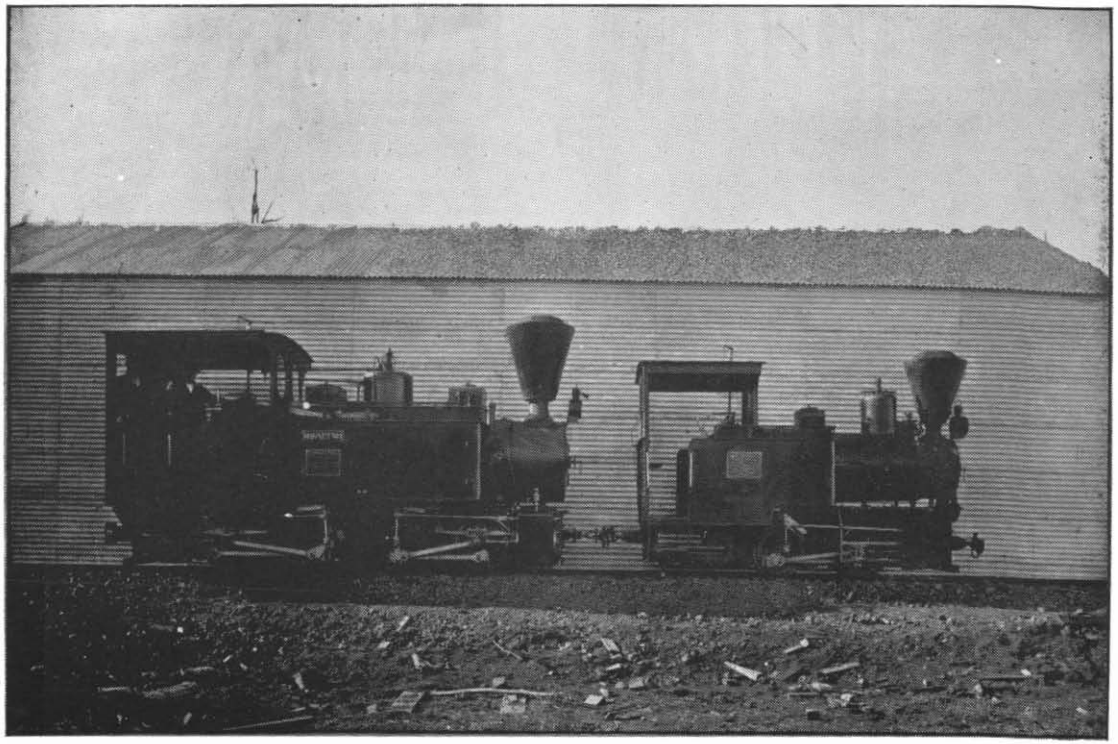
From what I have seen, I am inclined to place the limit of economical train length at three 15-ton trucks, or a gross load of 54 tons; but it is quite possible that this might be increased to four trucks before the extra power required for haulage cut away the gain due to the employment of fewer train-hands, &c. I think, however, that I should not care to go higher than to three.

This train could be easily and economically hauled on a 1 in 25 grade by an engine of the Mallet type, and of about the following dimensions :—

Cylinders, 9 inches and 14 inches diameter, 14-inch stroke.
Wheels, 26 inches diameter.
Boiler pressure, 170 lbs.
Weight in steam, 22 tons.
Adhesion (one-sixth), 8213 lbs.
Tractive force (65 per cent.), 8420 lbs.
Work to haul load on 1 in 25 grade, 7940 lbs.

I may note here that one, sometimes heavy, item in repair-bills, the re-turning of tyres, is very materially reduced in engines with articulated frames. My tyres have run 5000 miles, and show no signs of wanting the lathe as yet.

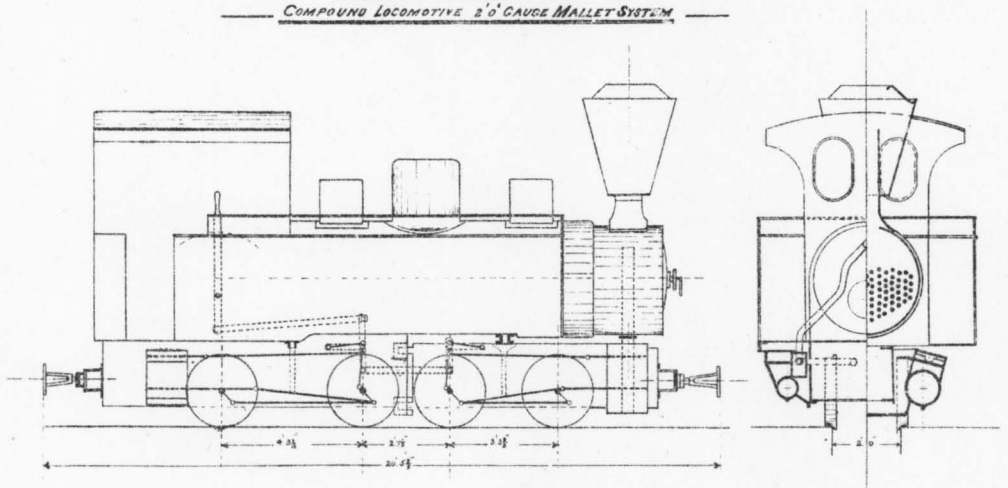
The trucks used are the standard Government 15-ton, low-side, double-bogie waggons. These are excellent stock, tare only

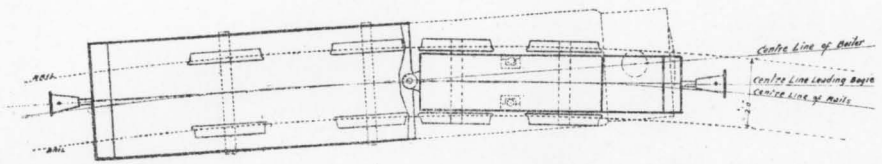


MAGNET COMPANY'S LOCOMOTIVE.

MACKNET S.M.Co.ʸ TRAMWAY

COMPOUND LOCOMOTIVE 2'0" GAUGE MALLET SYSTEM





Plan shewing Carriage on 1¼ chain curve

JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

5 cm

four tons, and will carry their nominal load. I have only hitherto loaded them, in regular work, to 13½ tons, but they will carry the full 15 tons without trouble. They have done all my ballasting, and have been in constant and heavy work for twelve months without any repairs whatever. These trucks are 24 feet long, and 6 feet 6 inches wide over all. While all the advantages are in favour of increasing the size of trucks for narrow-gauge lines, I do not think that these dimensions can be much exceeded in practice.

As prime cost was of maximum importance when the line was being constructed, stock was not fitted with vacuum brakes, though the saving in running cost is obvious; as on such work as ours a guard can be dispensed with, a saving of some £150 a year, or, in our case, of about 2*d*. per ton in freight cost.

On a line such as this, and indeed on all lines, the advantage of keeping the tare of trucks low is very marked. I have been strongly recommended (by the makers) to go in for a better class of steel framed and bodied truck, with a tare of five tons, or even heavier—with a guarantee that they would still be good trucks in ten years' time. I figure out the problem something like this. The present trucks cost me (from America) about £150 each. I can comfortably manage with them a train-load of 35 tons, of which 27 tons is ore, and 8 tons dead weight. The cost of carriage, taking into consideration wages, coal, and maintenance of road, amounts to about 2*s*. 6*d*. per ton of ore, but per ton of total load carried about 2*s*. If, therefore, I use five-ton trucks, I carry two tons dead-weight extra per train; that is, I must leave two tons of ore per train, or four tons, behind daily, which amounts to a loss of 4*s*. per truck per day, or £60 per year. So that, if I were given five-ton steel trucks for nothing, it would pay better to buy four-ton trucks, wear them out in three years, and then throw them away.

The guard's van was purchased with a view to accommodating general goods traffic; but I have hitherto always had full loading of ore for the trains, and we hardly use the van, as it does not pay to drag an extra two tons, in the shape of a van, for the reasons given above, for reducing the tare of trucks. We carry goods in the empty trucks on the back trip. We provide no passenger accommodation, except a seat on the ore-trucks.

The cost of construction and equipment ran out as follows:—

	£	*s*.	*d*.
Survey	1008	1	9
Clearing and grubbing...	682	17	3
Culverts and bridges	523	0	6
Earthworks	3876	3	6
Permanent way material	6171	1	4
Platelaying	519	14	2
Ballasting	1362	13	11
General equipment (buildings, &c.)	808	16	10
Supervision	1010	6	9
Rolling-stock	2961	7	8
Fuel	3	5	9
Stores	150	7	11
General expenses...	93	7	0
Interest and exchange	9	13	11
	£19,250	18	3

The details of this cost-sheet may be of interest.

The line cost, equipped with rolling-stock, £1925 per mile; survey cost just over £100 per mile; clearing and grubbing, for a width of 20 feet from end to end of line, cost 16*s.* 6*d.* per chain; rails, sleepers, &c., cost £617 per mile, of which the sleepers (2200 per mile) cost 1*s.* each—cost per yard of road 7*s.* Platelaying, including curving rails, adzing and boring sleepers, charged with its share of locomotive, cost £52 per mile, or 7*d.* per yard. Ballasting cost £136 per mile, or about 3*s.* per cubic yard, laid and packed in the road. Finally, I may note that included in above costs is an amount of £2100 for duty, wharfage, and freight on the Emu Bay Railway from Burnie, which materially enhanced the cost of construction.

30th June, 1902.

DESCRIPTION OF THE HERCULES COMPANY'S SELF-ACTING TRAMWAY.

By Sydney Thow, General Manager.

The Hercules Mine, situated on the western slope of Mt. Hamilton, a spur of Mt. Read, is connected with the terminus of the North-East Dundas Railway at Williamsford by means of an inclined self-acting tramway on the endless-rope system. The slope length of this line is 80½ chains, and the difference in elevation between the Government line and the "send-off" at the mine is 1642 feet. The average gradient is, therefore, 1 in 3·2, the maximum gradient being 1 in 1·5, and the minimum, *i.e.*, the approach to Williamsford terminus, 1 in 7·5.

The permanent way consists of double 2-feet gauge lines of 20 lbs. per yard steel rails, spaced 7 feet centre to centre of tracks. All joints are made with double fish-plates, and the rails are dogged to sleepers spaced at 2½ feet centres. The flanges of rails are notched to take dogs, in order to prevent the down-creep of tracks, and at intervals on the steep gradients extra heavy sleepers extend right across both tracks, and are bolted to the rock-formation, with the same object.

The controlling machinery house is placed above the level of the main surface tramway, which connects with all underground workings from which ore is at present produced for sale purposes; this allows of the inclined haulage-trucks being run underground in rakes, and filled direct from the various ore-passes. The distance from the "send-off" to the entrance of No. 2 tunnel (the lowest level of the northern workings) is 9·8 chains, and to the No. 4 tunnel (the most southerly portion of the mine workings) is 21·7 chains. Storage bins for ore from upper workings and surface benches are also situate upon this level.

Plate I. shows formation gradients. All cuttings are in rock, and embankments are formed from the spoil therefrom and rock side-cutting. The average rainfall of about 100 inches annually called for ample drainage provision in the shape of side-ditches and culverts.

The controlling machinery comprises two cast-iron grooved wheels, each fitted with dynamometer brake-bands, and the brakes are applied through a lever system connecting with a worm and hand-wheel. The multiplied leverage or pull on brake-band is 680 times the pressure imposed at the periphery of the hand-wheel, affording in practice a tension of three to four tons upon each brake-strap. The front wheel is 7 feet in diameter, and has three rope-grooves; the back wheel is 7½ feet diameter, with four grooves. The endless-rope is led to the lowest groove of the back wheel, and, after traversing a half-circle, leads direct in turn to the three grooves of the other wheel. The maximum bend in rope is therefore half round a 7-feet diameter wheel, and the rope leaves the wheel-house from the top groove of the back wheel (see figure 3, Plate II.). The two wheels are placed in

tandem, and in the same horizontal plane guide-sheaves are used to change the inclined travel of the rope to a horizontal one (see figure 2, Plate II.). The brake-bands are of 5 inches by 7 ·16 inches soft steel, having an ultimate tensile strength of 24 tons per square inch, and the brake-blocks are 15 inches long of 5 inches by 3 inches kauri pine. The grooved wheels are cast in halves and bolted together; they have 6-inch diameter shafts of forged steel, case-hardened at lower ends, and revolve on cast-steel pivots. The bearings are of cast-iron, with hard gun-metal bushes. The wooden frame-work is built of celery-top pine throughout, with the exception of the bed-logs, which are of hardwood. These bed-logs are set in concrete and lewis bolted to the rock foundation.

The hauling-rope was manufactured by Messrs. Bullivant and Co., England; it weighs 11 tons, and is 3½ inches in circumference. It is a six-strand seven-wire extra plough steel rope with hemp core, the rope being closed in the same way as the strands are laid, and having an ultimate (tested) tensile strength of 42½ tons. For convenience of handling, it was ordered in three coils, each of 3970 feet in length; three splices were therefore required, and were made each 66 feet in length, the tucked ends measuring 5 feet 6 inches, and were carefully served with tarred twine, to correspond in size with the hemp core which they replaced. The terminal stations of the haulage-line are connected by telephone, and the line is operated by a system of electrical bell signals. At the Williamsford end of the tramway, the method of dealing with the working shocks, and the slacking or taking up of the endless-rope caused by temperature variation, is shown on Plate II., figure 2. The rope passes over jockey-pulleys, round a 7-feet grooved wheel, attached to a carriage-frame which traverses an inclined road. To this carriage is fastened an adjustable counterpois weight. A breastwork of cross-timbers is built at the lower end of inclined road, to safeguard vehicles standing upon the Government line, should by any chance the balance-frame become detached.

To reduce friction and minimise wear, the rope is carried over rollers wherever it comes in contact with the formation. Composite rollers 8 inches in diameter, made of Tasmanian blue gum, with castiron flanged ends and bearings and steel spindles, are found to give most satisfactory results; but at places where the rubbing is unusually severe, notably at the 31½ and 40½ chains distances, cast-iron rollers 9 inches in diameter are substituted for the wooden ones.

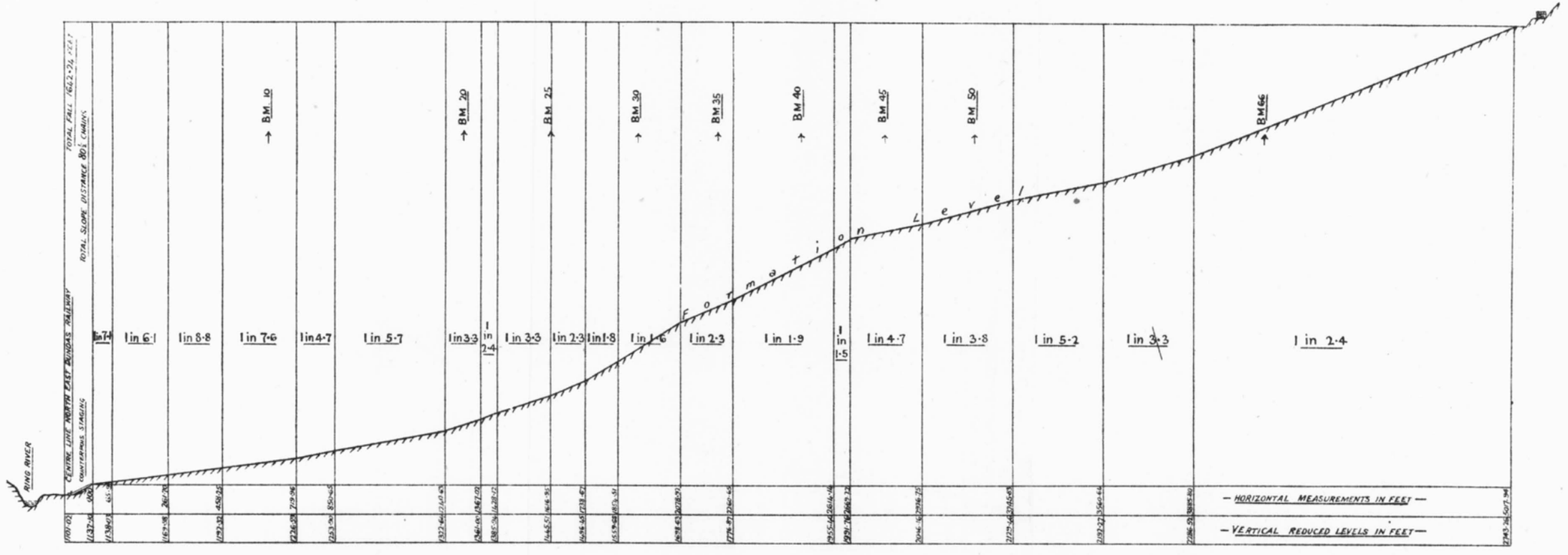
The rope is kept well coated with a mixture of heavy Nubian oil, resin oil, and Stockholm tar. The brake-wheel bearings are fitted with Stauffer's patent force lubricators, feeding a compound, and the brake-band surfaces are lubricated with graphite paste.

All trucks are attached to the rope per medium of a chain and grip. These grips (figure 4, Plate II.) are designed on the cam-and-lever principle, and are made of wrought material throughout. The pivot-pins are of crucible steel, $1\frac{5}{16}$ inch diameter, and the cam levers are of Lowmoor iron. The chains are $\frac{7}{16}$ inch diameter best charcoal iron crane-chain, having a breaking strength of 6½ tons. The maximum gross load permitted for any individual truck upon one grip-chain is 1½ ton, and, as the resistance on steepest gradient is 1263 lbs. per ton, the safe factor upon grip-chain is therefore 8, which is not too high, as

PLATE I.

The Hercules Gold & Silver Mining Co.,

INCLINED HAULAGE TRAMWAY



JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

LONGITUDINAL SECTION

5 cm

- PLATE II -

Fig. 1.

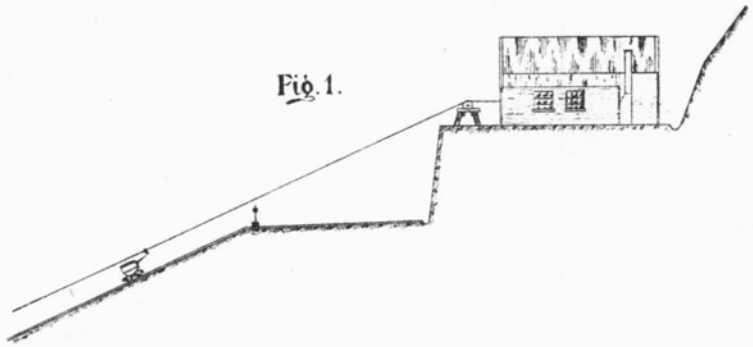
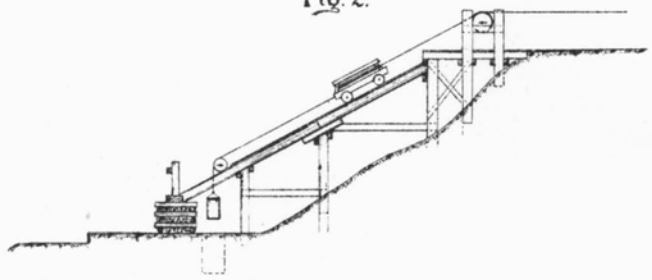


Fig. 2.



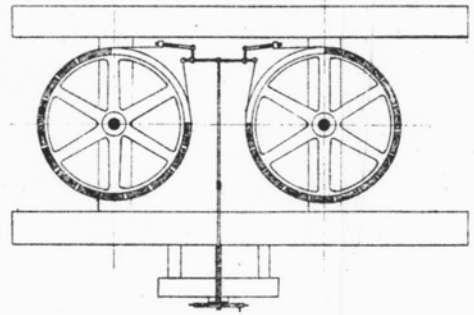
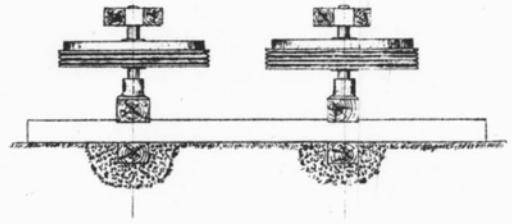


Fig. 3.



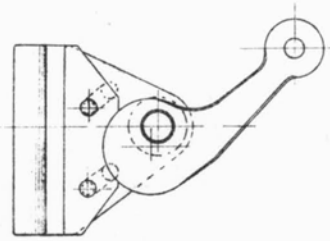
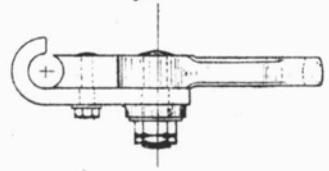


Fig. 4.



JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

5 cm

the intense cold experienced in winter months renders all couplings brittle.

The quick variations in gradients make it necessary to attach the trucks to the rope in this manner, so that the rope may be free to rise and fall in accordance with the position of the loaded points.

By reference to Plate I., showing the line formation, it will be observed that the section generally falls short of attaining the ideal "catenary" curve, *i.e.*, the curve in which a perfectly flexible cord hangs when suspended from two points. The distance between the rope and the track being a variable one prevents, in a large measure, the adoption of any system of continuous working with automatically-actuated grips; and, on the other hand, the gradients are so disposed that any attempt to adopt a "tail-rake system" of working, without exterior power, would be hampered by the fact that the returning empty rake would take a position upon a rising grade of 1 in $1\frac{1}{2}$, when the corresponding loaded rake was upon a down grade of 1 in 5·2. It is found, therefore, that uploading is handled to best advantage by adopting the present system of a continuous rope with distributed loading.

The trucks are spaced upon both up and down roads, opposite each other, at 350-feet intervals. Therefore, an empty truck arrives at the top, and a loaded truck at the bottom, simultaneously. Two trucks are often coupled at the same station, and the average number of trucks attached to the rope at one time is 36. The iron skip-trucks carry 12 cwts. of bulk sulphide ore, or 8 cwts. of bagged gossan ore. The wooden trucks carry one ton of bagged gossan ore, and are used for the uploading of general goods and mine-timber. In general working, the number of truck-journeys each way per shift of eight hours averages 200 to 250. The percentage of up to down loading is not up to tram's capacity, which is about 4 to 1. Seven men are required to operate this haulage; the labour costs, therefore, about 6*d.* per ton of loading. The capital cost of tramway and plant to date is about £8750.

At Williamsford terminus the bulk ore is emptied into storage bins, which discharge direct into the railway trucks, and the bagged ore is passed down a wooden shute, which also delivers into the railway trucks.

In addition to fulfilling the requirements of the Hercules Mine, general goods and merchandise are carried for the public at scheduled rates, and about 7000 tons of ore has been carried for the British Mount Reid Mining Company, Limited.

30th June, 1902.

OPERATIONS OF THE MOUNT LYELL MINING AND RAILWAY COMPANY, LIMITED, FOR THE YEAR 1901–2.

By Members of the Company's Staff.

The Mines.

Mt. Lyell Mine.—During the year under review in this Report, operations at the "Big Mine" have been characterised by the usual activity, the ore output being maintained the same as before, *i.e.*, approximately 1000 tons per working day. However, partly on account of the heavy fall in the price of copper, and partly in consequence of the lowering of the average assay value of the ore since the open-cut has advanced into the heart of the ore-body, the excavation of ore is at present restricted practically to the south-eastern half of the body.

The open-cut is now laid out in nine terraces or benches, numbered downward, as follows :—Nos. 0, 0a, 1, 2, 2a, 3, 3a, 3b, and 4, the numbers 1, 2, 3, and 4 corresponding to the original tunnels or levels. The vertical distance between Nos. 0 and 4 is 266 feet. Of these benches, the first three are now only in overburden; Nos. 2 and 2a are partly in ore and partly in overburden; all the others are in ore. The depth from the top surface of the knoll on which the mine is situated, and back of the ore-body, *i.e.*, in the hanging-wall, to the bottom of the open-cut, is about 320 feet. The surface opening of the excavation is oval in shape, and measures at the present 800 feet by 630 feet. Of the former underground mine levels, Nos. 1 and 2 levels are now completely obliterated by the open-cut; while of No. 3 level workings, a small portion still remains on the hanging-wall side; No. 4 level has only latterly been attacked by open-cutting, and the contour drives are still in existence.

Thirty-seven rock-drilling machines are made use of for the winning of ore in the open-cut and underground, and the removal of overburden. They are mostly of Rand Drill Company's make. The air-compressor is a fine piece of Australian designed and made machinery, and was supplied several years ago by Messrs. Thompson and Company, of Castlemaine, Victoria. It is duplex compound, fitted with inter-cooler and surface condenser; steam cylinders, 14¼ inches and 24½ inches; air cylinders, 15 inches and 24 inches; stroke, 36 inches; delivery, 1000 cubic feet per minute free air at 60 revolutions; working pressure, 80 to 90 lbs. at compressor. Blasting is done in the open-cut twice a day—at noon and at 5 p.m.—the daily number of shots varying from 180 to 280, and the depth of holes from 22 feet to mere pops for breaking boulders of ore. The chief explosives used are gelignite, black powder, and chlorate and nitro-benzol compounds (rack-a-rock), of which the total annual consumption is 60 tons, divided about equally among the three kinds. Blasting by electricity is largely practised, principally in the overburden benches, on deep holes, up to a dozen being fired together, and

dislodging 1000 to 1500 tons at a time. A travelling revolving steam-crane handles the larger pieces of overburden rock. The ore excavated is lowered from the upper benches by means of two self-acting gravity-inclines, in five-ton trucks, to the mine storage-bins. These are situated a little below No. 4 level, and have a total capacity of 6000 tons, and feed both the haulage-line, *i.e.*, surface tram connecting the mine with the Smelting Works, and the aerial ropeway serving the same purpose.

In the company's report for the half-year ended the 31st of March, 1901, a re-estimate of the ore reserves above No. 4 level is given, and the ore-body divided into five equal sections, running transversely across the mass. As before, the estimate is restricted to the ore available above No. 4 level. This was the original main working level for underground exploration purposes in the past, and is regarded as the provisional bottom level of the open-cut. In other words, the horizontal section of the ore-body at No. 4 level being taken as a basis, the extent of overburden to be shifted in the course of time for the purpose of freeing the entire mass of ore above this level was marked off by prolonging proper batter-lines from the periphery of the body at that level to the surface of the ground, and it is towards this ultimate circumferential limit of the open-cast that the excavation of the overlying rocks is being systematically conducted. This programme involves very extensive works, not alone for the removal of ore, but still more for the removal of the overburden. The original mass of the former was estimated at 693,045 cubic yards, and of the latter at 1,500,000 cubic yards. The official estimate above referred to states that there were then left for removal above No. 4 level, over the entire five sections referred to, 1,626,665 tons of ore, and of this quantity 978,337 tons were available in the south-east sections Nos. 1, 2, and 3, of an average assay of—Copper, 2·35 per cent.; silver, 2 ozs.; and gold, 0·0725 oz. No estimate made at any time for the purpose of guidance in open-cut operations has paid any attention to the extraction, by this means, of ore below No. 4 level, since it was considered that, for practical purposes, the latter was a sufficient limit *pro tem.* Since the payable ore, however, extends below No. 4 level, and in places has been found to reach as low as No. 5 level, 150 feet lower down, the above programme of operations will have to be amplified by carrying open-cutting operations below No. 4 level until the apex formed by the junction of the batter lines is reached. It may be stated that the management already has the necessary provisions for this lower work in hand.

It is to be regretted that the continued low price of copper has a manifest influence on the payableness of the ore, and that, in consequence, certain grades are now being avoided and left standing which might with profit be included in the treatment in more prosperous times. However, as is apparent from the regularity of the assays published in the monthly returns, the management is endeavouring—and has succeeded with exceptional success—to maintain the average copper assay of 2·35 per cent., which last year's estimate affirmed. For this purpose an elaborate system of sampling is in vogue, as a check on the values won and despatched, and both the open-cut and underground surveys are kept strictly up to date. In both respects the supervision is of an exemplary character, as indeed is required in all departments, considering the fact that the mine is what is called "a low-grade proposition."

Below No. 4 level the usual development work, by way of exploration drives and crosscuts in advance of stoping, has been going on, hand-in-hand, during the year with the stoping operations themselves. The latter are carried out on local enrichments of more or less size, chiefly on the south-eastern hanging-wall end of the main mass, although the footwall is also in places characterised by occurrences of richer ore, and in fact the famous rich pocket which gave the impetus to developing the property on a large scale was so located. This Bonanza returned £105,000 net by sale in London, out of 850 tons of ore. These old workings were again entered this year, but examination revealed that in the first extraction, in 1894, the rich ore was very thoroughly removed.

Below the horizon of the above-mentioned workings, which are intermediate between Nos. 4 and 5 levels, the body has been contoured completely in No. 5 level, and proved to be somewhat smaller in extent than at No. 4 level. At No. 6 level, however, 100 feet below No. 5 level, the body experiences an increase in width, as has been established by the driving on footwall and hanging-wall. The latter work has recently rounded both the north-eastern and north-western corner of the ore-body, and will be brought to a closure in the course of a few months. Sixty feet below No. 6 level there is No. 7 level, in which the usual contour exploration work has also been started, but it was only carried for a short distance on each wall, on account of the preferableness of contouring at No. 8 level. This last level has been opened up from a vertical three-compartment shaft sunk in recent times from No. 5 level down through the hanging-wall schists, thus bringing its bottom close to the contact of conglomerate and schist, between which two rocks, it may be said, the ore-body as a whole is enclosed at its southern end. The shaft itself is so situated as to admit of rising to the surface at a point most suitably located for future hoisting and surface transportation. In No. 8 level, 100 feet below No. 7 level, corresponding to 410 feet below No. 4 level, or 730 feet from the surface, crosscut drives to the main ore-body have been driven, and the search for the pyritic main mass has recently been attended with success. Considerable driving has also been done on the contact of schist and conglomerate in Nos. 4, 5, and 8 levels, in a direction south from the main body, for the purpose of investigating the presence of continuations or repetitions of the latter, but so far without result.

Simultaneously with defining the contour of the main mass underground in the levels named, its assay value has also been determined at all points, and this has proved the bulk of the underground ore to be of a similar grade to that in the now untouched portions of the open-cut. Occasional richer patches have been met with, and the downward extent of the larger enrichments in the south-eastern portion of the main mass has been traced as far as No. 8 level, thus showing them to characterise, in a more or less connected manner, the entire depth of the ore-body from the surface down. These richer shoots seem to be of a subsidiary nature, standing in some geological relation to the main mass, but not always by way of direct alteration of same. Especially in the greater depths of the mine, the character of the enrichments mineralogically, on the whole, may be said to be quite distinct from the main body, inasmuch as the ore is an occurrence of bornite, and occasionally chalcopyrite, or both together,



MOUNT LYELL MINING AND RAILWAY COMPANY'S MINE.

in a quartz matrix, making the whole not very dissimilar from the ore occurring in the northern portion of the field, one mile and more away. The main mass, on the other hand, is emphatically only cupriferous iron pyrites, with rarely over 10 per cent. of impurities, *i.e.*, silica, heavy spar, alumina, &c. The enrichments referred to are undoubtedly offshoots from the pyritic body, most likely of subsequent origin to same.

The following are data relating to the size, &c., of the ore-body :—

At No. 4 Level—total length 660 feet; greatest width 270 feet.
At No. 5 Level—total length 510 feet; greatest width 210 feet.
At No. 6 Level—total length 510 feet; greatest width 270 feet.
Strike of major axis of deposit at No. 4 Level—N.W. to S.E.
Strike of major axis of deposit at No. 5 & 6 Levels—N.N.W. to S.S.E.,

with a dip constantly to the south-west into the hill; on the whole, rather steeper nearer the surface than at a depth. The footwall extends very steeply from No. 3, past Nos. 4, 5, and 6 down to No. 7 level. The same is also true of the south-east corner of the ore-body, but at the north-west corner the underlie goes flatly to the south-east. The hanging-wall is very steep from Nos. 3 and 4 levels to No. 5, but flattens out between Nos. 5 and 6 levels in the middle of the body, there being a considerable bulge-out at No. 6 level.

The typical chemical composition of the pyritic ore may at present be taken as follows, the figures representing the last half-yearly average analysis :—

	Per cent.
Iron	40 ·30
Silica	4 ·42
Barium Sulphate	2 ·50
Copper	2 ·35
Alumina	2 ·04
Sulphur	46 ·50

The average composition of the underground ore for the same period was :—

	Per cent.
Iron	24 ·75
Silica	30 ·69
Barium Sulphate	1 ·48
Copper	5 ·33
Alumina	6 ·30
Sulphur	30 ·0

In consequence of the mining operations being confined chiefly to the simple method of surface extraction by means of open-cutting or quarrying, with the attendant removal of overburden, while the underground driving has been restricted to the determination of the size, direction, and value of the ore-body, the summary of underground distances traversed is not very large for a mine of this prominence, although the figures total up a tolerable amount. The following is a *résumé* of the exploration

and other work done since the inception of mining operations up to 30th June this year :—

	Feet.	
Mount Lyell Mine—		
Driving	12,092	
Crosscutting	2,962	
Winzes and rises	1,571	
Shafts	703	
Total...	17,328	
Other mines acquired by the company.	6,220	
Grand total	23,548	ft., or 4 ·46m.

It may be stated that latterly operations with the diamond-drill have been inaugurated in the "Big Mine," starting in No. 6 level. Several holes have here been drilled horizontally through the ore-body, in order to test the assay value, and no doubt the same means will be used to explore other portions of the main mass. The convenience of this method of prospecting is reported to be fully realised, very prominent being the speed of penetration into new ground, notwithstanding the hardness of the pyrites, its occasional laminated and even shattered condition, and the inclusion of layers of excessively hard chert and jasper-like rock near the footwall.

The underground workings are lighted by electricity, and they are also connected with the company's main telephone system. Hoisting underground is done by small winding-engines, of which there are six on the ground, with compressed air as motive power, average pressure 80 lbs. per square inch. The well-known square-set system of underground timbering is in use in the stopes, and filling is done where necessary or convenient for stowage of mullock.

The mine has a well-appointed machine shop of its own, for current repairs, &c., but relies on the Reduction Works for larger work of this kind.

Considering the well-known heavy rainfall of the district, it may seem strange that one of the greatest difficulties to contend with at the mine is a rather irregular water supply. During the last seven years the annual average number of rainy days was 221, and the rainfall 116 ·77 inches, yet water is occasionally scarce. The company has not felt justified to impound on a very large scale above the level of the mine (at an elevation of 1500 feet), owing to the extreme costliness of the necessary work in consequence of the peculiar much-cut-up topographical features of the locality, which make extensive water-storage impossible anywhere except at the bottom of the valley, some 500 feet below the top of the open-cut. The supply is derived from Conglomerate Creek, 1¼ miles distant, a small tributary of the Queen River, at an elevation of 1750 feet on the western fall of Mt. Owen, and is led to the workings by race, flume, and piping (involving a syphon across a valley 400 feet deep), to a service-reservoir of 150,000 gallons capacity. An average of 170,000 gallons is delivered daily, of which 50,000 gallons are used on surface and underground mining, the remainder being consumed by machinery, &c. The quantity of water making in the underground workings is very slight, and varies with the surface de-

position. The mine is, from the miner's point of view, practically absolutely dry. The quantity of mine water being small, it is fairly acid in character in consequence, and both expensive and difficult to handle. The corrosive qualities have been constantly on the increase since the growth of the underground workings (and the open-cut) has opened new surfaces of the pyrites to contact with the atmosphere. Iron pipes would be completely ruined in less than three weeks, and within a fortnight a single drop, constantly falling from the roof of a drive will eat a hole through a half-inch plate of iron. The water leaving the lowest adit, No. 5 tunnel, carries up to 23 grains of copper and 200 grains of sulphuric acid per gallon, and is treated for recovery of the copper by precipitation with scrap-iron. A suitable system of mud-settling tanks, precipitating-boxes, launders, copper-collecting boxes, &c., is in use, and will shortly be enlarged. The precipitate carries about 50 per cent. copper, and is sent to the converter plant.

Auxiliary Mines.—The "other mines" referred to in the above table are the Royal Tharsis, South Tharsis, King Lyell, Glen Lyell, and the Mt. Lyell Reserve leases, all of which have been acquired by the company of late as additions to its metal-bearing flux resources, and swell the total acreage of the company's mine and smelter leases to 2697.

At the Royal Tharsis Mine, which is about three-quarters of a mile north of the "Big Mine," considerable underground exploration has been carried out, and a couple of thousand tons of silicious copper-bearing flux have been forwarded to the smelters. Steps are now in progress to start open-cut operations as well.

The South Tharsis deposit is in immediate proximity to the Royal Tharsis one, and is being worked by means of open-cut. The South Tharsis and Royal Tharsis mineral shoots, though close to each other, do not appear to be connected. Both are simply locally-intensified occurrences of the general mineralisation characterising certain schists of the district, and are wholly different in character from either the "Big Mine" or the northern ores of the field. A total of 33,024 tons of these mineral-bearing fluxes has been delivered to the smelters since the company acquired the two properties, the average assay value of the flux being—Copper, 1·64 per cent., with small amounts of silver and gold. Delivery of these fluxes to the smelters is effected over the gravity-incline built by the former South Tharsis Company from mine to concentrators, and from this point by 60 chains of 2½ feet wooden-rail tram, on steep descending gradients, to bins on the "through tram," *i.e.*, the 2-feet steam-tram running from the foot of the haulage-line to the smelters. This system fully answers all requirements, including cheapness of working, and has been retained as most suitable after thorough investigation of all alternatives.

The further underground exploration of these deposits has so far been held in abeyance, but it is stated that the diamond-drill will shortly be made use of for underground prospecting. An interesting property recommending itself for exploration by this method is the King Lyell, which lies at the foot of the "Big Mine," and in which, report has it, there are deposits of cupriferous clayey gossan, similar in character to that of the Mt. Lyell Blocks Mine, but lower in grade, although the mediocre results of the sluicing and puddling operations carried out by the previous owners do not encourage high expectations.

On the Lyell Reserve Block 4691 an interesting pyrites deposit carrying fahl-ore, opened up by the former owners, has been further explored by the company, but its small size precludes extensive operations. The value goes up to 6 per cent. copper.

The average chemical composition of the metal-bearing fluxes for the last half-year was as follows :—

	Silica. Per cent.	Iron. Per cent.	Alumina. Per cent.
South Tharsis flux ...	62 ·67	8 ·05	12 ·17
Royal Tharsis flux ...	61 ·17	9 ·94	10 ·44

This composition does not differ essentially from that of the purchase-ores derived from the northern portion of the field, but the fluxes are somewhat denser in character than the latter, and require more careful treatment in smelting.

The concentrating works erected by the old South Tharsis Company have not been made use of. The machinery has partly been removed elsewhere; the boiler, for instance, having been taken to the company's haulage-line and the steam-engine to No. 2 smelting plant; and some portions have been sold. The experience of the former owners in the concentration of these difficult ores was disappointing. Although the detailed results are not available, and in any case extended over too limited a period of time to be final, the fact is established that there was a remarkably heavy copper loss. The iron pyrites by itself was saved fairly easily, but it did not contain the copper expected, and which was apparently associated with it in the ore. The copper went its own way, remaining with the tailings of the jigs, and enriching them beyond the copper contents of even the cleanest pyrites headings. On the slime-tables the concentration of the copper was much better, yet all through it seemed as if the copper slimed considerably, and occurred in the ore quite distinct from the iron pyrites, much in the manner of a mere cover on the particles of the latter, with a strong tendency to float off instead of settling. This experience does not augur well for the easy concentration by water of the low-grade ores of the district.

The Reduction Works.

Smelting Plants.—At the company's Smelting Works the usual energetic operations were continued during the year. Since the beginning of 1902, however, a smaller number of furnaces has been made use of for the same ore-consumption. At the present it may be said that there are five furnaces in continuous operation, whereas the number formerly used to be seven and eight. The total number possessed by the company is eleven blast-furnaces, arranged in two smelting plants, the older or No. 1 plant containing six blast-furnaces, and the newer plant, No. 2, five. The latter furnaces were built according to experience gained in the operation of the former, and were made considerably larger, the respective sizes in the plane of tuyeres being as follows :—No. 1 plant, 40 inches by 168 inches (except No. 3, which is 36 inches by 126 inches); No. 2 plant, 42 inches by 210 inches; the height in each case, from the tapping to charge floor, is 20 feet overall; the height of ore-column above tuyeres is 9½ feet; the number of tuyeres (3 inches throughout) is 32 in No. 1 plant (24 in No. 3 furnace), and 40 in No. 2 plant. The

furnaces are water-jacketted high up, the jackets all being cast-iron, with the exception of the small steel-plate tymp-jacket. At the present time it may be said that three of the large furnaces of No. 2 plant practically smelt into first matte all the ore that is delivered, while two furnaces of No. 1 plant are devoted to the concentration of the first matte into converter matte, and only occasionally treat ore alone. Under these circumstances, each furnace of No. 2 plant sometimes smelts up to 350 tons of Mt. Lyell pyrites per diem, and the average, as calculated from the four weekly returns, is about 270 tons of pyrites daily. Phenomenal tonnages are occasionally reached; thus, No. 6 furnace recently treated a total of 724 tons of material (matte, silica, limestone, and slag) in a single day. This vigorous work is due to the fact that the amount of air formerly distributed to the large number of furnaces is now supplied to the smaller number. Simultaneously, the blast pressure also has risen, until it is now on a level with the pressure made use of in the progressive matte-smelting establishments of the United States and British Columbia, and ranges from 36 to 40 ozs. at the blowers, and from 30 to 34 ozs. at the furnaces, the difference at the two points being loss by friction in hot blast-stoves, blast-mains, and furnace-connections. To meet this higher pressure no alteration was made to the furnaces, except the raising of the sump, *i.e.*, the elevating of the overflow-level of the furnaces by several inches for the proper trapping of the blast, the same as before.

At the same time, important improvements were also made in the motive-power department by the installation, in each smelting plant, of steam-saving appliances, consisting of Green's economisers, with induced draught-fans and a system of steam superheaters. The economy effected by the economisers is determined as 15 per cent., and by the superheaters as 16 per cent., total saving 31 per cent The waste heat of the fireboxes of the hot-blast stoves, in addition to that of the boilers, contributes to this high result. The steam plant of the Smelting Works is, therefore, entirely up to date, and the various improvements have succeeded in lowering the cost of power to what must be regarded as the local minimum. The fuel employed is still chiefly firewood, the use of coal being merely auxiliary. The respective consumptions under the boilers were, for the year, 36,443 tons of wood and 1794 tons of coal.

The work done in this department for the year was the highest yet performed. There are six 124-h.p. Babcock and Wilcox boilers available in each smelting plant, two in each case now being in reserve. The average indicated horse-power was 1905; total engine revolutions, 310 millions; air delivered to furnaces, 31 billions cubic feet, weighing 1,054,000 tons. This air was heated to an average temperature of 580° Fahr., thus absorbing 291¼ billions British Thermal units out of the combustion of 49,000 tons of firewood in the hot-blast stoves. The latter have continued to give every satisfaction. In point of repairs the eight stoves (four in No. 1 plant, with 56 castiron U tubes each, at 16 cwts., and four in No. 2, with 70 U tubes each) have given practically no trouble, there having been only about a dozen tubes completely replaced since the beginning, on account of burning out. The number of hands employed in the smelter motive-power departments is 80, comprising engine-drivers, firemen, cleaners, wood-handlers, &c. It may be mentioned that,

for the production of the blast, there are in use nine vertical compound condensing-engines, 12 inches and 22 inches by 18 inches, set up in marine style, and direct coupled, by means of a flexible coupling, to a No. 8 Root's blower, each of 116 cubic feet displacement; also one reserve No. 7 Root's blower with vertical engine attached, ordinary style, and two reserve No. 7 Root's blowers, belt driven from a horizontal tandem compound-engine, 12 inches and 20 inches by 30 inches. The power-plant thus follows the unit system, *i.e.*, each furnace has a blower driven by an individual engine, although the blast is not conducted to each furnace separately, but directed into a common blast-main. The condensers are of the surface type (1000 square feet), also with vertical compound-engines, 6 inches and 12 inches by 6 inches, and air-pumps to suit—the latest with Edwardes' pump.

The following are the statistical figures of ore treated, rendered by the company for each quarter of the past year :—

Treated	Quarter ending Sept. 30th, 1901. Tons.	Quarter ending Dec. 31st, 1901. Tons.	Quarter ending Mar. 31st, 1901. Tons.	Quarter ending June 30th, 1902. Tons.	Total for year 1901-02. Tons.
Mt. Lyell ore ...	69,289	65,688	71,111	79,969	286,057
Purchase-ores ...	21,257	20,731	11,680	4,841	58,509
Metal-bearing fluxes	5,726	6,480	7,702	8,139	28,047
Total	96,272	92,899	90,493	92,949	372,613

It is thus apparent that the average per day was the treatment of over 1000 tons of raw mineral-bearing substances, besides which the company has treated in its blast-furnaces all the first matte, converter slags and linings, flue-dust, and similar middle-products formed in the process.

It may be remarked that the grade of the first matte at present does not exceed 15 per cent. copper, being a concentration of from 6 to 7, and more, from the original ore into first matte, all of which work is practically performed, as remarked, by the furnaces of No. 2 plant. The re-treatment of this first matte, or concentration of same, by the furnaces of No. 1 plant, raises its grade to 45 per cent. and 50 per cent. copper, which is the standard required for proper economical bessemerising into blister copper.

The output of the furnaces in copper, silver, and gold, for the year under review, is as follows :—

Output.	Quarter ending Sept. 30th, 1901.	Quarter ending Dec. 31st, 1901.	Quarter ending Mar. 31st, 1901.	Quarter ending June 30th, 1902.	Total for year 1901-02.
Fine copper in blister (tons)	2,630	2,579	2,520	1,870	9,608
Silver, fine (ozs.)	164,932	160,102	182,487	171,133	678,654
Gold, fine (ozs.)	5,224	5,002	5,650	5,555	21,451

The total money-value of this year's output, calculated upon the changing quotations for the copper and silver, is given as £765,584.

The grand total of ore treated since the beginning of smelting operations on 25th June, 1896, up to the 31st of March, 1902, as

given in the company's last report, together with average assays, is as follows :—

	Total tons.	AVERAGE ASSAY. Copper. per cent.	Silver. ozs.	Gold. oz.
Mt. Lyell Mine	1,160,684	3 ·00	2 ·81	0 ·101
Purchase-ores	154,923			
Total ores	1,315,607			
Total metal-bearing fluxes	33,023	1 ·64	0 ·21	0 ·020
Grand total ores and metal-bearing fluxes . .	1,348,630			

The principal consignor of outside purchase-ores was the North Mt. Lyell Company, which has supplied half the total. Then, in order, follow the Lyell Tharsis, Mt. Lyell Blocks, and the old South Tharsis Company, while small lots have been received from the King Lyell, Duke Lyell, and Prince Lyell companies. The North Mt. Lyell Company completed its contract shortly after the end of the year. It is interesting to state that the average assay of all of the purchase-ores, representing, as it does (with the exception of a quantity of rich ore shipped to England by the North Mt. Lyell Company), an approximation to the average value of the silicious bornite ores of the district, is—Copper, 6 ·70 per cent.; silver, 1 ·93 oz.; gold, 0 ·002 oz. The Mt. Lyell pyrites, therefore, though lower in copper, are relatively higher in silver and gold than the average bornite ore of the district. The aggregate average assay of all ores treated by the company in the course of time is—Copper, 3 ·44 per cent.; silver, 2 ·70 ozs.; and gold, 0 ·090 oz.

The following last half-yearly average analyses may be of interest :—

	Silica. per cent.	Iron. per cent.	Alumina. per cent.
North Mt. Lyell...	63 ·70	6 ·22	10 ·10
Lyell Tharsis...	64 ·00	5 ·08	17 ·25
Mt. Lyell Blocks	60 ·91	7 ·91	10 ·60

If the returns for the quarter from the end of the company's half-year to that of the statistical year are added to the above, the results are as follow :—

	Tons.
Mt. Lyell ore treated	1,240,653
Purchase-ores	159,764
Metal-bearing fluxes	41,162
Grand total	1,441,579

tons of local ores furnaced by the company from the beginning to 30th June, 1902.

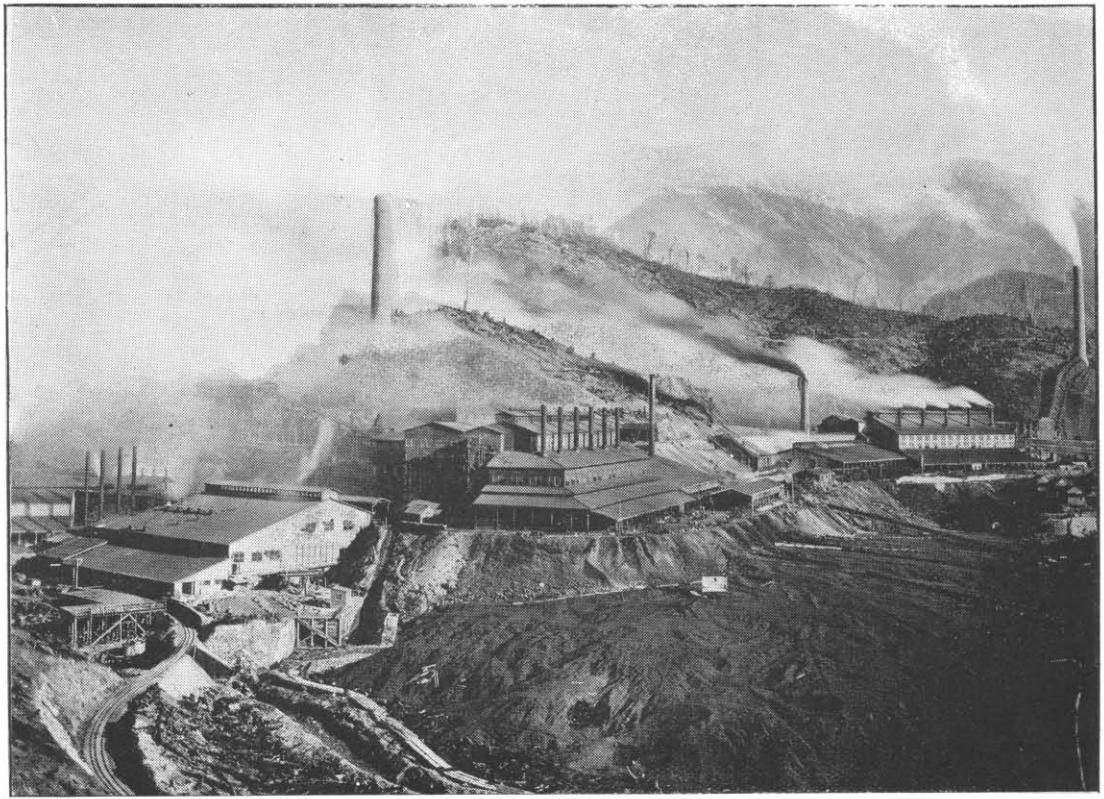
Besides the above-mentioned, there have also been smelted the following quantities of other materials from commencement up to the end of the company's last half-year (31st March last) :—

	Tons.
First matte	271,913
Silica flux	327,183
Limestone flux	182,202
Flux slag	281,134
Coke used at blast-furnaces	81,044
Flue-dust re-treated	24,022
Converter slags	45,223
Converter linings	7,276
	1,219,99
Add ores and metal-bearing fluxes...	1,348,631
Total materials furnaced	2,568,628

The above figures apply to the twofold smelting, but do not include the bessemerising of the product, *i.e.*, converter matte.

The method of metallurgical treatment has remained the same as at the start, *i.e.*, direct pyritic smelting, with the use of only a very small percentage of carbonaceous fuel and with a heated blast, and subsequent bessemerising after Manhés. The type and details of the blast-furnaces have required no alteration from the original design. The use of a hot blast for the furnace treatment has been proved by experience to be obligatory and not to be circumvented, as indeed is demonstrated by a careful investigation of the thermo-chemistry of the method. The process, as a whole, is divided into three stages, *i.e.*, two smeltings into matte, and the converting of the enriched matte into blister copper.

The quantity of coke used in the blast-furnace smelting, when calculated on the ore, is about 5 per cent. in current work for the twofold furnacing, and 6 per cent. on the ore including all incidental coke for glowing-in purposes and similar occasional use, while, on all the material fed into the furnaces (less coke itself), the percentage is only 3¼ per cent. for the double smelting. It can hardly be maintained that so small an addition of coke has any vital bearing on the furnace reactions, from a heat point of view, and it is commonly remarked that the coke simply serves to keep the tuyeres from becoming too hard. It is fed along the long walls of the furnaces with this special object in view. Such low percentages of coke are only possible owing to the application of the oxygen of the atmosphere to the ore mixture under conditions which make the oxygen perform a function somewhat different in its effect from that which it exercises in ordinary blast-furnace smelting, where a larger percentage of carbonaceous fuel is necessary. In all three stages of the process the material (ore or matte) is constantly subjected to an oxidising action, and not a reducing one. The process, therefore, in this respect is the direct inverse of ordinary smelting operations in blast-furnaces. A potent factor establishing the feasibility of the furnace-smelting is the presence of a heavy percentage of iron and sulphur in the Mt. Lyell pyrites, which elements yield a sufficient quantity of heat, during their com-



Mount Lyell Mining and Railway Company's Smelters.



Mount Lyell Mining and Railway Company's Haulage Line.

bustion, or union with the oxygen of the atmosphere, to allow the solid products of combustion to remain in a superheated molten condition. This peculiarity also distinguishes the bessemerising operation. In fact, it may be said that the Mt. Lyell ore-smelting is nothing more than a bessemerising of ores, or matte therefrom, direct in blast-furnaces, but so managed as to be continuous, and not intermittent, as is the bessemerising operation, and also under perfect control, both as to the composition of slags and mattes and the proper mechanical separation of these two products. The company remains to this day the only instance of this idea being utilised on a large scale as the exclusive method of treatment. The entire length of time occupied by the transition of the copper in the ore from the latter into blister copper, *i.e.*, from the moment the ore enters the first furnace until the blister copper issues from the converters, is only from five to six hours, if the time lost through cooling and transportation between apparatus is disregarded. An essential condition of success is rapidity of treatment, for it is only by this means that the necessary heat is concentrated to the required pitch.

The blast-furnaces were blown in successively on the following dates :—No. 1, 25th June, 1896; No. 2, 6th October, 1896; No. 3, 24th June, 1897; No. 4, 13th September, 1897; No. 5, 13th September, 1897; No. 6, 26th May, 1898; No. 7, 3rd October, 1898; No. 8, 18th October, 1898; No. 9, 26th January, 1899; No. 10, 8th May, 1899; and No. 11, 29th June, 1899.

The blast-furnace slags vary between the following limits of composition, the furnace-charges for ore-smelting and matte-concentration differing somewhat from each other. Limestone is used only in the latter operation, and not on the ore. The first matte is re-smelted by itself, as a rule, *i.e.*, very exceptionally only has pyritic ore been used with it :—

	Per cent.		Per cent.
Silica	36 ·66	to	41 ·70
Iron protoxide	50 ·67	to	43 ·14
Calcium oxide	1 ·20	to	8 ·16
Barium oxide	1 ·90	to	0 ·16
Alumina	7 ·47	to	5 ·46
Copper	0 ·25	to	0 ·35

The flue-dust is ground up and mixed in a steam-driven mud-mill with about 4 per cent. of common clay and the addition of a little water, and no lime is used for binding. The briquettes are of the size of ordinary bricks, are made by hand in preference to presses, and weigh about 14 lbs. each. They are laid on shelves in a large drying-room, and rough-dried by the heat of pots of slag ranged alongside. The quantity of flue-dust so handled was 4666 tons for the year. Its average assay was—Copper, 3 ·5 per cent.; silver, 2 ·5 ozs.; gold, 0 ·07 oz. It contains about one-third silica, which comes from the dust and sand accompanying the quartz flux. More elaborate means of preparing the flue-dust, like fusion in a reverberatory furnace, moulding and burning in closed kilns, as well as a briquetting machine of good repute, have been given lengthy trials, but have all been discarded on account of being too expensive, and preference was finally given to the present means, which is primitive in character, but more satisfactory in regard to cost and

efficiency. The flue-dust is partly oxidised, but there are not sufficient sulphates in it to act as binding-material for machine briquetting, and the cost of the obligatory lime has decided against the method.

The system of getting rid of the slag by granulation has been in use since the start, but of late years it has become necessary to resort to mechanically raising the accumulating dump of each smelting plant to a higher level, to keep the talus of the dump within bounds. This is effected by centrifugal pumps of a special construction—the outcome of the simplification of prevalent types and adaptation to the special work to be performed. The pumps are at present steam-driven, but will shortly be run by electricity. The slag-pumps are of small diameter, 10-inch suction by 9-inch discharge, with 18-inch beaters or vanes, and are run at from 540 to 600 revolutions per minute. The quantity of slag elevated during the year was 170,000 tons at No. 2 plant and 40,000 tons at No. 1 plant, together with all the water entering the two smelting plants, with the exception of that used for steam-generation, sprinkling, &c. The respective lifts are 15 and 11 feet at present.

The new sampling works, which were erected in place of the original mill which was destroyed by fire a couple of years ago, treats the samples of all ores and mineral fluxes, also purchase-ores used, and prepares them for the Assay Office. The proportions taken in transit and delivered to the sampling works are—every 25th ropeway bucket of open-cut pyrites, every 16th truck of underground ore, every 18th truck of mineral flux, while the proportion on purchase-ores varies from all to ¼ to 1-8th. The balance of lots goes direct to the furnaces; none of the ores, &c., are specially crushed, but are smelted in the size as broken at the mines.

Converter Plant.—The converting operations were conducted in conformity with the amount of matte produced by the blast-furnaces. The bessemerising plant is a double one, *i.e.*, consists of two independent equal-sized departments, each with facilities for turning out from 25 to 40 tons of copper a day. The total number of vessels is 14 (12 in use), vessel-stands 6; and there are two re-melting-furnaces with a No. 5 rotary blower each, with vertical engine attached; two high-class Fraser and Chalmers' horizontal compound condensing blowing-engines, 16 inch and 24 inch by 30 inches, with air-cylinders 30 inches by 30 inches, delivering 3000 cubic feet of free air at 60 revolutions; a 14 inch by 3½ inch by 10 inch duplex Worthington high-pressure pump; an accumulator; and all other necessary paraphernalia for the handling and tilting of the vessels, including hydraulic cars for shifting same, travelling crane, &c., together with the necessary machinery, grinding-pans, &c., for the preparation of the vessel linings; also drilling-machines for drilling the blister copper for sample. Steam is supplied by four 70 h.p. multitubular boilers. In the motive-power department the average indicated horse-power developed for the year was 300, and the amount of wood fuel consumed 13,043 tons. The average blast-pressure is 8 lbs. per square inch at the vessels.

This portion of the reduction works is also unique, for it is the only case of bessemer works for copper in Australasia. The first converter was started on continuous work on 14th January, 1897. The style of vessel is that known as the Stalmann type, which has proved eminently satisfactory, and slight in repairs

to which latter fact the square shape of the vessels has essentially contributed. The tilting-gear is extremely simple and effective, the rack being on the cylinder itself, which travels horizontally on the hollowed piston-rod, through which the pressure-water enters and leaves.

The clay for the vessel linings is a fine white variety of refractory nature, won in the immediate vicinity of the converter plant, and the silica is supplied by the screened fines or refuse from the quartz-crushing plant at the quarries. In these important respects the company is therefore fortunately situated. The composition of the clay is the following :—

	Per cent.
Silica	62 ·52
Alumina	23 ·89
Iron oxide	0 ·26
Calcium oxide	0 ·25
Magnesium oxide	0 ·40
Water and undetermined	12 ·68
	100 ·00

The number of "blows" which a lining will stand until corroded so thin that the vessel has to be removed is from five to seven.

The production of the bessemerising plant for the four quarters of the year is given above, under the output of the furnaces in metals. Since the beginning of operations to the end of the company's last half-year (31st March) the total results are as follow :—

Blister copper, 40,168 tons, of an average assay per ton of—Copper, 98 ·83 per cent.; silver, 81 ·36 ozs.; gold, 3 ·124 ozs.; containing—Copper, 39,698 tons; silver, 3,268,016 ozs.,; gold, 125,498 ozs.

Adding on the production for the last quarter, the figures become the following, from the commencement of work to 1st July, 1902 :—

Blister copper, 42,060 tons; containing—Copper, 41,568 tons; silver, 3,439,149 ozs.; gold, 131,053 ozs.

The quantity of converter matte treated by the converters from the beginning to the 31st March is 87,229 tons, of an average assay of—Copper, 49 ·48 per cent.; silver, 39 ·34 ozs.; and gold, 1 ·480 ozs.

The blister copper is now poured into plates, or cakes, measuring 16 inches by 24 inches and 2¼ inches thick, the former bars or pigs having been abandoned. Five hundred plates constitute a lot or parcel of 50 tons, the sample of which is kept distinct. Sampling is done by drilling two ⅝-inch holes through each plate, with power-driven drill-presses. The blister copper is all shipped to the United States, *viâ* London, and is refined by the Baltimore Copper Smelting and Rolling Company in Maryland, on a toll arrangement, the products being turned over to the company. The products, *i.e.*, electrolytic copper, as ingots, wire bars, &c., on the one hand, and fine silver and fine gold on the other, are sold by the company, the two precious metals being disposed of at the United States Mints, and the copper in the open market. It is chiefly exported to Europe, its identity being merged in that of the well-known brand "B.E.R."

Subsidiary Plants, &c.—An important adjunct to the company's reduction works is the coking plant it possesses at Port Kembla, near Wollongong, New South Wales. This consists of 62 ovens of longitudinal horizontal type, 24 feet long by 3 feet 6 inches wide by 5 feet 4 inches high, with circulating gas-flues, and a capacity each of about ten tons of coke per week. The works are supplied with complete grinding and elevating machinery, hydraulic handling apparatus, including coke-pushing machine, and all other necessary paraphernalia, bringing the installation up to date. The small coal used is from the Mt. Kembla Mine, and prior to grinding for coking is dressed by washing-machinery to remove the slate. The coking plant supplies the entire requirements of the reduction works, which, in view of the small consumption of coke due to the peculiar smelting method, are comparatively light, and fall below 350 tons per week for the treatment of 7000 tons of metal-bearing material. An excess of output is disposed of by sale.

In addition to using the South Tharsis and Royal Tharsis metal-bearing fluxes, the company has latterly reverted to the more extensive use of barren quartz-flux, chiefly on account of the slackening of deliveries of silicious ores by the neighbouring mines. The supply of natural silica is inexhaustible, for one of the principal rocks of the district, which occurs in very massive deposits right on the spot, is quartzite, and, failing this, an equally inexhaustible supply of conglomerate would have been available. The silica quarry is now opened up on a large scale, and, as formerly, quarrying is restricted to the crest of the hill, 500 feet above the river flat, where the material is harder than in the valley, where it was first attacked. This quarry is worked in three benches, and covers an area of 10 by 20 chains, involving about 3½ miles of trams. The stone is sent by a self-acting three-rope Otto ropeway, of the same type as the larger one between the mine and smelters, down to a special crushing plant, situated in the flat about 1200 feet distant, and connected with the reduction works by a regular 3½ and 2 feet tram service. The capacity of this ropeway is 30 tons an hour, and it is run by seven men, including loaders and dischargers. The crushing plant consists of two of the largest-sized "Comet" rotary crushers, driven by a 25-h.p. engine and multitubular boiler, and is situated on top of a set of stout storage-bins of 1000 cubic yards total capacity. The stone is broken to 3-inch size, and is screened free of sand and fine stone by perforated percussion tables. A drawback of the silica quarry is the occasional softness of the stone and the occurrence of sandy streaks, which have to be shifted separate from the hard quartz. This removal is effected by two self-acting rope inclines, of the double fixed and single-moving rope, alternate-motion type, with stop-blocks on the carrying-ropes and automatic tripping-gear on the conveyors. The two latter are connected by a ½-inch rope, while the fixed cables are discarded 1¼-inch haulage-line ropes; clear spans 1000 feet; height above ground, 90 feet in centre of lines. The sand is thus dumped into an out-of-the-way flat, and 150,000 cubic yards have been tipped in the last three years. The nominal capacity of each sand-tip is 50 cubic yards an hour, and the attendants are a man to work the brake and a boy to tend the loading-bin doors.

The quartzite directly overlies a limestone bank, the strike and dip of which are practically parallel to those of the quartzite, the

dip in both cases being almost vertical. The limestone, however, is worked in a gully at the foot of the silica hill, and is directly accessible to the railway. The exposed width of the limestone bank is 7 chains, and length of stripping 10 chains from entrance to head of gully, where the overburden is too heavy to remove. The quarrying is done in five benches, over a vertical height of 130 feet. The stone is lowered from the three upper levels, in wooden, steel-lined shutes, to the storage-bins, a means of conveyance which has given every satisfaction, and shown surprisingly little wear, both with limestone and quartzite. The longest shute now used is about 150 feet, with a uniform slope of about 28°, but formerly one of 300 feet length and 1½ foot square section, with an inclination of 32°, was successfully negotiated on quartzite. The limestone is napped to a coarse size only.

The quantity of stone supplied by the silica quarry from 1st January, 1898, to 30th June, 1902, is 316,563 cubic yards of crushed, for furnaces, and 12,930 cubic yards of fine, for converters. The output of the limestone quarry for the same period was 155,451 cubic yards of broken rock. Number of men employed at present, on silica 100, and on limestone 65. Explosives used on silica, chiefly black powder; on limestone, chlorate-nitrobenzol compounds.

Typical analyses of these two barren fluxes are the following :—

	Silica. Per cent.	Iron Oxide. Per cent.	Alumina. Per cent.	Carb. of Mag. Per cent.	Carb. of Lime. Per cent.
Quartz-flux, white	91 ·44	1 ·54	3 ·09	....	....
Quartz-flux, dark	88 ·72	3 ·60	7 ·03	....	....
Limestone, grey...	10 ·92	·57	2 ·88	3 ·00	83 ·40
Limestone, black	3 ·26	·85	·86	trace	95 ·10

The limestone, though not very pure, serves all purposes for copper-smelting, and also makes a good burnt lime. For the latter there are two kilns at the quarry, 18 feet high by 6½ feet diameter.

Both quarries continue to constitute the lucky factors, by way of fluxes, which made their presence, in such close proximity to the smelting works (60 chains), so valuable to the company. The same is also true of the clay deposits in the immediate vicinity of the smelting works which have supplied all the bricks used in the construction of the works (4,000,000), and which the company utilises for the manufacture both of ordinary bricks and firebricks. The brick plant was, a couple of years ago, shifted from its original site at Queen's Crossing to Ragged Creek, close to the township. This year's output was 533,000 red bricks, 128,000 firebricks, and a quantity of piping. The quality of the firebricks is quite equal to ordinary Australian makes, and the price of production considerably cheaper than the local cost of the imported varieties, so that the company has given up the use of the latter.

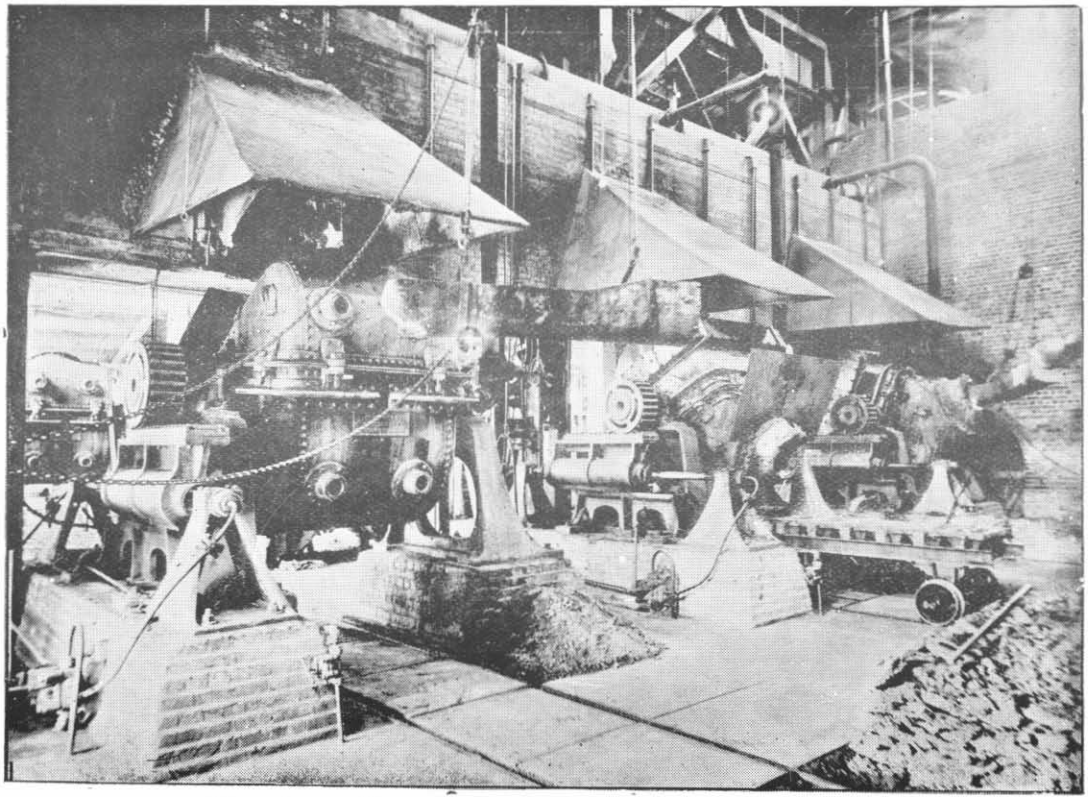
The means of ore-transit at the reduction works are, as before, between the mine and the smelting plants, on the one hand, the old haulage-line, which now chiefly carries the underground ore, and takes back supplies for the mine, and, on the other hand, the large aerial ropeway, over which the bulk of the Mt. Lyell open-cut ore is carried. These two lines run practically parallel to

each other, and, as the ropeway is subject to occasional shut-downs for repairs, the retention of the haulage-line has been of the utmost value for the purpose of continuous traffic, for the line is quite equal, temporarily and in three shifts, to take the place of the ropeway. During the year the haulage-line carried 114,857 tons wet weight of ore, in 55,518 full trucks, divided as follows :—Open-cut ore, 22,904 trucks, or 57,260 tons; underground ore, 7,794 trucks, or 41,865 tons. Besides this, it carried all the mine supplies (coal, wood, explosives, and general) on the return trip. The number of men employed on the line, and at the bins for loading trucks, is 13.

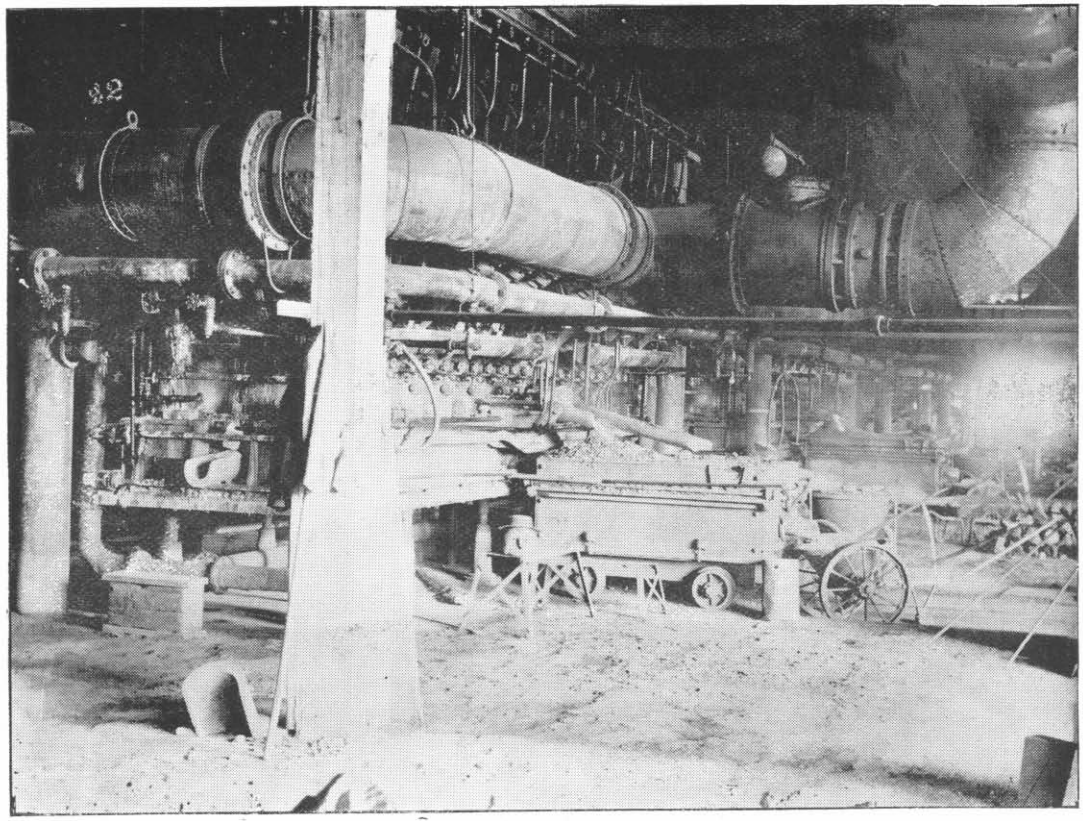
The aerial ropeway is a further unique feature of the plant. It is an exceptionally difficult line from an engineering point of view, but has splendidly established the suitability of such methods of transport in rough country like the mining fields of the West Coast. The following are the chief particulars of the line :—

Main Line from ore-bins at mine to central station, near No. 1 plant, horizontal length 6750 feet.
Vertical rise on mine side to top of mountain saddle, 430 feet.
Vertical fall on reduction works side from top of mountain saddle, 920 feet.
Mean gradient, mine side, 1 in 2·9.
Mean gradient, smelter side, 1 in 6·3.
Maximum gradient on mine side, 1 in 2·5.
Mean gradient, mine to smelters, 1 in 14·7.
Number of standards, 13; also 1 "viaduct" (double standard), 1 tension-gear (intermediate station joining ropes), and a rail-passage, five chains long, on top of saddle.
Height of standards—Lowest, 8 feet; highest, 51 feet.
Tension weights—On large carrying-rope, 15 tons; on small carrying-rope, 8 tons; on traction-rope, 1 ton.
Longest spans between standards, 1155 feet, 1188 feet, and 1320 feet.
Greatest height of rope above ground, 220 feet.
Distance of carrying-ropes apart, 6½ feet.
Length of branch from central station to No. 2 plant, nearly at right angles to main line, 890 feet.
Length of branch from central station to No. 1 plant, in straight continuation of alignment, 300 feet.
Capacity of carriers or buckets, 11 cwts. of Mt. Lyell pyrites.
Speed of travel of buckets, 6 feet per minute.
Rate of delivery, one ton per minute, *i.e.*, one bucket, or carrier, arrives each half-minute.
Number of buckets on line at one time, 70.
Cost of delivery from mine bins to smelter floors, including all labour, supplies, maintenance, new ropes, breakdowns, supervision, light, &c., also including loading, shunting, and discharging buckets at stations, per dry ton of ore carried, varies from 6*d.* to 7*d.*

The entire quantity of ore is deliverable, as desired, to either smelting plant, *viâ* the central station. The main line, as well as both branches, is self-acting, there being no power used, except at the starting of the empty line, when it is necessary to get the buckets from the mine terminus over the top of the hill. When the line is fully loaded, it is entirely self-acting. The



MOUNT LYELL MINING AND RAILWAY COMPANY'S CONVERTERS.



MOUNT LYELL MINING AND RAILWAY COMPANY'S WATER JACKET FURNACES.

carrying-ropes are of the "locked section" type, with perfectly round and smooth periphery, the diameters being 35m.m. on the loaded and 25m.m. on the empty route. They are coupled together, in lengths exceeding 500 feet, by means of a special coupling in halves joined by a right and left-hand union piece. These ropes act as flying rails, over which the buckets pass, the hanger carrying each bucket having at the top two grooved pulleys, placed together tandem fashion. The traction is done by means of an endless running rope, ¾-inch diameter, 16,000 feet long, of flexible construction. To this the buckets are attached by means of an ingenious special grip, suitable for the steepest gradients. The traction-rope is kept in motion by the descending loaded buckets, the speed being under the control of a brake at the upper or mine end of the line. The carrying-ropes are not continuous from the mine to the reduction works, but the total distance is divided into three sections—one from the mine to the top of the saddle, and two from there to the central station. A novel feature is the substitution, on top of the hill, for the carrying-ropes, of a fixed line of rails about 300 feet long, sweeping over the narrow ridge on top of the saddle. This is the point at which the carrying-ropes would be exposed to most wear, and their replacement by a fixed rail at this point has proved faultless. The number of full buckets carried by the line during the year was 396,944, delivering 220,304 tons wet weight of open-cut ore. The ton-miles amounted to 330,456. The total number of hands employed in connection with the work, the chief portion of which is engaged in the filling and emptying of the buckets, is 48. The cost of delivery appears lower than that of similar lines of the same size, and is about equal to the cost of carriage over the haulage-line from mine-bins to foot of smelters side of that line. From this point the haulage-line still necessitates three-quarters of a mile of carriage to smelters on the 2-feet "through tram," while the ropeway delivers direct to furnaces.

As already mentioned, there is a similar ropeway at the silica quarry, and there is a third of the same style connecting the Lyell Tharsis Mine with the "through tram." This is about one mile long, and of the same capacity as the silica line.

Besides the above means of transportation for ore, an extensive system of 2 feet steam-trams is in use, of a total length of 12½ miles, with five Krauss locomotives, for the delivery of supplies like silica, limestone, timber, and firewood from the respective local sources. Four and a half miles of this is combined with the 3 feet 6 inch system, as a three-rail track. In addition there are in use, for firewood and timber getting, about 18½ miles of 2 feet 6 inch wooden bush-trams. The materials received over sea, such as coal, coke, and machinery, are, of course, brought over the company's own 3 feet 6 inch railway line from Regatta Point to Queenstown and the reduction works. Such goods arrive at Regatta Point, on Macquarie Harbour, either direct by boat, or overland by the Emu Bay and Government Railways, *viâ* Burnie, a portion of the coke and coal being diverted over the last-named routes. As connection is now made at Strahan with the general railway system of the State, it is possible for blister copper to be shipped direct by rail to Hobart, were this necessary. The coal carried is still Newcastle or southern coal from New South Wales, Tasmanian coals being

placed at a disadvantage, partly because of inferior quality and partly on account of high transportation rates.

The company's repair shops have attained considerable magnitude in course of time, and the works are now practically wholly self-contained and self-reliant, except for the supply of raw materials like pig and wrought iron, steel, &c. The machine shops contain seven forges, five lathes, locomotive wheel lathe, pipe and bolt screwing machines, planing, drilling, and shaping machines, power-driven punching and shearing machine, boiler-maker's rolls, 7 inch by 20 inch steam-hammer, &c., and can cope with any variety and size of job likely to occur, in turning, fitting, blacksmithing, boilermaking, tinsmithing, plumbing, wood-turning, &c. The number of mechanics employed is 39. The foundry has proved a most useful addition, and now has sufficient capacity to supply all the castings necessary in the company's operations, both of greater quality and greater durability, as well as considerably cheaper, than outside sources.

The foundry is fitted with two cupolas, drying-stove, three-ton travelling-crane, &c., and a large stock of patterns. Moulding-sand is found locally, and very good. The chief articles turned out are a great variety of water-jackets, slag and matte pots, fore-hearths, spouts, and other furnace-parts, rolls, pulleys, brake-blocks, firebars, &c. The number of foundry hands is 24. It may be of interest to mention that the blast for cupolas and forges is supplied by a compound portable engine and a No. 4½ Baker rotary blower, which latter, about ten years ago, was secured from the defunct lead-smelter at Argenton, near Zeehan, by the then manager of the mine, and laboriously conveyed to the "Blow" for the purpose of experimenting on pyritic smelting, but never used.

The carpenters' shop also plays an important *rôle* towards the supply of various articles of current use, like truck-parts, rope-way bucket-linings, wheelbarrows, tuyere chips and plugs, cabinet and joiners' work, &c., to which must be added all pattern-making for the foundry.

Apart from the above shops, 92 hands are engaged in floating gangs in the construction, erection, and maintenance of the various paraphernalia used in smelting, steam-generation, engine-driving, building-maintenance, electric machinery, &c. They comprise fitters, blacksmiths, strikers, pipe-fitters, plumbers, bricklayers, carpenters, electricians, and labourers.

The electric light installation is complete in each plant and department.

The water-supply is derived from the middle and west branches of the Queen River by pumping, and from Conglomerate Creek and the east branch of the Queen River by gravitation, the respective deliveries being 529,000,000 and 931,000,000 gallons for the year; total, 1,460,000,000 gallons. The pumps employed are two sets of duplex double-acting power-driven plunger-pumps, 10 inches by 36 inches, with a large Worthington duplex compound steam-pump as a stand-by. Power is supplied by two 12 inch by 24 inch horizontal engines and two multitubular 70 h.p. boilers.

Every precaution has been taken, by means of an elaborate reticulation and the installation of alternative pumping facilities, to protect the various buildings against serious danger from fire. At an elevation of 180 feet above the slag-dump level there is a reservoir of 300,000 gallons capacity, fed by race from Con-

glomerate Creek, which supplies pressure-water for fire, slag-granulation, and hydraulic furnace-lifts, &c.

The company's telephone system is extensive, ramifying to all points of importance, and reaching from the depths of the mine to Regatta Point. It has 66 instruments and 109¼ miles of wire, aside from 60 miles of wire belonging to the Government, but on the company's posts, and maintained by the company's railway department.

Finally, the company's sawmill, working on local timber, need only be named, while the same is true of the lubricating-oil refinery, a small establishment which has the merit of saving at least one-half of the oil consumption.

Financial, &c.—The following table shows the cost of treatment of ore, as collected from the company's half-yearly reports :—

Half-year ended	Mining.		Overburden removal.		Smelting.		Converting.		Total.		
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	£	*s.*	*d.*
31st Mar. '97	1	8·27	2	0	18	1·64	3	10·39	1	5	8·30
30th Sept. '97	1	4·88	2	0	16	2·44	3	7·78	1	3	3·10
31st Mar. '98	2	4·64	2	0	17	9·87	2	9·18	1	4	11·69
30th Sept. '98	2	5·83	2	0	16	5·31	2	5·33	1	3	4·47
31st Mar. '99	2	3·56	2	0	16	3·61	1	11·19	1	2	6·36
30th Sept. '99	2	5·31	2	0	17	10·45	2	2·15	1	4	5·91
31st Mar. '00	2	11·76	2	0	15	10·70	2	2·30	1	3	0·76
30th Sept '00	3	5·00	2	0	14	11·89	2	0·29	1	2	5·18
31st Mar. '01	3	1·40	2	0	15	9·65	2	1·16	1	3	0·21
30th Sept. '01	2	6·86	2	1	14	8·04	2	0·45	1	1	4·35
31st Mar. '02	2	3·89	2	1	14	8·17	2	2·15	1	1	3·21

It has to be remarked that the overburden charge is a nominal one, debited against the winning of ore, irrespective of the actual cost. This charge was determined once for all, when the programme for open-cutting was made out, in such a manner as to even up the average of the cost over the total quantity of ore to be extracted; otherwise, the later days of the open-cut, when the amount of overburden to be removed per ton of ore would be considerably in excess of what it was at the initial stages of the work, would then oblige the ore to suffer an extreme charge in this respect.

The item of mining comprehends the usual complete working expenses, including supervision and management, also the delivery of ore from the open-cut benches to the mine ore-bins and similar expenses attendant on or subsequent to excavation, until the smelting department receives the ore. The figures are, therefore, swelled by expenses not necessarily of a mining nature.

The item of smelting similarly comprises the usual essential costs attaching to the operation itself, such as labour, coke, supplies, stores, hot-blast, supervision, electric light, &c., beginning with the sampling of the ore, and concluding with the second smelting to converter matte; but it also includes the carriage of the ore from mine-bins to smelter storage-bins over ropeway or haulage-line; the cost of winning and delivering all barren and mineral-bearing fluxes; the maintenance of plant and buildings; the pumping of water-supply; all motive-power costs; collection and re-treatment of flue-dust and other middle products, both from the furnaces and the converters; all cost of transportation

of raw and middle products between the furnace plants and the converters; and, in fact, all incidentals of an operating nature, to which are added cost of laboratory work, telephones and signals, stationery and general office expenses. Converting is treated with similar fulness. The only items not included in the above figures are London and Melbourne head-office expenses, which are slight compared with the rest of the outlay, as well as depreciation of plant. All three departments, moreover, pay the company's railway the usual rates above actual cost of transportation, thus leaving that branch of the company's enterprise a profit. It is, therefore, apparent that the actual mining and smelting costs, *i.e.*, the winning and treatment, as such, are lower than these more comprehensive figures indicate. The cost of shipping and realising on blister copper, of course, is not included, this not being a local cost.

The mine, smelter, and railway departments deal with each other financially as entirely independent concerns, and account separately to the Melbourne head office for all transactions. The mine, however, is not treated as selling to the reduction works the ore which it supplies, *i.e.*, the monetary value of the ore is disregarded. This would, under the circumstances, only be a very unnecessary complication.

The company, in its last report, publishes a summary of dividends, to which we have added the one paid since the issue of the last report, being that of 1st July.

Dividends Paid.

No.	Date when paid.	Amount of Dividend per Share.		Amount of Bonus per Share.		Total.		
		s.	*d.*	*s.*	*d.*	£	*s.*	*d.*
1	1st July, 1897	4	0	...		44,220	0	0
2	1st October, 1897...	4	0	...		50,000	0	0
3	1st January, 1898	4	0	...		50,000	0	0
4	1st April, 1898	4	0	...		50,000	0	0
5	1st July, 1898	4	0	...		50,000	0	0
6	1st October, 1898...	2	0	...		27,114	18	10
7	3rd January, 1899	2	6	...		34,302	0	10
8	5th April, 1899	2	6	...		34,375	0	0
9	1st July, 1899...	3	0	...		41,250	0	0
10	2nd October, 1899	4	0	...		55,000	0	0
11	2nd January, 1900	4	0	1	0	68,750	0	0
12	2nd April, 1900	4	0	1	0	68,750	0	0
13	2nd July, 1900...	4	0	1	0	68,750	0	0
14	1st October, 1900...	2	0	...		27,500	0	0
15	3rd January, 1901	2	0	...		27,500	0	0
16	1st April, 1901	2	0	...		27,500	0	0
17	1st July, 1901...	2	6	...		34,375	0	0
18	1st October, 1901...	2	6	...		34,375	0	0
19	3rd January, 1902	2	6	1	6	55,000	0	0
20	3rd April, 1902	1	6	...		20,625	0	0
21	1st July, 1902...	1	6	...		20,625	0	0
		£3	2	6	4	6	£890,011	19	8

The wages paid by the company during the last three years, in the whole of the departments, *i.e.*, mine, reduction works, railway, and coke works, have averaged £263,326 per annum.

The number of men employed during the four quarters of the year is reported as follows :—

	Quarter ending 30.9.'01.	Quarter ending 31.12.'01.	Quarter ending 31.3.'02.	Quarter ending 30.6.'02.	Average.
At the Mt. Lyell Mine ...	419	426	344	326	379
At the other mines	46	42	52	50	47
At the reduction works ...	1221	1300	1300	1288	12,7
At the railway	235	225	220	207	222
Total...	1921	1993	1916	1871	1925

In conclusion, it is hoped that the above somewhat rambling notes may serve to give those interested a fair idea of the complexity and magnitude of the company's operations, and the up-to-date, progressive character of its operative policy.

THE MICROSCOPIC STRUCTURE OF SOME TASMANIAN ROCKS.

By W. F. PETTERD.

I PURPOSE to describe in this paper some aberrant members of the basalt family, which, although not common in this Island, are occasionally met with, and which are not only difficult of interpretation to the ordinary observer, but are sometimes a puzzle to the field geologist.

As is so well understood, the normal basalts are basic lavas (silica = 45 to 55%) of high specific gravity and dark colour, and are essentially composed of plagioclastic (labradorite), felspar, augite, magnetite, and often olivine. They cover considerable areas in the northern part of the Island, and isolated patches occur in the eastern and southern portions.

As far as is known, the Tertiary basalts as occurring here do not differ in their normal characteristics from the familiar types, with the exception of the fayalite basalt of One-Tree Point, and the melilite basalt of the Shannon Tier.

The varieties now enumerated and described are the abnormal accompaniments of the usual types which occur in but limited quantity, or are formed under peculiar local conditions.

No. 1.—Tachylyte, Bothwell.

(Sp. Gr.: Spherulitic, equal to 2·72; non-spherulitic, equal to 2·77.)

This is the glassy form of basalt, originating from the rapid cooling of the magma by contact with a cooler substance. It is commonly in thin selvage layers, but sometimes is met with, as at the locality quoted, in comparatively large lumps. It varies in colour from rich dark brown to intensely black, and when freshly broken has a shining vitreous lustre. It is sub-conchoidal in fracture, and, though hard, it is brittle. On weathering it often generates a thin film on the exposed surface of a beautiful pale to dark ultramarine blue, which renders it an object of curiosity and interest. External nodular spheruloids are occasionally prominent on the surface, which show a pronounced radiating structure. It may vary to a structure known as variolite, and in a single example which has come

under my notice the tachylyte has, apparently, become interwoven into this spherulitic substance.

It also occurs at Fern Hill, near Deddington, and, in a lesser quantity, at Burnie.

Microscopical Characters.

This is a basalt glass, yellowish brown and structureless, containing large opaque spheroidal segregations inert on polarised light, and only capable of being examined towards their edges, which, being thinner, transmit a little light. In this part their colour is dark brown, becoming slightly purple at the periphery, which is roughly crenulated. Over their thinnest areas they may be seen under a $\frac{1}{8}$ objective to be crowded with globulites and thin rods, the latter essentially trains of globulites forming longulites, and arranged mostly radially towards the circumference. Their arrangement side by side resembles that of hairs on the coat of a furry animal. This structure ceases on approaching the crenulate border. The smaller dark brown crenuli, or segregations, in the rock are too dense to transmit light. Many of them are surrounded by an absorption area, in which the glass is bleached to a pale yellow, and incipient areas of this description are scattered everywhere, giving the field a somewhat mottled appearance. These spheroids appear to be independent of the cracks in the glass, and which pass through them undeflected, which suggests that these segregations were the latest phase in the consolidation of the rock. The glass of which the rock consists is covered with a network of fractures, and trains of globulites have occasionally collected along the cracks, which are also frequently the depositories of minute granules of magnetite. With a high power, globulites may be discerned in abundance everywhere in the glass.

No. 2.—Limburgite.

(From Burnie-Waratah Railway. Sp. gr., equal to 2·8.)

This is a dense, hard, and extremely tough rock, so much so that it became notorious during the construction of the railway connecting Burnie and Waratah, where it occurs as a narrow band at the 7-mile. It is dark, almost black, in colour, and very fine-grained in texture.

Microscopical Characters.

This is a felspar-free basalt, with augite and olivine, equal to limburgite (Rosenbusch) and magma-basalt (Boricky), and has many of the features shown by slices of Bohemian

magma-basalts, and described by Boricky in his work on the basalt rocks of Bohemia (1). Such rocks occupy a position between the basic and ultra-basic rocks, and Rosenbusch has given the name of limburgite to those with abundant olivine, with the intention of detaching them from basalts, and of emphasising their position as extreme members of the nepheline and melilite effusive series. Limburgite has been recorded from Cape Verde, Kilimanjaro, and Madagascar, besides the European occurrences. Judd and Cole (2) describe it from Lamlash (Holy Isle), Arran (2).

The constituents of the Burnie rock are olivine, augite, and magnetite, in a brown glass devitrified by the development of globulites and crystallitic rods.

Augite is in colourless crystals, porphyritically dispersed, and, as numerous small laths and prisms, vertical sections give an extinction angle up to 36°-40°.

Olivine is abundant and fresh, giving numerous characteristic hexagonal sections in the zone (010), (001). Its crystals are often corroded and scattered, and cracks introduce inclusions of the base.

Magnetite is present in fair quantity in well-formed crystals and minute grains.

The base is a brown glass with globulites, belonites, and microlitic laths of augite. Some of the rods may, perhaps, be incipient felspars. The globulites cluster more densely round the borders and in the neighbourhood of the larger crystals, forming semi-opaque aggregations. Amygdaloidal cavities are discernible, some beautifully fringed with zeolites, some with an isotropic periphery and a faintly-polarising crystallitic centre.

No. 3.—Basaltvitrophyre (Glassy Basalt).*

(From Sheffield.)

This is, microscopically, one of the most attractive rocks occurring in this State. It is usually intensely black, although rarely of a dark grey-brown colour, with a shining vitreous lustre, having commonly numerous veins and patches of milk-white to glassy zeolitic magma, which, in

(1) Petrographische Studien an den Basaltgesteinen Böhmens, 1874, pp. 53–60.

(2) On the Basalt Glass of the Western Isles of Scotland, Q.J., Geo. Soc., 1883, p. 459.

* As Pitchstone, "The Geology and Palaeontology of Queensland and New Guinea," Jack and Etheridge, 1892.
Minerals of Tasmania, 1896, page 68.

the cavities, crystallises into definite forms, and then shows clusters of chabazite, phillipsite, with beautiful patches of mesolite interspersed. It is extremely brittle, and thus easily reduced to fragments.

Microscopical Characters.

This is the glassy form of basalt, a true vitreous basic lava, with pheno-crysts of olivine sparsely scattered in a structureless glass of a pale yellow tint, occasionally deepening into gamboge. Apparently, it occurs massive, and does not form a mere tachylytic selvage. It, consequently, falls into Rosenbusch's division of basaltvitrophyres. It is a volcanic product, which is typically represented by the Kilanea lavas in the Sandwich Islands, and its structure is strikingly repeated in slides of modern lava from Hawaii. The olivine crystals are nearly as fresh-looking, and have the same inroads of the corrosive magma.

Like the same form in the Sandwich Islands, the glass is wonderfully clear, a marked contrast to the opaque nature of so many European tachylytes. It carries small colourless or yellowish globulites, some with opaque margins, but the bulk of the iron, instead of separating out into magnetite, would seem to have been used up by the olivine. There are no complete displays of perlitic structure, but it is incipient, and some of the porphyritic crystals are surrounded by a perlitic ring associated with globulites. The strain phenomena are instructive. Several olivines have tufted fissures proceeding from their borders into the surrounding glass, arranged like cilia, evidently the result of the strain of crystallisation, upon the glass. These fissures sometimes connect two fissures, and spring, too, from larger cracks, which traverse the glass in various directions. The same crystals under partly-crossed nicols show a reaction rim, which in plain light is seen to be a granulated border. Wherever the smaller fissures are numerous, they are associated with granulation, yellow translucent globulites. The crystals of olivine often enclose the glassy base in ovoid and circular forms, some of which are prolongations of the base, being connected with the outside magma by a narrow neck. I could not detect more than a crystal or two of augite and triclinic felspar. In the darker portions of the glass zeolitic cavities occur with spherulites round their margins. Elsewhere a spherulite exists with an approach to an axiolitic nature, being elliptical in form, with an elongated medium axis.

No. 4.—Hydrated Olivine Basalt.

(From Native Point, Perth.)

A rock of abnormal physical character, inasmuch as it is invariably heavy from the absorbed moisture, and soft to a degree. It is pale brown in colour, showing a variety of tints between almost yellow to a fairly-dark shade. On exposure to atmospheric action, it commonly fractures in all directions, and finally breaks up into fragments. It closely resembles the tuffaceous substance known as palagonite. It was obtained in sinking-holes in the locality mentioned.

Microscopical Characters.

This structure is that of a normal basalt. The porphyritic mineral is olivine, and augite in the form of grains and minute prisms is embedded in a plexus of narrow lath-shaped felspars. There is a glassy base, and large patches of zeolitic substance (chabazite ?) and vesicles crowded with minute spherulites. Magnetite is present in small quantity. The twinned felspars give extinction angles up to 27°, and are probably labradorite.

The most important mineral is the olivine, which exhibits interesting alteration features. The crystals have the irregular forms which intra-telluric minerals receive from the attacks of the magma at the crisis of eruption, and are invariably margined with a deep orange or brownish-red border, consisting of fine fibres perpendicular to the contour. The interior is of a citron-yellow colour, and both the interior and the border have assumed a pleochroic nature. The former is serpentinous (sometimes chloritic), and the latter, in all probability, is a hydrated ferric oxide. No fresh olivine remains in the rock. The change sometimes proceeds until the precipitate of ferric oxide colours the whole crystal, and occasionally we see it result in laminæ with the cleavage lines, pleochroisms, and red and green interference colours of biotite. This mineral is very similar to the hydrated silicate of iron, lime, magnesia, and soda called " iddingsite," but its general features indicate that it is a pseudomorph after olivine. For a discussion of this kind of replacement, see H. H. Arnold-Bemrose on the Microscopical Structure of Carboniferous Dolerites and Tuffs. Q.J., Geol. Soc., 1894, p. 617.

REPORT ON SOME WOLFRAM SECTIONS NEAR PIEMAN HEADS.

Zeehan, 24th September, 1901.

SIR,

ACTING on your instructions, I left Zeehan on the 8th instant, to examine and report upon certain mineral sections which have been taken up for wolfram in the vicinity of the Pieman Heads, and have now the honour to present the following brief report. The weather was exceptionally rough during the trip, and this, coupled with the shortness of the time at my disposal, prevented me from making any extensive geological observations.

The deposits of wolfram ore are contained in a belt of granite country which runs along the coast for about ten miles north of the Pieman River. The same belt is said to extend southward, with few interruptions, as far as Mount Heemskirk, but as my route to the wolfram sections lay through Waratah, I was not able to examine this country. North of the Pieman, the granite belt is from two to three miles in width, and forms an undulating plain some 200 feet above sea-level. To the east the country rises in rather steep hills of metamorphic sandstones and slates. A little alluvial tin-mining is being carried on in the district, there being at present three men engaged in working the small creeks which traverse the granite belt. In past years a considerable quantity of tin has been won from this district, but as yet it has never been found *in situ*. The tin is both black and grey in colour, and most of it appears to be derived from quartz veins in the granite. Blocks of vein quartz are often met with, carrying quite large crystals of grey tin. Wolfram, except in the vicinity of the recent discovery, is not associated with the alluvial tin.

In the tin wash the miners occasionally find specimens of those remarkable objects—"Obsidian buttons" or "Australites." They consist of an acid natural glass,

and, in shape, very closely resemble a large button. The origin of these buttons is very obscure, but, according to the latest theories on the subject, they are supposed to be meteoric, though even this theory presents many serious difficulties. A terrestrial origin appears to be impossible, on account of the absence of any recent volcanic centre in Australia from which acid lavas have been erupted.

The granite is traversed by very numerous veins of quartz, varying in width from an inch or two up to several feet. These often stand out boldly above the general level of the surface of the granite, and may be traced for considerable distances. The majority of these veins are apparently barren, and are composed of pure white quartz, but others have been found carrying considerable quantities of wolfram, and the latter are much more complex in their mineralogical composition. I am, however, strongly of opinion that there is no sharp line of division to be drawn between the productive and the non-productive veins. Comparing the two extreme types they appear to have little in common, but a careful examination soon reveals many intermediate forms, showing that there is a gradual passing over from the one to the other. This passing over may sometimes be observed on the same vein.

The barren veins consist of pure white quartz, and exhibit little or no alteration of the wall-rock. They are simply fissures in the granite, filled with quartz. The productive veins are also filled fissures, but the filling matter is much more complex ; besides quartz there is also present wolframite, scheelite, tourmaline, arseno-pyrite, pyrite, mica, and feldspar, the latter only in small quantities, though often occurring as large well-defined crystals. Where the veins are productive the wall-rock always appears to have undergone a great deal of alteration for some distance on either side of the vein. The feldspar in the original granite has disappeared, and has been replaced by quartz and light-coloured mica. This quartz-mica rock is known as greisen, and is regarded as evidence of pneumatolytic action. It will be unnecessary for me to enter into any lengthy discussion of the pneumatolytic theory in the present report ; an account of the theory will be found in the Government Geologist's report on "Some tin mines in

the St. Paul's River Valley," and also in my late report on the "The Ben Lomond Tin Mining District." Suffice it here to say that there are very strong reasons for believing that during the latter stages of the consolidation of certain granite masses, highly heated solutions charged with mineral matter, probably in the form of vapour, of great chemical activity, are expelled from the granite, and pass upwards through any fissures that may be available. These solutions or vapours attack and alter the wall-rock of the fissures, producing greisenisation, and often deposit various metallic ores, either in the fissures themselves, or in the wall-rock which they penetrate. Greisen itself often contains sufficient tin ore to make it of economic value. In Tasmania the Roy's Hill Mine is an instance of such a deposit, and the Mount Rex Mine is a very similar occurrence. In the district under consideration, however, the greisen is apparently barren, the whole of the metallic contents being confined to the fissure vein.

As has already been stated, the productive veins pass over into the non-productive. This takes place by loss, first of wolframite, scheelite, and pyrite, then of tourmaline and mica, and, lastly, of feldspar. The wall-rock alteration also decreases with the decrease of tourmaline. It appears to me very evident that the origin of both sets of veins is one and the same. There are very large areas of country on the West Coast which are traversed by numerous small quartz veins of a similar nature to those described. In the sedimentary rocks these usually run parallel to the stratification, the gradual denudation sets free the quartz which forms a layer of angular gravel all over the surface. This quartz gravel is abundant in the Zeehan mining field, and occurs in large quantities at the Long Plains and Brown's Plains. I believe these veins are identical in origin with those I have described as occurring in the granite, and always point to the presence of this rock in depth.

The sections examined by me for wolfram are charted as follows:—Sections 4943–93M, 5015–93M, 5077–93M, and 5076–93M, all of 80 acres. Sections 4900–93M and 4901–93M, of 40 acres. All the above, as well as several other sections both north and south, are held under mineral lease by E. H. C. Oliphant. Also one other

section, west and adjoining 5077–93M, and south and adjoining 5015–93M, for which E. H. C. Oliphant is applicant.

The sections are situated about a mile to the north of the Interview River, a stream flowing westward into the ocean. The distance north from Pieman Heads is about 7 miles. The pack-track from Remine to Circular Head passes through the sections.

Several of the sections were worked on a small scale some ten years ago for wolfram, and some ore was exported, but I have been unable to ascertain the quantity. At present the old workings are fallen in, or full of water, and the veins could not be examined *in situ*. From the stone at grass, however, a general idea of the character of the stone can be obtained.

On the northern portion of Section 4943–93M, the most northerly of the sections examined, some old trenches exist, from which a good deal of vein quartz has been obtained ; some of the stone carries tourmaline freely, and a little wolfram. It is probable that there are two or three parallel veins at this point, and their width, to judge by the stone at grass, varies from 8 to about 18 inches. The vein walls were evidently greisenised.

Section 4943-93M is south and adjoining the above, but no work has been done upon it. South and adjoining 4943-93M is the vacant section for which E. H. C. Oliphant is applicant. About the centre of this section an old shaft has been sunk, and there are a few tons of quartz at grass carrying some wolfram and tourmaline. This has been spalled up and handpicked, and the greater part of the wolfram taken away. The country-rock is here also greisenised.

South and adjoining the above is Section 4900-93M, 40 acres. In the north-west portion of this section some deep trenches have been sunk, from which a large quantity of quartz has been taken. The quartz carries tourmaline very freely, but I did not notice any wolfram. Five or six chains east of these trenches a shaft has been sunk, from which a good deal of stone has been obtained. Some wolfram has been got, as shown by the heap of seconds produced by spalling up the stone. In this heap I found some nice pieces of wolfram and scheelite, the

latter in crystals. The quartz vein is exposed in the top of the shaft ; it is about 12 inches in thickness and strikes north-east and south-west. Several other old workings exist on the sections, but nothing else of importance has been uncovered.

About 18 months ago a new discovery of wolfram ore was made ; this is situated a little to the north-east of the centre of Section 4900. Several parallel veins have been exposed here in the bed of a small creek. The most important of these are two veins about three feet apart. The strike is a little east of north and the dip vertical, the width of the veins from 8 to 10 inches. Where laid bare in the creek both these veins are said to have carried good wolfram. A small shaft was sunk 9 feet in depth on the southern extremity of the shoot, and from this a trench was brought up 6 feet in depth along the shoot. The total length of this trench is 50 feet, and it is stated that two seams of almost solid wolfram-ore were exposed in the bottom, the width of each being from 8 to 40 inches. The shoot gave out in the north end of the trench. I regret that I was unable to confirm this account by observation. For some reason best known to the prospector who was entrusted with the opening up of the deposit, the trench has been almost entirely filled in, only a few feet at the north end being still open. This, of course, was full of water as well as the shaft, and although every effort was made to unwater the shaft and trench, these efforts were unavailing, owing to the recent rain. The re-opening of the trench would have occupied the two miners employed on the mine for at least a week, and as my time was limited I had to content myself with such conclusions as I could arrive at from the amount of ore obtained from the trench, and from an examination of the stone at grass.

I am told that 16 bags of rich wolfram ore, estimated to weigh one ton, have recently been exported from the mine. This ton of ore represents the first class ore obtained from the trench which is now filled in. There are at present some 6 or 8 tons of second class ore at grass, consisting of quartz, with a good deal of pyrite, arseno-pyrite, and wolfram, and a little scheelite distributed through it, from which, at a liberal estimate, three-quarters of a ton of wolfram ore might be obtained

with adequate dressing machinery. This gives 1¾ tons of wolfram from a surface stope 6 feet deep and 50 feet in length. This is a very small quantity considering the trench is supposed to have followed the shoot nearly the whole way. It is, however, possible that the wolfram ore near the surface may have become leached away by surface waters, thus rendering the upper six feet exceptionally poor. This supposition is strengthened by the presence of a little wolfram ochre among the seconds, proving that decomposition of the wolframite has taken place. Even allowing for this I must confess that I find it difficult to believe any large proportion of vein material consists of wolfram ore throughout the whole 50 feet. If the wolfram is only present in bunches through the stone, then I fear the shoot is too short and too small to pay for mining and development.

I understand that the whole shoot of ore has never been examined by a qualified mining expert. I do not doubt that in places the shoot is very rich; indeed, one large piece of ore which was amongst the stone at grass proved the wolfram to be at least 6 or 8 inches in thickness, and nearly solid; but I have no assurance that the wolfram preserves this thickness and richness throughout the 50 feet. Judging by the amount of pyrites present in the stone, I think much of the "metal" in the bottom of the trench must consist of this mineral. However as I did not see the bottom of the trench, I may be mistaken, and I can only recommend the owners of the property to have the trench cleaned out and examined by a reliable authority. If there is, then, still reason to hope the shoot of wolfram ore is a payable one, it will be fair to assume that there are others still undiscovered on the same line of reef. Wolfram ores are notoriously bunchy, and where one rich bunch has been found it is only reasonable to expect others to occur in the vicinity.

Before concluding, I would like to point out the futility of mine-owners asking for Government reports on their mines without making adequate provision for the unwatering or the uncovering of the discoveries upon which reports are desired. There are many cases where the geologist can make a general statement as to the probability or otherwise of mineral deposits occurring in a given belt of country without actually seeing the

deposits *in situ*, but when it is a question of determining whether a known deposit is payable or not, then it is absolutely necessary that he should be able to see the ore in order to determine its extent and its value. In the case in question I have not been able to examine the ore *in situ*, and my conclusions are only based on the amount of ore taken out. This, as I have already stated, is not satisfactory, considering the amount of work done, and unless the wolfram contents are very much richer below the level of the present trench than they have been in the trench, the shoot of ore is not a payable one.

I have the honour to be,
Sir,
Your obedient Servant,
GEORGE A. WALLER,
Assistant Government Geologist.

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

REPORT ON THE COALFIELD OF LLANDAFF, THE DENISON AND DOUGLAS RIVERS, ON DEPOSITS OF TIN ORE ON SCHOUTEN MAIN, AND ON OUTCROPS OF QUARTZ NEAR BUCKLAND.

Government Geologist's Office,
Launceston, 19th October, 1901.

SIR,

I HAVE the honour to report that, pursuant to your instructions, I proceeded to the East Coast on the 20th May, to examine the coal measures north of Swansea, and some tin deposits at the neck of the promontory named Freycinet's Peninsula, known as Schouten Main. My inspection lasted till the 14th June, when I went to Buckland to inspect some quartz country in that neighbourhood.

Swansea is situate in the north-east corner of Oyster Bay, which is here eight to ten miles across, and the eastern side of which is formed by the bold promontory of Freycinet's Peninsula, 12 miles long in a north and south direction. Viewed from Swansea, the granite peaks of the peninsula form a picturesque panorama. One of these, Mount Freycinet, rises 2014 feet from the sea. On the eastern side of the peninsula, Mount Mayson, overhanging Wineglass Bay, is 1670 feet high.

The head of the bay is formed by a fine fringe of sand called the Nine-Mile Beach, which sweeps eastward in a gentle curve as far as Point Bagot. Opposite that point, at Buckley's and eastward, a little round Hepburn's Point, diabase appears, and then gives place to the granite of the peninsula. At the back of the sand-dunes of the Nine-Mile Beach, and north of King Bay, at the mouth of the Swan River, a tongue of diabase rock runs north between the river and the Moulting Lagoon, connecting with Lyne's Sugar Loaf and the diabase on the coastal range further north. Recent sands and gravels extend up the valley of the Moulting Lagoon as far as the surveyed township of Llandaff. They also extend a good way up the Mere

dith River. Mr. Jno. Meredith showed me the river shingle at Cambria, which forms a good deal of the land there, and marks the course of the former river-bed. Old charred gum timber has been found there, 15 feet below the surface. The deposit is geologically recent, and rests on hard mud, pipeclay, &c. There are signs here of a recent or present rising movement of the land.

It is not always easy to distinguish between the recent deposits and the Tertiary clays which overspread the flat country in the valley of the Swan. These clays are of middle to Upper Tertiary age, and are highly ferruginous, containing beds of impure limonite or argillaceous oxide of iron. The habit of the mineral is largely concretionary, and it is sometimes pretty dense and solid. On the Cambria estate Mr. E. Meredith took me to a spot where lumps of rather pure iron oxide are to be found, but I take them to belong to the same deposit. Sometimes the ore is cellular, clay having been removed from it by weathering or water. The mineral in its purest form is not available in quantity sufficient for exploitation; in its impure forms the percentage of iron is too low. Iron ore—hematite—is also found elsewhere in this part of the Island in seams in the Mesozoic sandstone, often at the contact of the latter with diabase. An example of this may be seen at Kelvedon, on the road south of the Horse-shoe Bridge over the 30-acre rivulet. About 40 feet from the contact of intrusive diabase with Mesozoic sandstone a vein of hematite occurs in the latter. Numerous parallel instances are to be found. There is no use in looking for precious metals in the iron at these contacts. A piece of the ferruginous contact rock at Little Swanport was given to me by Mr. Mitchelmore, but on assay at the Government laboratories it was not found to contain any economic mineral. On the other hand, iron ore gossanous veins are met with in the granite area intersecting that rock, and these require examining individually to see whether some of them are not the upper parts of tin-bearing lodes. Thus there are three distinct modes of occurrence of iron ore in the district. The largest quantity is certainly in the Tertiary clay deposits, and some of it is of a quality which would lend itself to fluxing other ores in smelting operations, but at present, in this part of the Island, it has no economic value.

The form of Oyster Bay illustrates the eroding force of the waves on a large scale. We must believe that the surviving fringe of diabase on the E. side of the bay at Hepburn's Point, on the S.W. end of the peninsula, and on Schouten Island, was once continuous with the sea-front of the same rock on the Swansea side of the bay. The fragmentary deposits of Mesozoic sandstone (free-stone) associated with the diabase, indicate that it, too, extended across the bay to Kelvedon. It follows, accordingly, that the present Oyster Bay has been scooped out of the coal measures, sandstones, and diabase, the eroding process being, perhaps, assisted in its initial stage by the weakness of the strata along the contact line of the diabase with granite on the eastern shore of the bay. The excavating process has extended to a depth of 12 fathoms, on the average. Cole's Bay is 6 to 14 fathoms deep. Off Rocky Hills the average depth is 17 fathoms, and the water is so clear that Mr. Edward Cotton tells me he can generally see the kelp anywhere on the bottom on a fine day, that is, judging by the colour of the water. Towards the head of the bay the water shoals, and the jetty at Swansea, nearly a quarter of a mile long, does not project into more than a couple of fathoms of water at low-tide. The present depth of the bay does not represent the sum total of erosion since the coal period, for it has probably been reduced by deposition in Tertiary times of sediments which have since been denuded as the land has risen again. The Tertiary deposits in the lower part of the valleys of the Swan and Apsley illustrate the depression and subsequent elevation of the land during that period observed frequently elsewhere in Tasmania. These deposits cover up the older formations on the flat land, and speculations as to whether coal measures exist below them have no very precise data to go upon, for, in the first place, we do not know how much denudation has taken place, and, in the second place, we are not quite certain whether the Tertiary and recent sands and clays rest naturally upon a floor of diabasic greenstone, or upon Mesozoic sandstone. The reply to the latter question depends upon the view taken of the general geology of the district, and this, again, involves a consideration of the oft-debated and never satisfactorily-settled question of the relations of the diabase to the coal measures sandstones. The conclu-

sions drawn will be found to have far-reaching consequences, for they will affect the interpretation of coal measures geology and the search for coal in other parts of the State.

Coal measures are not seen in the immediate vicinity of Swansea, but seven miles north a patch of Mesozoic sandstone occurs on both banks of the Swan River, half a mile above Cranbrook. This is bounded on the west by beds lower in the series, terminating in fossiliferous beds of Permo-carboniferous limestone. At the bridge over the Swan the river-bed is diabase, and this continues up the river a few hundred yards, when a stretch of bank comes in occupied for two hundred yards by white and red clays, with nodular, concretionary iron ore (limonite). Another hundred yards up the river is yellow sandstone. The clay may be considered as marking the contact of the intrusive diabase with the freestone. Two or three miles north-west of the river is a sandstone quarry, the stone of which is used for bridge-making, but is not very durable. The yellow flaggy sandstone lies nearly horizontally in the river-banks. It may dip a little to the south. A seam of coal is exposed in the river-bed, crossing the stream N.W.–S.E. About six inches of this was exposed above the water's edge, but I was told it approaches 3 feet in thickness. It would be more accessible when the river waters are lower. It is overlaid by dark clod. I took a sample from the seam in the bank, but the quality has not proved to be at all good. When analysed by Mr. W. F. Ward, Government Analyst, it was shown to consist of—

	Per cent.	
Fixed Carbon	19·20	
Ash	64·10	No coke formed.
Gases, &c.	9·70	
Moisture	7·00	
	100·00	

The poor quality is, very likely, due to surface deterioration. By going from the river about 100 feet S.E., and sinking 10 or 15 feet in the bottom of a dry gully which runs parallel with the river, the seam would be struck. This coal is in the N.W. corner of block 1-198, John Amos, owned by Mr. A. J. Amos, of Cranbrook.

North and north-east of the above, the diabase continues to Lyne's Sugar Loaf, into the Parishes of Bicheno and Douglas, rising into and forming the crest of a mountain-range roughly parallel with the coast. This range is fringed with sandstone beds, containing our Upper Coal Measures, and an important part of my examination was to ascertain whether these sandstones, as is alleged, pass into the mountains under the diabase capping, or whether they simply flank the range and are cut off by a central core of eruptive rock.

Before discussing the several occurrences of coal, it will be well to consider this matter of the diabase. In the first place, the order of the rocks of the district may be illustrated by the following table:—

RECENT.	Superficial sands and gravels, sand-dunes.
TERTIARY.	Palæogene clays and ferruginous sands, with fossil leaves. Impure concretionary iron ore at Riversdale, Cambria, Swan River; consolidated sand-bluffs on Schouten Main.
CRETACEOUS?	Diabase or dolerite in intrusive masses and sheets, penetrating the Coal Measure sandstones, and crowning the mountain ranges.
JURA.	Soft green-and-yellow felspathic sandstones, enclosing seams of coal, and containing the fossil fern *Thinnfeldia odontopteroides* (Morris).
TRIAS.	White, hard quarrying sandstones.
PERMO-CARBONIFEROUS.	Marine fossiliferous mudstones and sandstones west of Glen Gala. Grits and conglomerates near Isaac's Point.
DEVONIAN.	Granite of Freycinet's Peninsula, Bicheno, and Seymour.
SILURIAN.	Micaceous sandstone at Bluestone Bay. Slate near Isaac's Point.

Although I give equivalent European systems in the above table, it must not be supposed that the formations can be correlated with the identical ones in Europe. It is with the Gondwana formation in India, and not with Europe, that our Permo-Carboniferous and Mesozoic systems are to be compared. That large system of fresh-water beds, with some marine representatives, is spread widely over India, and the continent, of which the beds form the remains, extended at one time to Australia and Tasmania. Our Mesozoic sandstones, with their coal measures, then formed an integral part of the Gondwana-land which sank beneath the Indian Ocean prior to the Tertiary period.

The eruptive rock is known by the various names of ironstone, greenstone, bluestone, trap, and basalt. The first four names are vague field terms. The last is an attempt to be precise, but is hopelessly incorrect. It is a holocrystalline rock, consisting of plagioclase felspar, augite, and titanic iron, is structurally diabasic, and would be called dolerite in England and diabase in Europe and America. Its structure is that of a rock which was formed at a moderate depth below the surface, and wherever it is now found at surface we must assume it to have been exposed by denudation. It may, therefore, have consolidated at first both as intrusive masses of indefinite size and shapes, and as sills or sheets thrust between the bedding-planes of overlying rocks. In the latter case, we may regard the superincumbent rocks as having been denuded. I am aware that the argument derived from its crystalline texture must not be pushed to an extreme. Thus, Messrs. Newton & Teall, in writing on the basaltic formations of Franz Josef Land,* state :—"Unfortunately there is no petrographical character by which sills can be in all cases distinguished from lavas in the Brito-Arctic province. The sills are usually coarser in grain, columnar, holocrystalline, and ophitic in structure; but none of these characters can be relied upon as distinctive."

M. Lacroix, in describing the ophitic diabase of the Pyrenees,† divides it into two categories, in one of which it is shown by its contact phenomena to be an intrusive rock, and, in the other, an effusive product with tuffs and volcanic

* Quart. Jour., Geol. Soc., 1897, p. 489.
† Le Gabbro du Pallet et ses modifications, 1899, p. 29.

ejectamenta. Yet, he says, holocrystalline varieties occur in the flows of the volcanic type, and scarcely differ in structure from that of the normal type of intrusive diabases, "making any petrographical distinction which we might be tempted to draw between the two extremely fragile."

But other facts besides its structure must be taken into account. The two facts which make against the idea of the rock being a contemporaneous lava flow are—

1. Its uniformity of composition through very thick masses (and without lines of demarcation, such as would be produced by successive floods of lava), a uniformity persistent through Palæozoic and Mesozoic rocks, which is a singular thing if the eruptive rock is regarded as contemporaneous with the strata of two great divisions of the geological record.
2. The alteration produced on the adjoining rocks where it invades them.

The proofs of intrusion are more decisive and abundant to the south of Swansea than to the north, where the stratification of the sandstone is less disturbed. In several parts of the district flinty rock, resembling hornstone or chert, is found. It varies in colour from grey to green and black. It has a conchoidal splintery fracture, with sharp corners and edges. The thin edge is translucent. It weathers with a brown crust. It should not be called chert, which is a rock of organic origin. This rock is adinole, or shale metamorphosed by contact with diabase. The shale substance has been converted into a mixture of albite, felspar, and quartz. This kind of stone is plentiful at Kelvedon, six miles S. of Swansea, on Mr. Edward Cotton's estate. It is so splintery that it easily injures the fingers if broken and handled incautiously. The aborigines used split chips of this stone for cutting purposes, and worked flakes are still to be picked up on the grassy headlands on the coast-line. In the roadside section south of the Horseshoe Bridge, near Kelvedon, decayed prismatic diabase, with concentric weathering, is seen tilting up beds of quartzose sandstone. Between the diabase and sandstone are four feet of clay, and a vein or seam of this black adinole. On Mr. Cotton's property, west of the lagoon, the sandstone is changed into a typical white

quartzite, and is associated with flinty adinole. This indurated sandstone and quartzite area comprises five acres of flat land, the quartzite proper appearing to run N.E. as a narrow strip. On the southern edge diabase comes in, and its intrusive nature is further shown by a curious development of marl in the 30-acre rivulet. On the section south of the creek a good deal of silicified wood and loose chalcedonic quartz may be picked up.

Further south on the coast road at Ravensdale the diabase appears tilting the sandstone where the bridge crosses the rivulet near Mr. Salier's homestead. I caught sight of it as the coach passed over the bridge in stormy weather, and did not feel sure about it till Mr. Salier told me such was the case.

On Slate Hill, west of Swansea, dark adinole is frequent. On Boomer's Hill, between Glen Gala and Apsley, Mr. Amos took me to where some surface pieces of yellowish resinous-looking adinole represented the alteration of shales or sandstone.

At Glen Albyn, in Marshall's Creek, 6½ miles west of Bicheno, and about 300 feet above sea-level, some seams of hard stony coal are exposed in compact sandstone with a rudely columnar jointing. Both the sandstone and coal have evidently been indurated in the vicinity of the diabasic rock.

The bores put down with the diamond-drill at sundry points along this coast prove the intrusiveness of the diabase no less decisively, for some of them, after passing down several hundred feet in sandstone, have bottomed upon the igneous rock. Thus, No. 3 bore at Seymour went through 241 feet 5¾ inches sandstone and shale, and then penetrated 5 feet 8 inches into diabase. The bore at Back River, Prosser's Plains, went down 436 feet 9 inches in sandstone and shale, and 3 feet into diabase. A bore at Spring Bay descended through 117 feet of sandstone to the diabase. This is in harmony with what has happened in other parts of the State, where boring for coal has been carried on. At Jerusalem, in 1891, the drill went through 337 feet 0½ inches sandstone, and then 6 feet 10 inches into diabase. At Langloh Park, in 1892, sandstone and coal were bored through 115 feet 6 inches, and then the diabase was pierced for 5 feet 2 inches. No. 2 bore there went through 339 feet 5 inches sandstone, and penetrated

2 feet into diabase. On the flank of Mount Wellington a bore at the Cascades went 509 to 519 feet through the Permo-Carboniferous marine mudstones, and then 100 feet into diabase.

Numerous dykes of diabase everywhere traverse the Permo-Carboniferous and Mesozoic sandstones, proving the eruptive rock to be younger than those strata. It follows that the boring operations which disclose its existence below the latter show that it exists there as an intrusive mass. It has invaded the sandstones, and cannot be described as a superfical flow contemporaneous with them. If we now also see it in other positions overlying the sedimentary strata, we must assume that the beds below which it was thrust have been removed.

The occurrence of massive bodies of this rock at greatly differing levels adds to the difficulty of interpretation. At Swansea and along the coast line to the south diabase (dolerite) forms the shore. It is, consequently, at sea-level. But, at Kelvedon, side by side with the diabase, sandstones and shales exist at sea-level and descend below it. On the sea-bank, near the boathouse, a shaft was sunk about the year 1852 some 86 feet, the bottom reaching 75 feet below sea-level. The strata first passed through were light-coloured shales, and at bottom a soft argillaceous shale with some carbonaceous markings came in. The shales go out to sea, and are seen at low-water. Just north of them a band of black flinty adinole also runs seaward. The appearance of the dark shale in shaft indicates metamorphism to some extent, induced, doubtless, by proximity to diabase. A little distance north of this the eruptive rock borders the sea, and also south towards the Rocky Hills. West of the Kelvedon paddocks it rises from the sandstone into a hill range. North of the homestead is a conical hill, 250 feet high, consisting of felspathic sandstone, which extends halfway up. The upper part is diabase. This is the highest horizon of the sandstone to be seen about here. The plain at the base shows some marl in fragments in the drain ; and in the flat at the back of the farm, as also in the well behind the house, all is sandstone. West of the homestead is a field, with a slightly arched surface, all brown felspathic sandstone strewn with fossil wood. This continues up to the base of the diabase hills, which rise steeply from the plain, with

the appearance of an eruptive contact, to between 500 and 800 feet high. Do the sandstones pass beneath the diabase? The absence of sandstone cliffs along the fringe of these hills and of heavy diabase detritus is against the theory of the sandstone passing into the range. The juxtaposition of both classes of rock at sea-level strongly suggests faulting which has thrown one up or down.

There are indications of coal in the strata on the seashore, but the Kelvedon patch of coal measure sandstone is otherwise surrounded by intrusive diabase, and bears, in many places, such evident signs of the influence of that rock, that I do not think it a very favourable spot for boring operations. It is true the sandstone beds have not been much disturbed as regards position, but the large quantity of quartzite and dark adinole betokens injurious igneous intrusions.

If the fact be thoroughly realised that the diabase is younger than the coal measure sandstones, and has intruded into them, then the diabase capping on the sandstone of the coast range further north must be explained in a way which will not contradict this fact. On this hypothesis the capping was not originally a cap, but an intrusive sheet. The difficulty is to understand how such a thick mass could be forced between sedimentary strata without distorting them enormously, and of this we see no sign.

Passing from Glen Gala to Llandaff, the road up to the summit of the pass, about 500 feet above sea-level, is on diabase country, which runs down south to the Moulting Lagoon, and northwards through Lyne's Sugar Loaf to the coastal tier. In the road-cutting on the pass, the rock is decomposed and weathered to a yellow clay, with nodular lumps. Descending the pass on the N.E. side, a gap in the country is seen opposite Quinn's, which marks the contact of the diabase with the Mesozoic sandstone. A shaft was put down in sandstone some years ago without any result. It is difficult, now, to get any precise information as to this shaft, but report says it went down alongside a wall of igneous rock. It is called Williams' Shaft. The sandstone runs from here north along the side of the range to the north of Llandaff. It descends into the head of the Llandaff valley, called Comb End, and forms the Llandaff basin, in which, however, some

apparently intrusive exposures of diabase occur. On the south side of the road is the diabase rock-mass, which extends south to the Moulting Lagoon. Mr. Jas. Lyne's homestead "Apsley," is situate on the fringe of this diabase, and overlooks on the E. the Tertiary and recent deposits which cover the ground between the north end of the Moulting Lagoon and Fosbrooke's land, west of Llandaff. Inside the western boundary of the surveyed township is some diabase, forming low hills and knolls, but the rest of the area is sandstone. For over a couple of miles N. of Llandaff this freestone, as it is called locally, extends up the mountain to a height of about 800 feet, and contains the coal seams which I had to inspect. At about that height the mountains are crowned with diabase, the *débris* of which, in the form of huge blocks and parts of broken columns, strews the hillside profusely. This talus conceals the sandstone, excepting where cliffs of it are exposed in the banks of creeks. Thus, under a heavy overburden of diabase detritus, unsuspected sandstone strata often show themselves. This detritus is so heavy and the fallen blocks are often so enormous, that I doubt whether the fragments have rolled any distance down the slope. At the Douglas River, on similar ground, I noticed a broken column 40 feet long and 15 feet thick lying prostrate, and altogether the size of the *débris* forbids the idea of any great transport. I am inclined to think that this is an indication of the igneous sheet having once extended over the most wasted sandstones, and that its fragments have settled down gradually to where we now see them.

The igneous rock itself consolidated after all our well-known lode systems had been found; consequently, no ores except those of iron have been discovered in it. Occasionally a zeolitic mineral, scolecite (a hydrous silicate of alumina and lime), bluish-white in colour and stellate in habit, has formed in the joints of the rock.

Llandaff Coal.

This has been found both on the flat, at the base of the range, and up on the hillside, to a height of 650 feet above the sea. The quality is very variable, some of the coal containing only 35 to 43 per cent. fixed carbon, while

what may be taken as being a cleaner variety goes up to 53 per cent., which compares well with the average of Mount Nicholas—46 per cent. to 50 per cent. It is a sub-bituminous coal, with a bedded structure, some of the layers being dull, others bright black. It burns readily, with a yellow flame, emits much smoke and great heat. Some of it forms coke in the assay. Whether, on a large scale, it could be called a coking coal, requires bulk tests to show. The mere fact of a coal coking, too, is not sufficient, for the coke formed may be poor and unusable either for railway or metallurgical purposes. This is too often lost sight of.

Pike's Shaft.—On Crown land leased to Hume, outside the north boundary of the Llandaff township block, there is a seam of dense dull shaly coal, which, though it agglomerates somewhat on the grate, does not form a coke. It has been analysed by Mr. W. F. Ward, with the following result:—

	Per cent.
Fixed carbon..... ..	35·4
Ash	34·4
Gases, &c.....	26·4
Moisture	3·8
Sulphur.....	—*
	100·00

No coke formed.

The quantity of ash is hostile to the caking property. The water in the creek prevented my seeing the full thickness of the seam, but I was told it is three feet. A small shaft has been sunk on the flat above the creek bank, and has bottomed on the seam. Further work was suspended, owing to water. The strata are the soft felspathic sandstones of the Upper Measures. Near here would be an excellent place for using the diamond-drill. The strata are, apparently, undisturbed, and lie nearly horizontal, and may be expected to enclose more than one coal seam. The bore, too, may show whether the edge of the range is not a line of fault, which is, to say the least, probable.

Pike's Creek.—The slope of the hill up to this seam is covered with detritus from the diabase above, and this

*Not determined.

conceals the sandstone bedrock. No solid diabase is seen below the 700-foot line. The seam is about 300 feet above the plains, and cliffs of sandstone are there massively exposed in the creek. A 3-foot seam of fair-looking coal crops out on the east bank of the gully, and can be traced right across. A short tunnel, 13 feet, has been driven on at N. 130° E. The dip is 2° to S.E., and the section exposed, in descending order, is as follows:—

	ft.	in.
Yellowish sandstone roof.		
Coal	1	1
Parting	0	2
Coal	0	5
Parting	0	0½
Coal	1	7
Clay floor.		
White sandstone.		

The thickness of the partings is inconstant; the lower one is thinning out. There is about 2 feet 6 inches of fair coal; some of the 3-feet seems as if it had suffered deterioration from atmospheric influences. The quality of the samples which I took has proved to be excellent. The Government Analyst's assay is—

	Per cent.
Fixed carbon	50·20
Ash	12·00
Gases, &c.	34·70
Moisture	2·40
Sulphur	0·70
	100·00

The rocks in the gully choke the entrance at present, and the seam would have to be worked a little to the west. There would not be much difficulty in running out a horizontal tramway to where a self-actor could be constructed, to convey the coal to the plain below. But it is, I fear, too much to hope that the seam would be profitable, unless a thicker one can be discovered close by, and the two worked in conjunction. The approximate distance to Cole's Bay has been surveyed by Mr. A. T. Mayson as 19 miles 10 chains, of which 3 miles 72 chains would be by branch tramway to the main line required to run the output of the entire district to a safe shipping port.

Gully into Steep Creek.—In an adjacent ravine, higher up the mountain, about 500 feet above sea-level, a seam is exposed as follows :—

Coal.....	6 inches
Clay band ...	9 „
Coal.....	9 „
Band	1 ft. 5 inches
Coal.....	3 ft. 3 inches

with a clay parting.

The coal floor has not been bottomed. The seam was worked at one time for Mr. Cahill, and some coal from it sent to Adelaide. It lies flat, dipping a little to the S.E. The coal exposed is of fair quality, burns freely, and has good heating powers. The Government Analyst's assay is as follows :—

	Per cent.	
Fixed Carbon	48·30	
Ash	24·50	Readily powdered
Gases, &c.....	25·60	coke
Moisture	1·60	
	100·00	

It will be noted that the proportion of ash is high.

Steep Creek.—This creek exposes numerous seams and outcrops of coal at varying elevations from 200 to 650 feet above sea-level. Among these are :—

(1.) At 200 feet ... Coal outcrop, not proved.
(2.) At 450 feet ... Seam of brittle coal, 3 ft.
(3.) At 500 feet ... Coal outcrop not proved.
(4.) At 520 feet ... Seam of coal 3ft. 6in., known as A 1.
(5.) At 580 feet ... Coal outcrop worked by Mr. J. R. Cahill.
(6.) Branch gully .. Ditto.
(7.) At 610 feet ... Coal outcrop on south bank.
(8.) At 620 feet ... Coal outcrop.
(9.) At 650 feet ... Coal formation, broken.

The seam known as A1, and the highest seam, are the two most important outcrops.

The A1 seam was first worked on the south bank, in about two feet of coal, the upper seven inches being of inferior quality. Coal from the lower 17 inches was analysed in Launceston, May 9, 1898, by Mr. Austin Allom, as follows:—Fixed Carbon, 56·20; Volatile Matter (gas), 27·00; Ash, 12·80; Water, 4·00 –per cent. Sample was a bright bituminous coal, free-burning, with very white ash. The Morning Star Company (formed 25th Feb., 1898), meeting with difficulty in working on this side of the creek, after driving a tunnel over 20 feet, put in a longer drive on the opposite side in a seam from 3 ft. 2 in. to 3 ft. 6 in. thick, of which 18 inches is stony. The dip is very slight to the south. A small shaft (12 or 13 feet deep), called Ramsay's shaft, has been sunk outside for no apparent purpose; it has not bottomed on any coal. I found the good-quality coal from this seam to burn well and throw out a good heat. All these outcrops, I notice, have large proportions of inferior coal, some unusable, but in a great measure this is probably due to atmospheric influences, and, further in, some of this sort of coal will doubtless be replaced by coal of superior quality. This does not apply to brittle and stony coal, but to the perished, earthy kind which has become soaked and spoiled by exposure.

The samples which I took from the A1 seam have been assayed by the Government Analyst, who reports as follows:—

	Per cent.	
Fixed Carbon.....	57·30	
Ash.....	5·80	Rather tender
Gases, &c.	31·90	coke.
Moisture	4·30	
Sulphur	0·70	
	100·00	

This is a good result, the ash being particularly low for Tasmanian coals. The high situation of the seam is a drawback, but the ground is open and would enable work to be carried on with less difficulty than at some of the other outcrops. The thickness of coal exposed at present is not sufficient to admit of profitable working, but if the drill can be got some distance up the hill, it would test the ground, and show whether more workable seams exist.

The highest outcrop which I saw on Steep Creek was at 650 feet above sea-level, and this did not expose the full thickness of the seam, as the coal is still going down in the floor. A face of about 12 feet is exposed in descending order, as follows:—

	ft.	in.
Carbonaceous formation of shale and bands	6	0
Band	0	4
Coal	0	3
Band	0	2
Coal and shale	0	8
Band	0	6
Coal and hard shale	2	10
Band	?	
Coal	2	6

False floor, coal going down.

Most of this coal is brittle, and inferior to the good coal in seam A1. The samples which I took were analysed in the Government Laboratories, with the following result:—

	Per cent.	
Fixed Carbon	42·9	
Ash	28·8	Rather powdery coke.
Gases, &c.	25·2	
Moisture	3·1	
	100·0	

Going down the hill, I observed an outcrop of 17 inches of good soft coal in Mosquito Gully, several hundred feet lower than the highest seam, and some more in the creek still lower down, near the Green Lawn boundary. The drill could be got up here without difficulty. I saw some loose adinole stone in Mosquito Gully, showing the diabase to be intrusive.

As the range is so thickly covered with overburden, it is difficult to fix the relations of the different seams to each other. From the differences in position and thickness as well as quality, none of the exposures appear to be outcrops of identical seams. I think, however, there may have been faulting. At between 200 and 300 feet, I noticed a pebbly bed, containing stones of quartz, quartzite, slate and granite. The granite is a fine-grained, red variety similar to some which occurs at the head of

Freycinet's Peninsula, and was doubtless derived from the coastal granite range. The probabilities are in favour of this conglomerate being low in the system, and this would mean that strong faulting has brought the lower beds to view. If this has really happened at Steep Creek, the higher seams may be struck by the diamond-drill on the flats, provided the intrusive diabase does not interfere there.

The hill north of Board's house is sandstone, and coal has been found on the north side of the hill. It probably comes through to the south under the house, and would be found below the gently sloping flat.

If thicker seams are discovered, and there are probably more seams in this system of beds than have been found up to now, there will be no great difficulty in getting the coal away to a safe and deep harbour site in Cole's Bay. A route for a main line of tramway from Denison River to Cole's Bay, with branches coming in near Landaff from Fosbrooke's and Steep Creek has been surveyed by Mr. A. T. Mayson. It runs along level country in a nearly north and south line to Hepburn's Point, Oyster Bay, thence east to Cole's Bay on the west side of the neck of the Peninsula, a total distance of 24 miles from the Upper Denison. From the Steep Creek junction it would be approximately 16 miles 32 chains to the Bay, and would not cost more than £1200, or, at the outside, for a well constructed line, £1500 per mile. The bay is of ample depth, and forms an ideal harbour.

The alternative is to tram the coal to Bicheno, a distance of seven miles only. This would have an apparent advantage in point of cost. The advantage however disappears when examined, for Bicheno Harbour in its present state is unsuited for large vessels, or shipments in all weathers. A breakwater would have to be constructed, extending from Peggy's Point, N.W. into water six or seven fathoms deep, as proposed many years ago. The cost of this, however, would be fully three times the sum of the supposed advantage.

The cost of mining in the range above Llandaff may be assumed at 7*s.* per ton, to which add 1*s.* for conveyance down the hill, and 2*s.* 6*d.* for transport to the port, so that the cost of the coal, f.o.b. the ship, will be about 11*s.* per ton. Taking into consideration the

quantities likely to be extracted from the comparatively thin seams prevalent in the district, I do not think it would be safe to estimate the cost at less. This would still place the shippers in a fair position with respect to the vendors of, say, Mt. Nicholas coal in Hobart. If thicker seams are discovered, the advantage thereby obtainable is apparent.

As the sandstone strata may or may not pass under the diabase rock, it is impossible to say what the superficial area of these seams may be. The yield however would be approximately 3600 tons per acre from a three-feet seam, and 2400 tons from a two-feet seam, of clean coal of this description. It is possible that the measures pass through the hill to Glen Albyn, a couple of miles to the north, where, however, the coal in Marshall's Creek is brittle and inferior from its proximity to eruptive rock.

I did not see the coal outcrops in Fosbrooke's Gully, deposited under the same conditions as those of Pike's and Steep creeks, from which they are not distant more than a mile W. Two outcrops were reported to me, one at 400 feet above sea-level, another somewhat higher. A tunnel has been driven on the lower seam, which is reported as 2 ft. 9 in. thick, interrupted by two bands of 3 and 6 inches respectively. The Morning Star Company's circular of the 10th May, 1898, gives Mr. Allom's analysis of the coal as under :—

"F.—*Bright bituminous coal.*

Fixed carbon.	Volatile matter (gas).	Ash.	Water.
55·5	33·75	8·5	2·25

free burning, with very white ash."

I recommend a bore (No. 3 on chart) to be put down at the base of the hill at the back of Fosbrooke's land, which will test this part of the field in the same way as I propose for the Llandaff township.

Some fear has been felt on the spot lest coal found in the valley should prove inferior in quality to that cropping out in the ranges. But I do not see any real reason for anticipating this. Coal-mining below sea-level in other parts of the world does not show a decrease of quality attendant upon depth. Coal outcrops may become impoverished by meteoric influences, but the seams resume their normal quality in depth.

Glen Albyn.

I visited Mr. R. Marshall's farm in order to inspect the outcrop at Glen Albyn. The land is on the S. side of the Apsley River at the northern base of the Llandaff range, and five to six miles W. of Bicheno. The flat land through which the Apsley flows is sandstone, which on the south rises into cliffs surmounted by diabase. Coal is exposed in the floor of a creek coming down from the mountain on the south. The principal outcrop is at about 300 feet above sea-level. The sandstone is the usual felspathic variety, but has been indurated locally. The impression left on my mind after examining the seam was an unfavourable one. The coal is hard and stony, apparently metamorphosed by the influence of an eruptive mass. I observed the following section in descending order :—

	ft.	in.
Soil.		
Clay	0	8
Hard stony coal	2	3
Hard stone	0	3
Clay	0	4
Hard coal	0	6
Hard sandstone with columnar jointing	1	9
Clay	0	3
Coal	0	3
Clay	0	2
Hard quartzose sandstone	3	0
Stony coal	1	0
Clay.		

Higher up the creek is a further exposure of the seam, and lower down the favourable felspathic sandstone crops out in the bed. The sandstone occupies the lower part of this range, and has the appearance of passing under the diabase crown to Llandaff, but whether it really does so or not cannot be definitely stated. If it does, the Steep Creek seams ought to be found here also. The strata to the N. and S.E. are cut off by diabase in rather low ground, but the flat at Glen Albyn, Traquhoun, and Blindburn undoubtedly conceals the sandstones of the coal measures. How far they go down can only be proved by boring. The best boring sites are on private property; I should say, on Glen Albyn and Traquhoun. If it could be arranged to put down a bore on the flat

land while the drill is in the neighbourhood, it would set the question at rest. The diabase to the east of Glen Albyn, between the farm and the coast, is much lower than that on the range, and the question again presents itself, whether the lower exposure of this rock is another and lower sill, or whether faulting has happened. And further, may we expect to find freestone again below the lower horizon of diabase, or does the latter go down indefinitely?

Denison River Coal Field.

At the northern boundary of the township of Bicheno, opposite Diamond Island, the granite country along the shore-line is replaced by the sandstone of the Upper Coal Measures. Incidentally, it may be mentioned that a line drawn northwards across Maclean's Bay from this point 7½ miles would strike granite again at Long Point, the intervening coast-line being sandstone. The line of contact between sandstone and granite is concealed by the waters of the bay. Southwards a narrow strip of granite runs through Bicheno, down Freycinet's Peninsula and Maria Island, and is prolonged to the Hippolyte Rocks.

The coast-line and flat country along Maclean's Bay comprise the sandstones referred to, and these mount up into the coastal range to a height of over 800 feet, when they are surmounted by columnar diabase. Here, too, there are coal seams in the level country at the foot of the hill, and others well up in the range. Some of these seams were worked between 1850 and 1860 by the Douglas River Coal Mining Co., which took up 1800 acres of land, which extended as far north as the Denison Rivulet. The old shafts on the Denison River, about 100 feet above sea-level, are not now accessible, but authentic reports state that two seams of coal were cut and worked for a little time—a 4-feet seam, at the 92-feet level, consisting of two parts, 2ft. 7 in. and 1 ft. 5 in., and a 5-feet seam at the 165-feet level. The carriage to Bicheno (four miles) was found too costly for profitable working of these "inner mines," consequently, after raising about 800 tons of coal, the owners removed to the Lagoon country, within three miles of the port, to which they laid a wooden tramway. The bottom seam of the inner mines yielded good-quality coal. The company, in its report, 1850, p. 24, says:—

"It was tried at Mr Walker's establishment in Barrack-street, and Mr. Robert Walker states that with this coal the boiler was heated 40 minutes sooner than had been usual. It was tried in Mr. Davidson's foundry, in the smelting furnace, where the tilt-hammer is worked, for which a strong heat and much flame are essential; and it was considered to be superior in heating power to some English coal which they had been using, and for which they had paid 35*s*. per ton. Messrs. Easby & Robertson gave an equally favourable account of the behaviour of the coal at their establishment, where, after being tried in the forge, it was used to heat the furnace for working their steam-engine."

At the Lagoon or "outer" mines a small seam was passed through at 90 feet, and a 5 to 7 feet seam at 192 feet. A bore from the 192-feet level proved the strata downwards for another 164 feet, being a total depth of 356 feet, but no further seams were met with.

The published descriptions of the bottom seam worked by the company at the outer mines are discrepant. Mr. Selwyn, in his report on some of the coal seams of Van Diemen's Land, 1855, gives the section of this seam as under:—

	ft.	in.
Black shale	2	0
Coal	0	6
Parting	0	3
Coal worked	1	8
Parting	0	3
Coal	0	6
Black shale	2	0
	7	2

Mr. Chas. Gould, in his Report on Coal Fields, 1861, represents the same seam as consisting of—

	ft.	in.
Black shale	2	0
Coal	0	6
Parting	0	3
Coal	0	6
Black shale	2	0
	5	3

After realising the nature of the seams as presented by either of the above sections, I do not think surprise need be felt at the company ceasing operations. Mr. Selwyn figures out estimated contents of the 20-inch seam as 800,000 tons of coal per square mile; but any such calculation is superfluous and delusive, for the simple reason that a seam of this size and quality cannot be worked profitably. After the company stopped working there was an irruption of water into the workings from the Lagoon, and this now blocks all ingress.

The idea has been expressed that the seams near the Lagoon are continuations of those cut in the Denison River shafts at the inner mines; but I do not think they are, because the latter are a hundred feet higher than those at the outer mine, and the dip of the country is in opposite directions.

Four shafts were sunk near the offices, and borings were put down all over the flat, but with no result beyond proving the existence of seams. No records of these bores are available, but as no seams were worked, it may be assumed that those met with were not payable.

I proceeded from here to the Denison River, where freestone is seen on Thornbury's farm. Going up the river from Thornbury's, I saw a few exposures of coal in the bed and banks. Only 8 inches of the first of these was above water. I was told the seam is about 4 feet thick, 18 inches of which (at bottom) consists of bright coal, the rest being interrupted by bands. A small tunnel was cut in the north bank about 50 years ago, and a little coal was seen at the entrance. Fifty yards further up the river is a clay bank on the north side, and a 5-inch seam of impure coal above the clay, about 20 feet above water-level, and under 15 feet of soil with boulders. About 200 yards higher up a small tunnel has been driven into an outcrop on the N. bank of the river. About a foot of rotten and inferior coal is now exposed. It may have been a little thicker, as the tunnel is now fallen in, and there appears to be no roof, but only a cover of boulder clay. This may account for the decayed nature of the coal. To the north of this would, I think, be a good site for boring on private land.

The old inner mines of the Douglas River Coal Mining Company are on the Denison River, not a mile from the sea. Three shafts have been sunk, one on the north side,

two on the south side of the stream, within a chain of each other. A north and south fault exists near the shafts, owing to which a bore was put down 300 yards distant from one of them without intersecting a seam. I have already alluded to the good bottom seam worked here. Mr. Gould gives its section as :—

	ft.	in.
Gas coal	1	3
Soft band.....	0	3
Coal	1	4
Black band	0	6
Clean coal	1	0
Band of coal, with stone...	1	0
TOTAL	5	4

The upper seam is so split up with bands that it cannot be considered as payable, and, according to the above section, the lower one is none too profitable. This is about 24 miles from Cole's Bay.

About two miles up the Denison a series of seams was exploited by the Morning Star Company in 1898. The river-bed rises in this distance to 425 feet above sea-level. These seams were already known in Mr. Gould's time, and are familiar to those interested in them as B 1, B 2, and B 3 seams. They are in the same greenish-grey sandstone which encloses the lower seams, and the strata dip in the same direction as at the inner mines, viz., S.W. about 3°.

At a height of about 280 feet above sea-level, and 40 feet above the river on its north bank, is an old shaft, now filled in, which was sunk about 17 feet through a 3-feet formation of broken impure coal, resting on clay floor, and sandstone below. There is no proper roof seen, as the coal is covered with soil. If work is continued here by driving into the hill, it will probably show a solid seam to exist further in.

A few chains higher up the river is seam B1. A drive N. has been put into this for 14 feet, but is now half-full of water. The floor of the seam is a soft grey clay. The coal is 17 inches thick, its appearance clean, alternately dull and lustrous, practically the same coal as in B2, about to be described. Fair samples from this seam

have been analysed by Mr. W. F. Ward, the Government Analyst, who reports as follows :—

	Per cent.	
Fixed carbon	54·8	
Volatile matter, gas	32·4	Gives a very firm coke.
Moisture	5·6	
Sulphur.....	0·6	
Ash	6·0	
	99·4	

The coal is dense in texture, breaks in large cubical pieces, soils the fingers readily, and is free from pyrites. According to the analysis, it corresponds nearly with the requirements of a gas coal, which ought not to contain more than 5 per cent. ash, ½ per cent. sulphur, should have 35 per cent. to 40 per cent. volatile matter, and give 58 to 60 per cent. of good coke. Tried on the open hearth, the B1 coal gives a good heat, emits a bright yellow flame, and fuses fairly well. In fixed carbon it is a few units higher than Mt. Nicholas coal, and ought to prove an excellent smith's coal, as the proportion of carbon ensures heating power, the sulphur contents and ash are low, and it cokes sufficiently for the forge. It should answer well for steaming purposes, the ash and sulphur being so low, and fixed carbon high, and it does not appear to have enough iron in it to fuse and clinker on the bars.

The Morning Star Company had an analysis of this coal made by Mr. Austin Allom, Launceston, 9th May, 1898, and this corresponds substantially with that made by the Government Analyst, as given above. Mr. Allom's assay was :—

		Per cent.
B 1. Bright bituminous coal—	Fixed carbon	55·15
	Volatile matter (gas)...	33·00
	Ash.....	6·85
	Water.....	5·00
		100·000

Further down the river, at 200 feet above sea-level, is the big seam, called the 3-feet seam or B 2, below the 17-feet shaft mentioned above. A tunnel has been driven

into it 60 feet on the north side of the river. The section in descending order is—

Sandstone roof	40 feet
Coal	16 inches
Band or parting	5 „
Coal	3 „
Band	2 „
Coal	5 to 6 inches
Clay parting	1 inch
Coal	3 inches
Hard clay floor level with river.	

The top coal thickens sometimes to 20 inches. The coal below would not be payable to work. The dip of both B 1 and B 2 is identical, about 2 or 3 degrees S.W.; but the difference in level precludes the idea of them being the same seam, though the quality of the coal is similar in each. The samples which I took from B 2 were analysed by the Government Analyst, with result as under :—

	Per cent.	
Fixed carbon	54·0	
Gases, &c.	33·5	
Ash	5·6	Gives a fine coke.
Sulphur	0·6	
Moisture	6·3	
	100·0	

Tests of coal purporting to come from seams B 1 and B 2 were made by the Launceston Gas Company in 1898, and gave highly satisfactory results. Mr. Arthur Green, the manager of that company, reports to the Morning Star Company, under date of 21st April, 1898, as follows :—

"We charged two retorts, each with 2 cwt. 3 qrs. of coal, one retort being charged with coal from No. 1 seam, B claim, and the other from No. 2, B. The charges were left in for six hours, and produced coke as under:—

"No. 1. 2 cwts. 0 qrs. 9 lbs.
No. 2. 2 cwts. 0 qrs. 0 lbs. } (= 74·18 per cent. coke)."

"The coke from both samples was very similar: it is a good marketable coke, and burns beautifully, giving out a great heat. I have seen nothing like it before from any

Tasmanian coal, and have no doubt that, with proper coke ovens, you will be able to turn out a very excellent and valuable product."

Mr. Green further reports, April 27th, 1898:—

"I have to report that a test has been made at these works of the coal from your 1 and 2 B claims for coke. In this instance the coal was left in the retorts for 12 hours, the result being that a very excellent coke was obtained. The results of the tests made to-day in your presence for gas are as under:—

"Gas made per ton of coal—10,000 cubic feet.
Coke „ „ „ 13 cwts. 3 qrs. 2 lbs. (= 68·84 per cent)."

This is eminently satisfactory, as anything over 60 per cent. clean coke is excellent. From inquiries which I made on the spot, I am satisfied that the coal which was broken out of this mine for the above tests was duly loaded on the railway truck at St. Marys. It is, consequently, strange that a trial of a sample of the B 2 coal at the Thornhill Collieries, Dewsbury, Yorkshire, in March, 1899, proved very unsatisfactory in respect of its coking properties. The sample was taken by Mr. M. J. Griffin, Inspector of Mines, in the presence of Mr. Bedgegood, who informed me it was a fair sample of the coal which would be sent away. I have seen the remaining half of the same, and it is in every way representative of the seam.

It was given to T. L. Ingham, Esq., of Leathley Hall, Otley, Yorkshire, during his visit to Tasmania in 1898, and he handed it over to E. T. Ingham, Esq., of the Thornhill Collieries. The latter gentleman's instructions to his head coke-burner were as follow:—"27th March, 1899.—I send you herewith a sample of coal. Carefully reduce it to pieces no larger than a pea. Place in a wooden box inside one of your best ovens, so that it shall be thoroughly well burnt. Break the sample in half, taking care not to break it up more than necessary, so that you may judge of the fracture and quality, and report to me in writing the number of hours it has been burnt, the conditions generally, and your opinion of the quality of the product. The sample to be returned to this office entire."

The coke-burner's report on the test, 30th March, 1899, is as follows:—"The sample of coal received on 27th March, and the instructions with regard to it have been carried out. The coal was broken up and inserted in an oven working under the best conditions, both with regard to the oven itself and the dry load it contained. It was burnt 68½ hours at a good heat. The condition of the burnt sample is very poor indeed, and such coal as the sample will not make coke under any conditions, as it could not have had a better trial."

Mr. J. L. Ingham reports upon the coke obtained as under:—"30th March, 1899.—I have examined the coke from Tasmania burned by Ainsley. It is very soft and friable, and there does not seem to be any tendency to cake. It is fairly dense in the fracture, but very light in weight; in fact, is not a coking coal at all. It has turned into little round nodules about the size of a pea, which are more or less held together, but which separate fairly easily with rubbing. It is fairly bright in colour. Am I to have it analysed? It hardly seems worth it."

The coke was analysed by Reynolds and Branson, Limited, Leeds, and Mr. F. W. Branson, F.I.C., reports:—

"12th April, 1899.—The following is the analysis of the sample of coke received from you on the 8th inst.:—

	Per cent.
Moisture	7·90
Ash	8·30
Sulphur	0·82
Carbon by difference	82·98
	100·00

Ash and sulphur very fair, but the coke is mechanically very poor, and useless for any metallurgical purposes."

The coke has been returned to Inspector Griffin, and may be inspected at my office. It is a bright nodular variety, apt to crumble.

Mr. E. T. Ingham reports with reference to the whole test as follows:—

"25th April, 1899.—My own opinion is, this coal, the Morning Star B2, will not make a first-class coke by itself, but with the addition of a small percentage of

bituminous coal, and the two thoroughly mixed together and ground to pieces less than $\frac{1}{8}$ in. diameter, I think it would make good foundry coke. The mechanical condition of the coke is poor, having been pounded up by hand, and it *might* have agglomerated more (which is what we desire) if it had been passed through a disintegrator. The ash is rather high, but the sulphur is fairly low, indeed quite as low as our best blast-furnace coke. Foundry coke should not exceed 7 per cent. sulphur, and ash 6 or 7 per cent., but this latter is not of so much consequence. I send herewith the coke itself, as burnt in my ovens."

The discrepancy between the English and Launceston reports is striking, and calculated to cause uneasiness, but as Mr. Ward's analysis confirms the tests by Mr. Allom and the Gas Company, the difference may be due either to the nature of the respective samples operated upon, or to the treatment. We know very well that when coke is manufactured in quantity, the product is firmer and more coherent than when made on a small scale, as the heat is greater and combustion is more perfect. Then, again, the methods of coking vary according to whether the coal is burned primarily for the production of gas or for coke. In the former case, the coke, a secondary by-product obtained in close vessels, is generally spongy and not so well suited for metallurgical operations.

In the next place, the sample taken was from exposed coal, and the latter may have been lying some time, to the injury of its coking properties. In this connection I may quote J. Arthur Phillips, who, in his "Elements of Metallurgy," page 45, says :—

"It has been asserted on good authority that certain Welsh coals lose their property of caking after a few days' exposure to the air, and M. de Marsilly states that strongly caking coal, which affords an excellent coke when fresh from the pit, yields an imperfect coke after exposure to the atmosphere for six months."

I am inclined to think that the poor results obtained from the English test must have been due to the inherent nature of the sample operated upon.

About 20 feet above B 1 seam there is an outcrop of very inferior coal, which has not been opened upon. It

is in the south bank of the river, and presents the following section :—

	ft.	in.
Stone	0	3
White band.....	0	4
Stone	0	2
Shaly coal	0	4
Band or parting	0	3
Shaly coal	10	0
Band	0	3
Shaly coal	1	8

This does not show anything encouraging, but a few yards higher up the river the B 3 seam is exposed as a broken coal formation under a sandstone bank. A tunnel has been driven into it in the north bank of the river, but it is not now in a safe condition for entering. In the bottom part of the seam is 2 feet 6 inches fair-looking coal, with one parting. It contains 13 per cent. ash, and does not form coke. The seam might be worth following up, as the samples which I took were from near the entrance. The tunnel is stated as 55 feet long. The analysis of my samples by the Government Analyst was :—

	Per cent.
Fixed carbon	53·1
Gases, &c.....	28·9
Ash	13·1
Moisture	4 9
	100·0

Sulphur not determined. No coke formed.

A little above the seam just alluded to a small seam, 1 foot to 18 inches, crops out, but no work has been done upon it.

I did not visit any seams higher than these, and do not know whether any exist, but the Upper Sandstone Measures continue for 200 or 300 feet higher before they give place to the diabase crown of the range. The known vertical extent of these sandstones here down to the bottom of the old Douglas River company's shafts is about 700 feet; but the actual horizon is affected by faults.

In a gully falling into the Denison, below the B 2 workings, I saw a seam of coal 2 feet 4 inches, but not opened upon enough to give an idea of what it really is. In another branch of the gully, at the same level, Mr. Mayson reports a recently-discovered exposure of 30 inches of superior coal; and this may be the same seam.

The general dip of the whole series, both up on the ranges and down at the inner mines, is gentle, and in a south-westerly direction. The only dip in a reverse direction is on the coast at the outer mines. The difference of dip may be due to either of two causes: firstly, it may represent two sides of an anti-clinal; secondly, it may be due to faulting. Minor faults in the area suggest the latter, and, if so, boring to a depth of several hundred feet on the level ground near the sea might pierce the same seams as are found in the hills. The old bores executed by the Douglas River Company were, apparently, not deep enough for this purpose.

Unfortunately, while the quality of some of the Denison coal is so good, the seams which have been discovered so far are not sufficiently thick to put beyond doubt the possibility of their profitable working. Mr. Ingham, of the Thornhill Collieries, in writing about the Denison coal, says:—

"B 2 seam is, practically, only 20 inches thick. I may say that no seam of this thickness is workable, unless of exceptionally good quality, such as our Yorkshire seam—the Better Bed—with which the Low Moor Iron is manufactured, and which makes a magnificent coke, with only ·5 per cent. of sulphur (one-half per cent.) and about 5 per cent. of ash."

I may add, that while such thin seams can only be worked under unusually favourable conditions—low wages, machine-cutting, solid roof and floor, near markets—seams over 8 and 10 feet thick are not required, as their working becomes more difficult.

B 1 and B 2 are the best seams, and these give 17 inches and 16 inches of good coal. The lower part of B 2 does not seem good enough to work; even if it were, it would only give another foot. Of course, systematic boring might disclose more powerful seams in these measures. I think also that, provided the quality of coal is satisfactory, some chance of profitable working is

offered by the lower seam of the inner mines, where 3 feet 7 inches of coal was worked with two bands—three inches and six inches respectively. A seam need not be condemned on account of its partings, provided they can be easily separated from the productive part of the seam ; but the whole question of profit and loss will require working out very carefully.

Douglas River Coal Field.

Two and a-half miles north of the Denison the Douglas River flows into Maclean's Bay. The level land along the coast continues to consist of the Mesozoic sandstones, sometimes yellowish-brown, sometimes greenish-grey, but always of the soft felspathic granular nature of the stone of this geological horizon.

On the sea-coast, about half a mile south of the Douglas, some low cliffs or banks, 10 feet high, called the Porches, have been eroded into cavities and pot-holes by the sea. They are formed of beds of yellowish-green felspathic sandstone, with fragmentary layers of clay containing lignite and coal. One of these clayey patches shows a tree-root in a vertical position, with a spread of about a yard wide. I saw no other fossil remains. The dip of the beds is very slight, about 2° to the N.W.

About half a mile further S., at Harmon's Creek, a small shaft has been sunk in sandstone, called Allen's shaft. At 70 feet it is reported to have cut shale. On the beach there are some thin coal seams at sea-level.

I followed the sandstone strata up the range as far as 500 feet above sea-level, and estimated their continuance for another 300 or 400 feet, so that, at least, 800 feet of these measures may be taken as existing above sea-level. The upper part is obscured by the talus of diabase, which forms a heavy overburden, and conceals the junction of the two rocks. The diabase, which rests on the mountain's summit, has an apparent thickness of between 200 and 300 feet. The section afforded by the course of the Douglas river is highly instructive. The stream, in its upper part, flows due south, and in its lower reaches, due east. By this means, the diabase cap of the mountain has been cut through down to the underlying sandstones which form the river-bed and cliffs on

its banks. This section indicates that the sandstones are not beds which merely lie against the eastern wall of a ridge of diabase, but really pass underneath the latter, at least as far into the heart of the range as the stream allows them to be observed. At the same time, theory requires us to assume the existence somewhere of central masses of the eruptive rock, and the intrusive sheets, could we follow them, must inevitably lead to these masses. This makes it difficult, in any given locality, to say how far the coal measures may continue below the intrusive sheet before they are cut off by the igneous boss or stock.

A confirmation of the above interpretation is found in the No. 5 bore, put down by Inspector Harrison in 1888, in the sandstone in this range, 2½ miles from the coast, at a height of 500 feet above the sea, and continuing to 145 feet below sea-level, without touching any diabase, although the bore-hole is nearly under the columnar face of St. Nicholas' Cap. If the diabase had formed a central boss here, a bore of this depth and at this place might have been expected to come in contact with its subterranean flank.

Four bores were put down at Seymour in 1888, and as their particulars do not appear to have been published before, or, if published, are out of print, I give them in the appendix to this report. They will be useful as a guide to future work. I have marked their approximate positions on the accompanying chart.

No. 1 bore left off in the hard floor below a foot of coal at 169′ 5½″. The last 20 feet of boring was in shale.
No. 2 bore left off at 308′ 3½″, in mud shale, with pebbles.
No. 3 bore left off at 247′ 1¾″, in eruptive rock, diabase.
No. 4 bore left off at 892′ 3″, in conglomerate, with rotten granite boulders. The last 430 feet of this bore were in the mudstones, limestone, and conglomerate of the Permo-Carboniferous system.

An important feature revealed by the No. 3 bore at Seymour is the existence of the igneous rock intrusive into the Mesozoic sandstone. It shows that an effusive cap theory, pure and simple, is untenable.

For 50 or 60 years back coal has been known to exist in the Douglas River. In 1881–2 some was taken out for trial by Messrs. Gill and party.

At about 300 feet above sea-level pebbles of quartz, quartzite, quartz-porphyry, and granite occur strewn over the slope of the hill. This is identical with the pebble bed already mentioned on the Steep Creek hill, and I have since seen the same formation north of Seymour, near Thompson's Marshes. The absence of diabase pebbles negatives the idea of it being a later marine terrace. At this height the heavy detritus of diabase begins to appear. Descending into the river-bed cliffs of massive square-jointed freestone are seen, dipping slightly to the S.E. In the river-bed, about 250 feet above the sea, a seam of coal, 8 feet thick, is exposed. Its roof is grey felspathic sandstone, and its floor is clay. Dip, 5° to S.E. The coal is shaly, and appears to be of inferior quality. The seam is cut up by numerous clay partings, from 1 to 3 inches thick. Altogether there are about 6 feet of coal, and 2 feet of clay and stone, distributed in a way which makes profitable working problematical. The section of the seam on the south bank is as follows :—

	ft.	in.
Coal	0	9
Band	0	1
Coal	0	9
Band	0	1
Coal	1	6
Parting	0	1
Coal	0	3
Band	0	4
Stony Coal	0	4

Coal under water 3ft. approximately.

On the north side there was a tunnel in the same seam, but it was full of water at the time of my visit.

Half a mile further up the river there is an important outcrop, of what I consider the same seam, only its dip is in the contrary direction, viz., N.W. 5°, so that there must be an anticline. This is about four miles from the mouth of the river, and forms a large crescent across the bed of the stream, which is here about 40 feet wide. The situation is well within the range, with St. Nicholas' Cap on the N.E. The river comes down from the north between lofty sandstone cliffs. The section presented on the W. side is as follows :—

	ft.	in.
Roof of sandstone.		
Coal, dull, black	3	6
Clay parting	0	5
Coal, dull	1	5
Parting	0	1
Coal, dense, somewhat flinty	2	0
Clay and sandstone (under water).		

In the above seam there is 4 ft. 11 in. of fair coal. The rest is inclined to be stony. The 3 ft. 6 in. at top form the best portion. Samples which I took from the upper part have been analysed by the Government Analyst, who reports :—

	Per cent.	
Fixed carbon	52·00	Yields a powdery
Gases, &c.	27·10	coke.
Ash	16·40	Sulphur not de-
Moisture	4·50	termined.
	100·00	

In 1881 a sample was assayed for Mr. A. J. Taylor by Mr. E. W. Woodgate, who gave the following report :—

"Sept. 29, 1881. I have examined the sample of coal received from you, and find it to be of a very good quality, and could be used for most purposes : also, after retorting for gas, it leaves a good solid coke. The majority of Tasmanian coals that I have examined do not coke properly. It is very free from sulphur, as the following analysis shows :—

	Per cent.	
Moisture	5·50	Volatile matter.
Volatile hydro-carbon	29·20	
Fixed carbon	48·10	Coke.
Ash : mineral matter	17·20	
Sulphur	0·05	
	100·05 "	

The two reports are somewhat conflicting as regards the coking, but this is probably due to differences in the sample. This can easily arise, as the seam varies in quality in different parts. The coal is high in ash. The

late Sir H. T. De la Beche assayed some coal from the Douglas River, probably from this seam, and obtained 14·5 per cent. ash therefrom, reporting on same :—"Good quality, like Newcastle, but large quantity of ash." Newcastle coal (in England) contains only from 1 to 6 per cent. ash, and has from 55 to 70 per cent. fixed carbon.

Mr. Hy. Rosales reported on this coal to Mr. F. M. Gill, Nov. 10, 1882 :—"The quality of the coal is bituminous, and it burns in an open fire with a fairly bright flame, leaving a black cinder, partly coke."

Dr. Milligan (Pro. Roy. Soc. 1849, p. 65) visited this seam, and writing of the lower outcrop, says :—

"The coal is of a deep black colour : its structure is cubical, but a few inches near the bottom of the seam incline to slaty with a flat conchoidal fracture. Its lustre is bright, rich, and splendent, like that of resin or jet, and it is easily frangible : it ignites readily, fuses to some extent, gives out dense volumes of black smoke, and burns, in a mass, with a wild ruddy flame and strong glare, yielding in detached pieces exposed to red heat, long piping jets of bright white flame."

The seam could be worked from a little lower down the river, and the basin cleared of stones, which now dam back the waters. The tramway would run on the north side of the river. Seymour is distant, probably, 6 miles by a tram route, but the harbour question would have to be considered first. The distance from the Douglas River seam to Cole's Bay being about 28 miles, we may perhaps consider this field as outside the area which that harbour would serve. If a few of the seams near Seymour were worked by a strong syndicate and the port made practicable to some extent, the produce of the Douglas River seams would find its way to Seymour without much difficulty. The harbour question, however, is one which I cannot touch upon.

The upper seam in the Douglas is one of the thickest met with in this range, and should be opened out and tested so as to give a fair idea of what the average quality of the coal is likely to be. The small drive into it has been abandoned nearly 10 years, and the weathered

exposures are unsafe *criteria*. I would not advise any arrangement for working on a large scale until more work has been done. If small shipments can be effected at Seymour, the seam is well worth trying, but the coal, as now exposed, does not seem suitable for anything more than domestic and forge use. It is not an ideal coal for steaming. It has too little fixed carbon: its proportion of ash is none too low, and it gives out a good deal of smoke. Still, I dare say it could be used for that purpose.

Coal Creek (*D.*)—About two miles up the Douglas River a creek flows into it from the south. A mile up this creek there is a two-feet seam of coaly clod resting on a clay floor, and with a roof of massive sandstone. The exposure is in the creek bed, half concealed under broken prismatic columns of diabase. Hence, I could not get at it properly, or ascertain really whether any coal exists. What I saw was wet and soft, and filled up with talus. This was about 300 feet above sea-level.

Lower down the creek, the bed of which is choked with diabase boulders, a seam of coal crosses it, and is exposed by a short tunnel, 8 feet in length, on the west side of the gully. I was told this tunnel was driven by Cooper Bros. over 15 years ago. The seam contains 2 feet 8 inches of coal and about 8 inches of partings. Its section is as follows:—

	ft.	in.
Sandstone roof.		
Shale, with some coal		2
White clay band	1 to	3
Coal		6
Hard grey clay band		1
Coal		9
Hard dark band		2
Coal		17
Floor, clod and shale.		
	3	4

The bands are variable, the 1-inch parting cutting out in one place, where it is replaced by good coal. Some

SKETCH MAP
SEYMOUR TO SCHOUTEN ISLAND

Scale 40 0 1M 2M 3M Chains

Sands and Clays tertiary and recent
Diabase (GREENSTONE)
Mesozoic sandstone
Granite
Silurian slate
Coal seams
Existing bores
Proposed bores

W.H. Twelvetrees, Govt. Geol.
October 1901

5 cm

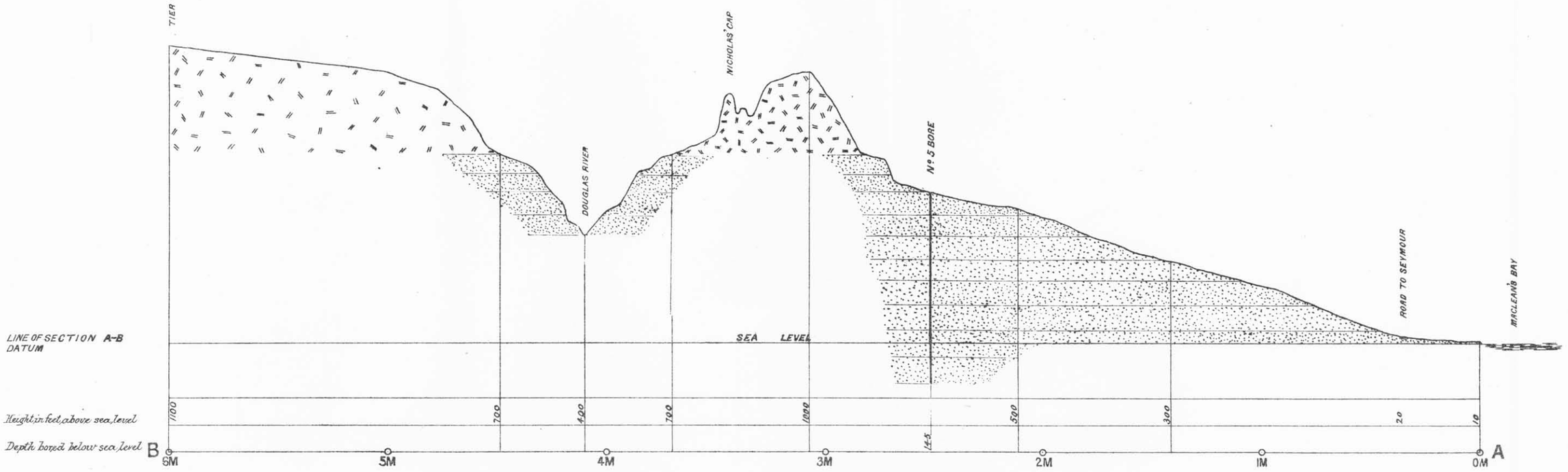
SEYMOUR
LONG POINT
DOCTOR'S CREEK
BLIND CREEK
LINE OF SECTION
B
A
RESERVED FOR COAL
DOUGLAS RIVER
HERMAN'S CREEK
DENISON RIVER
LAGOON OR
DIAMOND ISLAND
PEGGY'S POINT
BICHENO
KRAMIVAN
PROPOSED TRAMWAY
CAPE LODI
HALFMOON BAY
LYNE'S SUGAR LOAF
LLANDAFF
SWAN RIVER
CYGNET RIVER
SABUNAS Isd
MOULTING LAGOON
MT PETER
SALTWATER LAGOON
FRESHWATER LAGOON
ISAACS POINT
5 cm
TRAMWAY
PROPOSED
BERNACCHI'S BEACH
SWANSEA RA.
W. SINGLINE
F.M. GILL
BLUESTONE BAY
BOULDER
JACKS REEF
DREDGING FLAT
D.C. 235
D.C. 236
D.C. 208
THE THREE SISTERS
HEPBURNS PT
RABBIT Isd
COLES BAY
SLEEPY BAY
THOUIN OR WINEGLASS BAY
SHAG ROCK
HAZARD Isd
FREYCINET'S PENINSULA
SCHOUTEN PASSAGE
BARE HILL
TRUMPETER BAY
SCHOUTEN ISLAND
KING BAY
PELICAN BAY
GREAT SWANPORT
BUGLE
WYE RIVER
CYGNET RIVER
S'USKY RIVER
SHAW BLUFF
WATERLOO PT
MEREDITH RIVER
SWANSEA
STONY RIVER
WEBBERS PT
OYSTER BAY
OLD MAN RIVT.
BUXTONS RIVULET
BUXTONS PT

5 cm

GEOLOGICAL SECTION ALONG LINE A-B 6 MILES

SCALES
HORIZ: 20 10 0 10 20 30 40 50 60 CHAINS
VERT: 200 100 0 100 200 300 400 500 600 FEET

Diabase (GREENSTONE) | Mesozoic sandstone



of this coal is dark, with lustrous layers, burns freely, and cokes well. Mr. W. F. Ward's analysis is :—

	Per cent.	
Fixed carbon ...	50·8	
Ash	12·3	Yields firm coke.
Gases, &c.	30·9	
Moisture	5·5	
Sulphur	0·5	
	100·00	

It is to be regretted that this seam is too thin for profitable working. The dull portions of the seam show a rather dirty coal, and this will not make a clean coke. The seam and the sandstone have a dip of about 5° from the horizontal to S. 10° E. The coal is only a few feet lower than the lower outcrop in the Douglas River ; it dips in the same direction, and it may be the same seam. The roof is the usual grey felspathic sandstone, somewhat micaceous and pebbly, with imprints of fossil leaves and wood.

Descending the gully several exposures of impure carbonaceous material are seen, none of which are of any good for working, but which serve to show that conditions were favourable for the formation of coal deposits.

Only seven or eight feet below the above seam about 2 feet of stony carbonaceous clay are seen. Nearly 100 feet lower down, a similar dark stony clay is exposed below a 1-foot clay band. If there is any coal here it is likely to be above the clay. In fact, on the E. bank, it is seen above the clay, but ill-exposed. It looks as if it might be the black clod bottom of a seam. Here huge columns of diabase cover the stream, which trickles through underneath, hidden from sight.

Some 10 feet lower down a flat earthy seam is exposed in the bed of the creek, but it is too stony to be of any value. A bandicooting description of a tunnel has been driven in the west bank, but does not seem to have turned out any coal ; moreover, the overburden in this place is too heavy for any seam to be properly cut into without driving some distance. A few yards still lower down is another flat seam 5 or 6 inches thick, but stony, and of no good.

The banks of the creek are steep and inconvenient for economical working, but there are no insurmountable difficulties if a really good seam were discovered. Nothing at present shown in the gully will pay to work. It will be remembered that the seams dip east of south, and I recommend, as the best way of ascertaining whether they improve, and of testing the country generally, that a bore be put down about a mile or so to the south-east, as far up Harman's Creek as can be conveniently got with the drill There is a ti-tree marsh at the head of that creek, and there, or below there, are spots well suited for the drill. The ground rises gently from the sea for 200 to 300 feet, and the creek has water all the year round.

In the back country, a seam of coal has been recently discovered, about a couple of miles north of Lyne's Sugar Loaf, 7 miles inland; but the discoverers had left the district, and it could not be visited.

In concluding this part of the Report, I may draw attention to the proofs of a coal-field occupying the country, from Llandaff to the Douglas, for about 11 miles by an average of two miles. It extends as a fringe to the north of Seymour. The measures have every appearance of passing, at least, some distance under the mountain ranges. Even if a core or ridge of diabase should be found to occupy the centre of the mountains, the ravines cut by the rivers show that the coal measure sandstones run a good way under the igneous sheet which proceeded from the core. If, therefore, the seams are found profitable, I do not think fears of them being cut off by the eruptive rock need be entertained for a long time to come.

The Douglas River end of the field contains seams of coal as thick as 7 feet, of which, perhaps, 4 to 5 feet could be worked, but more development work is requisite before a definite opinion can be expressed, especially as the coal tested contains much ash, and only yields coke in a thin unprofitable seam on the South Creek.

The Denison field has a better coal in its outcrops in the ranges, B2 yielding a fine coke, but, unfortunately, in a seam which would not give more than 2 ft. 4 in. workable coal at the most. More work here, too, is required on the B3 seam, 2 ft. 6 in. of which is fair looking, but not a coking coal. The lower seam of the inner mines, 3 ft. 7 in., is the one which would appear to offer most induce-

ment at present, but I have no evidence of the nature of its coal.

Going south towards the Upper Apsley, the diabase capping of the hills sinks, and the country seems more under the influence of eruptive rock.

South of the Apsley, on the Glen Albyn flat, the sandstone appears to continue beneath the igneous cap, but whether it really does so cannot be stated. It re-appears at Steep and Board's Creeks, Fosbrooke's Gully, &c., above Llandaff, on the south side of the range. The coal seams on the Llandaff side contain coal of variable quality, but mostly yielding a fair coke. There is a good deal of brittle, stony, and otherwise impure coal, which detracts from the working value of the seams. Thus, of the 3 feet 6 inch seam, one of the most important of all, I should estimate not much more than 2 feet as marketable, and in the top seam, measuring 12 feet and upwards, perhaps not more than 3 feet is fit for sending away Until the outcrops are opened out more, it is unsafe to say how far they would justify a large outlay. The output must be large in order to support the cost of a tramway to the port. None of the outcrops which I saw would do this if worked singly, but two or three, worked in conjunction, might yield a profit. I think there is a likelihood of piercing the same or additional seams at the foot of the hills, where they will be nearer to the port of shipment, and may possibly prove of superior quality, through being farther away from the eruptive rock. Consequently, I have advised the bores referred to above. The Comb End part of this valley has never had a trial, and deserves attention, though the measures are more likely to be found disturbed than at the Llandaff end.

The bores about to be put down will test the ground, about which so much uncertainty has been felt in the past, and I regard this work as one to which the residents on the East Coast are unquestionably entitled.

Schouten Main.

This tinfield is reached by following the Nine-mile Beach from Swansea, round the head of Oyster Bay. The beach, backed by sand-dunes, forms a fine level stretch suitable for driving or riding at low-water. The rock on the west side of the Bay, at Shaw's Bluff, south of the Meredith River, is diabase, which re-appears on the east side at Hepburn's Point and Buckley's homestead, and joins the granite half a mile east of the point. Dr. Milligan also mentions a greenstone vein, running nearly N. and S. along the ridge of one of the granite mountains, near Wineglass Bay.

Schouten Main is the name used for that part of the mainland which is at the head of Freycinet's Peninsula, and consists of granite, with the exception of some Silurian metamorphic sandstone on the crest and east slope of the hill overlooking Bluestone Bay and the diabase which I have mentioned. There is also some Tertiary sandstone between Buckley's and Gill's. The granite is variable in character, being sometimes the even-grained pink biotite (dark mica) granite of Mount Cameron; sometimes the coarse grey pseudo-porphyritic granite of the Blue Tier; sometimes a fine red-grained variety, like that occurring in the pebble-beds of the Mesozoic sandstones. At one place it merges into a quartzless variety, containing augite (augite syenite), called locally "green granite" (at Charlie's Creek.) In all its numerous modifications it is, geologically, one and the same, a part of the huge mountain mass of Devonian age, which forms the bulk of Freycinet's Peninsula.

Prospectors at one time or another have gone through the Peninsula searching for tin, gold, and coal, and on Schouten Main it is estimated that as much as 150 tons alluvial tin ore have been won. This tin, it is conjectured, must have been shed from reefs, and these reefs or lodes have been diligently sought for, though it must be said that no great amount of money has been expended in the search. It is, of course, quite possible that large lodes exist in the granite, and have eluded discovery hitherto; but my observations led me to refer the alluvial ore to two

sources, which would be quite efficient distributors. These are—

1. Small quartz veins enclosing coarse tin.
2. Greisenised bands of granite containing small quantities of ore.

In the course of ages the degradation of the granite would account for the release of more tin than has been recovered, without the aid of any large reefs. These large reefs, I believe, are visionary.

I inspected Gill's sections, comprising two 80-acre blocks and a prospecting area of 370 acres, west of Bluestone Bay. A large flat west of the sections yielded a good deal of the alluvial tin referred to above. Another flat is just on the boundary-line between the two sections. The alluvial tin there was found 25 years ago, and was worked first by Messrs. Gill, Mayson, Gemmell, Glover, and Jack. The wash on the 80-acre block is from 1 to 2 feet deep, and has given from 3 ozs. to ½ lb. to the dish, a ton of ore having been once extracted from a space of three square yards. The tin is mostly ruby and resin, rarely black, and the crystals are not much rounded. The quality is good, some of it having gone as high as 75 per cent. The last return was 72·2 per cent. The two Koglins and party worked on these flats in 1875–7. It is considered they left all the wash which returned only one or two ounces per dish; and those who have watched the history of the work here believe that there is as much tin still in the drift as has come out of it. The flat between the two sections ought to yield something, provided water could be got to give pressure enough for a nozzle. This should be looked into.

I may mention as a matter of scientific interest, that the wash here adds one more to the list of localities where buttons of volcanic glass (obsidian) have been found. Some were discovered by Mr. Bingham in the tin-wash, 3 or 4 feet deep.

The country-rock is a pink to white or grey granite, with a little dark mica in it. In the granite is a greisenised zone, running through both sections in a north-westerly direction. Within this zone are bands of rock, from which the felspar has mostly disappeared, leaving a quartz-mica rock slightly chloritised by the decomposition of the

original dark mica, which has given place to silvery muscovite. The rock in this form is a tin granite, such as characterises the large stanniferous formations at the Blue Tier (formerly called quartz-porphyry), and is identical with the tin-bearing stone of the Anchor, Liberator, and Australian mines. There are five parallel exposures or outcrops in a belt of 700 or 800 feet wide.

No. 1 has been worked upon by a long trench and a shaft about 15 feet deep. The stanniferous band of country is here 50 to 60 feet wide, carrying thin greisen veins. The boundary of the belt on each side is dark mica granite. The shaft sunk N.W. of this trench is in the tin granite formation, which is intersected by vertical quartz veins. The jointing of the formation is in the direction of the extension of the zone, N. 30° W. The samples which I took from the stone in the shaft did not yield any tin when assayed by the Government Analyst, but in September, 1899, the Government assay showed traces of tin and copper in stone from the bottom of the shaft; also 3 per cent. tin from a bunch of ore in the trench; and from a leader below, 1·6 per cent. metallic tin. There is an increase of pyrites towards the bottom of the shaft, and the latter is to be sunk a few feet further, to see whether the improved mineralisation means anything.

On the northern section, to the N.E. of the works just alluded to, a cut has been made into tin granite (greenish mica-quartz rock), called No. 4 lode. This greisen is exposed at surface about 1 ft. wide, and goes down in a series of bands. In the side of the cut a dab of rich tin ore was met with, and I was told that a little had also been found in the bottom. Mr. J. S. MacArthur (Glasgow) reports the assay of the good ore from here as 6·31 per cent. tin. I picked up a piece from the pile at surface, which Mr. W. F. Ward, Government Analyst, has assayed. It yielded 4·6 per cent. metallic tin. This, however, must not be taken as a representative sample. It only shows what can be found sporadically. Further samples which I took from the pile were assayed by Mr. Ward and yielded 1·2 per cent. metallic tin. This little pile contains the remainder of the patch of ore, but I could find no tin in the face. As tree roots penetrate the formation to nearly the bottom of the cut, care should be taken in sampling

not to include the soft material between the joints. This cutting will be advanced a little further under the cover to see whether the tin found in the bottom continues.

No 5, higher up the hill, towards the north boundary of section, is an outcrop consisting of granite with bands of greisen. This appears to be on the strike of a long tourmaline joint further south. It is on a small knoll of granite boulders. No tin is visible in the stone, and none was obtained therefrom by assay. This line of stone has been traced a few chains north and south.

Still higher up the hill a greisen vein occurs in granite, composed of coarsely crystalline quartz, large flakes of muscovite, lithia mica, and tourmaline. A width of 18 inches is exposed, but a shot or two would uncover the whole for better examination. The samples which I brought away, however, on assay in the Government laboratories, returned no tin. The vein runs in a northerly direction in pink granite, with very little dark mica in it.

Still ascending the hill to the Pimple, 600 feet above sea-level, the crest is reached on Section 4779-93M, 37 acres, A. Dilger, where, overlooking the sea, the Swansea Prospecting Association has opened a hole about 7 feet deep, in soft granite rock veined with quartz and greisen. The felspars are becoming chloritised, and a little tourmaline is visible, enclosed in the mica. This is on the strike of the Gill outcrops. The samples which I took from here, upon assay, did not return any tin.

S.E. of Gill's south section is an area of dark brown metamorphic sandstone of nearly a square mile in extent, overhanging Bluestone Bay. As nuggets of gold have been picked up on the slope above the mine, it has been surmised that the sandstone formation may have been the source. These nuggets are sometimes in crescentic forms $\frac{1}{2}$" diameter, and in pellets like wheat grains. It is possible that some reef is still undiscovered in this sandstone, for it is a Silurian rock anterior to the granite, which has impregnated it with mica.

Gill's sections are to be further prospected. I think the large tin is likely to have come from quartz veins in the granite, but these ought not to be reckoned upon as a source of supply. The future of the property depends upon whether the greisen zone will pay to work open face, passing the whole of the stone through the battery. No

doubt, enriched portions exist here and there, but these will probably be found too limited in extent, and too far apart to be worked profitably. The whole formation will have to be worked as it stands, or be left alone. It would be comparatively easy to put in a cut right across the zone, and find out its extent and limits. Then bulk-sampling must be undertaken, and the average tin contents ascertained. It must be borne in mind that this is a low-grade proposition, and I cannot report more definitely about it until the necessary work is done to provide data for conclusions. I was told that 700 feet of backs could be got in 700 feet of driving-in from the sea coast, if a convenient place for starting a tunnel could be found on the shore-line. Without endorsing the precise height, I have no doubt the figure is not far out, but I do not believe that underground mining will pay in this ground, unless a strong lode be discovered.

I am not at all sure as to the water supply, but some could be got by damming the large flat to the W., once it is worked, and a machinery site could be selected below, about a mile from the present workings. For working on a large scale the water question will form a difficulty. Cole's Bay is 2½ miles south in a direct line.

Bernacchi's Gold Quartz Reef.—From Gill's sections I walked two miles north along the granite range overlooking the sea to Bernacchi's reef, on the sea coast, E. of Fresh Water Lagoon. This was discovered about 23 years ago, when a trial crushing of half a ton in Melbourne is reported variously as returning 13 dwts. and 17 dwts. gold per ton. From the source of information I have reason to believe the former figure is the more reliable. Mr. C. J. Ramsay, of the Morning Star Company, reported, 10th May, 1898, having got out a ton of stone for a trial crushing, but I believe it was not treated. Samples which I took, and which have been assayed by the Government Analyst, yielded only a minute trace of gold; but a battery test is the only fair way of arriving at an idea of the value of the stone.

The reef crops out at sea-level, where a short drive on its course has been put into the cliff. It is a solid reef of laminated quartz, 12 inches to 14 inches wide, white, and mottled green. A two-inch selvage occurs on the foot-

wall, another on the hanging-wall. The dip or underlie is 75° to the S.W. The country-rock is coarse dark-mica granite, pink in tint. On the footwall side of the lode there is a narrow band of dark, slate-like, granitic wall-rock, gradually altering to normal country granite a few yards away from the lode.

I saw no pyrites in the stone. I am afraid the reef is one of those which carry no payable mineral at the outcrop. Next to no work has been done on it, and it is in an awkward position for working.

On the saddle of the hill to the S., I observed water-worn pebbles of dark sedimentary rock scattered over the surface of the ground. I can only surmise that these have been derived from slate country to the N. Further south a well-defined hard elvan crosses the granite hill. This is a dyke of typical elvan or granite porphyry, rich in potash mica (muscovite). The rock is a compact, fine-grained admixture of quartz, mica, and felspar, with porphyritic crystals and nests of crystals of quartz and felspar. It contains no mineral.

Jack's Reef.—This is a veiny quartz reef in granite country, between Gill's and Buckley's, on Crown land. It was opened upon six years ago by a 7-feet cut, exposing a vertical face. The exposed width is 11 feet. It has not been tested hitherto for gold or tin. The samples which I took have been assayed by the Government Analyst, and returned a minute trace of gold—no tin.

The Boulder.—About a quarter mile further W. is an isolated boulder of quartz, which has excited much interest and curiosity in the district. It is a block of clean quartz, lying in a clayey, pebbly, and quartz wash. The valley is 250 feet above sea-level, and is apparently eroded in cemented Tertiary sand, bluffs of which are exposed in massive beds, 20 feet thick, a little distance to the west of the boulder. The boulder itself is 6 feet × 5 feet × 4 feet is a little smoothed by the action of water, and is composed of dense pinkish quartz, with here and there excessively finely divided pyrites. The ground around it has been excavated, and this shows that it is not *in situ*, but where it has come from can only be conjectured. It has most probably been derived from some reef in granite,

country, judging by the rather peculiar appearance of the quartz. It may have been imbedded in the wash while the latter was being deposited. This view removes all difficulty as to its transport, for though the sand bluffs are now 250 to 300 feet above the sea, they were at sea-level at that time, and the granite peaks of the Peninsula would still be high above the deposit. Some stones of slate and sandstone are found in the wash or in the surface soil, but these have no particular bearing on the question.

It was found 25 years ago by Mr. Gemmell, and half a ton of it was assayed in Ballarat, for 9 dwts. gold per ton. A trial like this is more satisfactory than the assay of the few samples taken by myself, which the Government Analyst reports did not contain any gold. As it is an individual boulder only, its occurrence is not important, unless it can be identified with its parent reef, which is probably not far off. The configuration of the country at the time it was deposited was different from what it is now; hence search for the reef on the hillside immediately above the boulder may be quite fruitless.

Some iron ore not far from Buckley's is of doubtful origin; that is, whether it be veinstone, or merely concretionary, like so much of the ironstone at the head of the bay. An assay of it by the Government Analyst showed that its contents in precious metals were *nil.*

Schouten Main Mining and Dredging Co.'s Claim.—I visited these properties comprising 4 dredging leases, of 39 acres each, and a mining lease of 20 acres, as follows:—D.C. 235, 39a. 3r. 9p.; D.C. 236, 39a. 3r. 9p.; D.C. 208, 39a. 3r. 29p.; D.C. 209, 38a. 2r. 31p.; 93M. 4387, 20a.

These are on the Saltwater Creek, on Schouten Main. There is a connection by track both to Buckley's, at Hepburn's Point, 2½ miles, and to Cole's Bay, 1½ miles, originally called Meredith's Fishery Bay.

The lower part of the claim is a flat, through which the small Saltwater Creek meanders sluggishly, the ground being full of nearly dead water. The banks of the creek show wash under 2 feet of soil. The part of the flat taken in by the claim is 5 chains on each side of the creek, which in this part of its course flows W. The

plain is bounded N. and S. by low granite hills, strewn with sea-sand. In the western portion of this flat four holes have been put down to a depth of 10 feet, the first 4 or 5 feet being in sand, the rest in a wash of small gravel. As far as I could learn, the drift in this part of the property did not show much tin : on the other hand, the holes did not go down to bedrock, on account of the water. The wash has been invaded by the sea, and what tin there is is much finer than in the upper part of the property.

Where the creek changes its course from N.—S, there is a small shallow lagoon, in which a dozen bores have been put down 15 to 20 feet, bottoming on soft granite. I was told that the same quality of wash was met with as that shown in the tin-bearing shafts further north.

Going up the creek from the lagoon northwards, the valley between the hills contracts, and the drift channel north of the camp on the 20-acre section does not exceed a chain in width. Still further north it pinches to about half a chain, widening out again finally to about 4 chains.

For about a mile up the creek from the lagoon a series of 30 holes and small shafts have been sunk to test the ground, which, on the whole, has been well prospected, the intention evidently having been to find out what it is really worth. The first hole is a chain east of the lagoon. It is down 6 feet in sea-sand, and shows a little gravel in the bottom. No. 2 shaft, a little further north, is 12 feet down, with an 8-feet borehole in the bottom. A sand and-quartz wash was touched at 3 feet below the soil. No. 3 shaft, to the north, is down about 20 feet in sea sand of granitic nature, and has bottomed on granite. Prospects from this sand, assayed by the Government Analyst, yielded 44 grains metallic tin per dish = 0·042 per cent = about $\frac{1}{10}$ oz. per dish, or $\frac{1}{2}$ lb. to the cubic yard. No. 4 shaft has been sunk 20 feet, and has not bottomed. The wash is here about 3 chains wide, and the gutter seems to be close to the hillside on the west, which rises steeply. No. 5 shaft is sunk 12 feet, and has not reached bedrock. This shaft is near the camp. The wash appears to improve going north. The prospects taken were assayed in the Government Laboratories, and returned 113 grains metallic tin per dish = 0·107 per cent. = say nearly $\frac{1}{4}$ oz. per dish, or $1\frac{1}{4}$ lbs. to the cubic yard. A shaft N. of the

camp bottomed at 10 feet, where the channel of wash is not more than a chain wide.

Further north a trench has been cut down to the bedrock a couple of feet in wash, here one chain wide, contracting to half a chain, and of good tin-bearing quality. The prospects washed yielded, on assay by the Government Analyst, 596 grains metallic tin per dish = 0·57 per cent. = say, $1\frac{1}{3}$ ozs. per dish, or $6\frac{2}{3}$ lbs. to the cubic yard.

The granite hills come, here, close together, with not more than $1\frac{1}{2}$ chains of alluvial between them. This, then, widens out to three chains, and acquires a stripping or overburden of seven or eight feet. An outcrop of quartz occurs here, running W. of N., and its course, parallel with the new direction of the creek, is marked by loose fragments of quartz. Prospecting holes have been put down, one in seven feet of wash, said to be worth half an ounce to the dish, and another through six feet of stripping into four feet of wash, estimated at 4 ozs. to the dish. The expanding alluvial ground has here formed a kind of basin, an ideal position for dredging. Some former prospectors worked in this part of the ground, but no record of their success or otherwise is available. The ground now pinches to almost nothing, and this seems to me the only place where there might be any difficulty in passing the dredge. This part of the claim may be taken as consisting of 10 to 12 feet of stripping and two to three feet of wash, as proved by a line of bores across the valley. The tin gets heavier as the head of the valley is approached.

Further N., where the ground is about two chains wide, shaft No. 7 has been sunk 12 feet, with four feet of wash at bottom, very wet. The prospects taken here, assayed by the Government Analyst, returned 408 grains metal c tin per dish = 0·39 per cent. = say, $\frac{9}{10}$ oz. per dish = $4\frac{1}{2}$ lbs. to the cubic yard. The width of the alluvial pinches again.

At the northern end of the claims the stripping is six feet, and overlies four feet of wash, which contains a few stones of quartz. The creek forks at this place, and the ground is between three and four chains wide, and the prospects taken (No. 8) were the best of any. The results of assay by the Government Analyst are 778 grains metallic tin per dish = 0·74 per cent. = over $1\frac{3}{4}$ ozs. per

dish, or nearly 9 lbs. to the cubic yard. This situation is, of course, the nearest to the assumed source of the tin, and the yield is, consequently, rather exceptional.

The prospects taken were selected for the purpose of gaining a general idea of the nature of the wash, and not for forming an accurate estimate of the value of the whole deposit. The latter would require systematic sampling from holes sunk regularly in lines across the flat at fixed intervals, and average prospects from fixed horizons in the deposit. Still, they afford some notion of the capabilities of the drift. The average of the places from which my prospects were taken gives 5¼ lbs. metallic tin per cubic yard; but I consider it unsafe to include the higher values of 6 lbs. and 9 lbs. to the yard at more than the average of the remainder, which is 2 lbs. metallic tin, or 2·86 lbs. tin ore (at 70 per cent.) per cubic yard. This estimate does not fall far short of that put forward by the promoters, who reckon upon 3 lbs. tin ore per cubic yard. I cannot speak with any certainty about the ground in the lower part of the claim, as the wash there was inaccessible. Taking the ground all through, I should think a width of two chains is a fair average, and the depth is, as may be seen from my remarks, variable from two to 20 feet of sand and wash. The promoters estimate the average as 12 feet. I think this is too high an estimate for the 2 lbs. a yard quality material. The edges of the formation have to be taken into consideration, and not the deepest parts only. The mean thickness of the payable part of the wash can only be ascertained by careful trials.

The proposition is a fair one for a moderate-sized company. The only way of dealing with the ground is by dredging. A bucket-dredge is mentioned in the prospectus, but, from the nature of the flat, I doubt whether a pump will not be found more suitable. Dredging is now carried on in flats, where it would not have been dreamed of some years ago. The proprietors will need the very best expert advice before embarking on the enterprise, for tin-saving is more difficult than gold-saving, and the failures of attempts at dredging in Tasmania hitherto suggest that some general difficulty exists which has not been sufficiently realised. Apart from the quality of the material handled, I think insufficiency in quantity has been the rock on which most of our recent undertakings have

struck. With good advice and ordinary care, the tin ought to be extracted from these claims profitably.

Quartz Country at Cutting-grass Marsh, near Buckland.

Cutting-grass Marsh is a marshy flat of 80 or 90 acres, about nine miles N.W. of Buckland, about 900 feet above sea-level. It lies just east of Woodsdale Bluff, called Bluff Hill. The treeless marsh-soil consists of humus and sand-grains resting on sandstone, knolls of which protrude a little from the plain. Hills of the same sandstone surround the marshy ground. There are no fossils to guide in the determination of the horizon of the strata: as the stone is not felspathic, it may belong either to the Lower Mesozoic or the Permo-Carboniferous. In the flat there is an outcrop of cellular iron ore, about three or four feet wide, which can be traced at intervals through the paddock in a direction S.E.—N.W. It has not been opened upon sufficiently to disclose what it really is, but, from the stone occurring in the paddock on the strike, I am inclined to think that it is simply a band of iron oxide in the sandstone, due, probably, to the influence of adjacent igneous rock (diabase). No gold was found in the stone when assayed in the Government laboratories, and the occurrence does not differ essentially from similar outcrops in the Swansea area. It has no value as a carrier of economic ores.

On the north side of the marsh there is a hill range, 300 feet high, on the summit of which is a trench, 10 feet deep, which has been cut down into a band of broken quartz and sandstone, about 10 feet wide, on a face of quartz which appears to be the south wall of a reef. The reef itself has not been cut into nor fully exposed. A few fathoms to the west a shaft has gone down 15 or 20 feet in a broken quartz formation, but it appeared to me a little too far south to catch the reef. The samples of quartz which I took have been assayed by Mr. W. F. Ward, Government Analyst, but returned no gold. The sandstone is a yellow quartzose variety. A few years ago some four or five men worked here for Mr. Goodwin, and gold in small quantities was reported. Since then

prospects have been taken repeatedly without results. There are very likely parallel veins in the neighbourhood, as the hill to the north is also strewn with pieces of quartz. The quartz of this occurrence has an unfavourable vitreous appearance, with a tendency to be lumpy, and altogether different from the dull, mottled, massive stone of our gold quartz reefs. A little specular iron is present in the brown oxidised matter. The age of this sandstone is much later than that of the auriferous quartz reefs in the Silurian slates of the State; and the deposition of the quartz was, probably, in infiltration veins, confined to the sandstone strata. I saw some samples of quartz from French's show, three miles east of this. Some of it is radiating, mammillary, and chalcedonic quartz, of a resinous appearance; just the sort of silica which might be expected to be derived by infiltration from the surrounding rock.

Of course, the above reef has not been properly broken into, but I have little faith in it as a gold-producer, as its silica cannot have been directly expelled from the granite, which had already cooled, and even been exposed by denudation before these sandstones existed. The sandstones themselves consist of material derived from the waste of the granite hills. If gold has ever been found in this quartz, it would only be in infinitesimal quantities derived from the sandstones, which had collected it from the waste of older hills.

I have very little doubt that the diabase exists at no great depth below this freestone basin, though the nearest exposure of it which I saw was at Johnny Mac's cutting, between Mr. Jas. Cornish's farm, on the Marsh, and Buckland.

The chart accompanying this Report is a sketch map of the geology of the district. The part referring to the country N. and S. of Swansea and Schouten Main embodies my own observation; the features of the Peninsula and Schouten Island are from the best information which I could gather.

Appendices I. to V. are official Registers of the bores put down at and near Seymour by the Government, in 1888.

Appendix VI. is a tabular statement of analysis of coal referred to in the present Report, and of other Mesozoic

coals in Tasmania, together with analyses of Newcastle coal, New South Wales and England, for comparison.

I have to tender my best thanks to many gentlemen in the Swansea district for help and information, and to all who formed the Committee for facilitating my examination, especially to Mr. E. O. Cotton, Mr. F. M. Gill, Mr. J. H. Jessen, and Mr. Jas. Lyne, who accompanied me, and Mr. A. Threlkeld Mason, who amassed a great deal of useful information for me.

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

W. H. TWELVETREES,
Government Geologist.

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

Appendix I.

Seymour No. 1 bore, total depth 169 feet 5½ inches.

1888.

	STRATA. ft.	ins.	TOTAL. ft.	ins.
Surface soil and clay	5	2	5	2
Yellow sandstone	3	0	8	2
Green sandstone	3	0	11	2
Iron stone	0	2	11	4
Grey and yellow sandstone ...	8	4	19	8
Dark shale, hard and brittle .	3	1	22	9
Bastard fireclay	1	10	24	7
Coal and black clod	0	4	24	11
Light bastard fireclay	1	1½	26	0½
Coal	1	1½	27	2
Band	0	1	27	3
Coal	0	1	27	4
Band	0	2½	27	6½
Coal	0	1½	27	8
Band	0	0½	27	8½
Coal	0	3	27	11½
Band	0	1	28	0½
Coal	0	0¾	28	1¼
Band	0	0¾	28	2
Coal	0	4	28	6
Band, very dark	0	1½	28	7½
Coal, very brittle	1	11½	30	7
Band	0	3	30	10
White fireclay...	2	2	33	0
Bastard fireclay	5	6	38	6
Coal	0	2	38	8
Bastard fireclay	5	2	43	10
Sandy seam	0	3	44	1
Bastard fireclay	2	2	46	3
Hard blue shale	0	11	47	2
Coal	0	2	47	4
Bastard fireclay	3	1½	50	5½
Black clod	5	2	55	7½
Sandstone and blue post... ...	24	11	80	6½
Hard sandstone	2	0	82	6½
Blue shale	1	1	83	7½
Coal and shale...	1	4½	85	0

	STRATA. ft.	ins.	TOTAL. ft.	ins.
Soft greasy shale...	1	2½	86	2½
Blue shale	2	6	88	8½
Sandstone	3	4	92	0½
Hard sandstone	1	0	93	0½
Blue shale	3	4	96	4½
Coal	0	2	96	6½
Band	0	1	96	7½
Coal and clod...	0	3½	96	11
Black clod...	5	1	102	0
Dark shale...	2	11	104	11
Light shale...	0	10	105	9
Dark sandstone...	1	8	107	5
Sandstone	31	0	138	5
Coal	0	2	138	7
Firm sandstone	5	6½	144	1½
Dark hard stone	0	2	144	3½
Coal	1	5	145	8½
Band	0	1½	145	10
Coal	1	6½	147	4½
Dark grey shale	1	6½	143	11
Sandstone showing coal stains	3	7	152	6
Sandstone	1	6	154	0
Firm blue shale	6	9	160	9
Coal	0	3	161	0
Brown shale	0	5	161	5
Light firm shale	3	4	164	9
Coal	0	2½	164	11½
Black clod and dark stone...	0	7½	165	7
Black shale...	1	5½	167	0½
Light shale	0	6	167	6½
Dark shale	0	5½	168	0
Coal	1	0½	169	0½
Hard floor	0	5	169	5½

Appendix II.

Seymour No. 2 bore, total depth 308 feet 3½ inches.

1888.

	STRATA. ft.	ins.	TOTAL. ft.	ins.
Surface soil and boulders ...	4	6	4	6
Sandstone	31	5	35	11
Hard shale	1	0	36	11
Fine-grained sandstone	3	5	40	4
Hard shale, full of coal marks	0	6	40	10
Fine-grained sandstone	11	1	51	11
Sandstone and conglomerate of hard shale and sandstone	19	8	71	7
Free-boring sandstone	25	10	97	5
Dark shale	3	7	101	0
Coal	0	6	101	6
Band	0	1¾	101	7¾
Coal	0	10	102	5¾
Band	0	1	102	6¾
Coal	0	1½	102	8¼
White parting	0	0⅛	102	8⅜
Coal	0	4⅛	103	0½
Band	0	2½	103	3
Coal	0	2½	103	5½
Coal, with white parting... ...	0	1	103	6½
Coal, with a few thin bands...	0	10½	104	5
White band...	0	1¼	104	6¼
Black band	0	2½	104	8¾
Coal, with thin bands...	0	9½	105	6¼
Coal	1	5	106	11¼
Light band	0	0½	106	11¾
Coal	0	1	107	0¾
Band	0	1	107	1¾
Coal	0	1	107	2¾
Floor	2	8	109	10¾
Firm shale	2	11	112	9¾
Coal	0	2	112	11¾
Brown sandy shale	3	8	116	7¾
Firm, light, sandy shale	4	1¾	120	9½
Sandy shale, full of coal-stains	1	6	122	3½
Coal	0	1	122	4½
Firm light shale	3	8	126	0½
Dark hard shale...	1	0	127	0½

	STRATA. ft.	ins.	TOTAL. ft.	ins.
Light and dark shale, alternate layers	4	2½	131	3
Sandstone, full of coal-stains	4	5	135	8
Blue post and sandstone	20	0	155	8
Sandstone	6	2½	161	10½
Blue post	0	8½	162	7
Firm dark sandy shale	1	6	164	1
Coal	0	4	164	5
Sandstone, full of coal-stains	2	5	166	10
Black shale, showing fern impressions	1	0	167	10
Dark sandstone	1	2	169	0
Black shale	3	0	172	0
Firm sandstone	2	5½	174	5½
Coal	0	1	174	6½
Brown band	0	2	174	8½
Coal	0	1½	174	10
Black shale, with two thin seams of coal	5	6	180	4
Sandstone, full of coal-stains	1	4	181	8
Very firm grey sandstone	2	0	183	8
Clean sandstone	23	11	207	7
White hard sandstone (showing carboniferous matter)	4	5	212	0
Very hard dark shale	8	6	220	6
Hard dark sandstone, with coal seams	1	6	222	0
Conglomerate, coal, shale, and sandstone	1	11	223	11
Conglomerate	1	2	225	1
Black shale	2	10	227	11
Dark sandstone	2	0	229	11
Conglomerate	0	4	230	3
Coal	0	1	230	4
Dark sandstone	1	1½	231	5½
Coal	3	0	234	5½
Band of grey parting	0	0¼	234	5¾
Coal	0	9	235	2¾
Soft dark greasy band	0	0¼	235	3
Coal	0	4	235	7
Very firm sandstone	0	10½	236	5½
Dark shale	1	0	237	5½
Dark sandstone	2	7½	240	1
Light sandstone, with coal-stains	2	0	242	1

	STRATA. ft.	ins.	TOTAL. ft.	ins.
Blue shale	3	3	245	4
Bastard fireclay	8	1	253	5
Dark shale	2	0	255	5
Coal	0	0½	255	5½
Black shale	0	8	256	1½
Coal, with three bands	1	3	257	4½
Black shale	1	6	258	10½
Light sandy shale	2	6	261	4½
Black shale	0	10	262	2½
Sandstone	1	0	263	2½
Grey sandstone	5	7	268	9½
Dark sandstone	1	9	270	6½
Dark shale	0	10	271	4½
Bastard fireclay	0	11	272	3½
Dark sandstone	2	4	274	7½
Coal	0	2	274	9½
Sandstone	2	10	277	7½
Coal	0	2	277	9½
Sandstone	0	8	278	5½
Firm blue sandy shale	5	6	283	11½
Dark shale	1	0	284	11½
Sandstone	0	10	285	9½
Dark shale	1	7	287	4½
Hard coarse sandstone	0	4	287	8½
Blue shale	2	4	290	0½
Dark shale	1	2½	291	3
Conglomerate	1	4	292	7
Very hard light shale	2	10½	295	5½
Mud shale, with pebbles	12	10	308	3½

Appendix III.

Seymour No. 3 bore, total depth 247 feet 1¾ inches.

	ft.	ins.	ft.	ins.
Surface soil and loam	1	6	1	6
Clay	10	6	12	0
Decomposed sandstone	1	0	13	0
Sandstone	53	3	66	3
Blue shale	4	0	70	3
Sandstone	1	6	71	9
Dark shale	3	1	74	10
Dark and light shales	4	4	79	2
Coal	0	0½	79	2½

	STRATA. ft.	ins.	TOTAL. ft.	ins.
Band	0	2¼	79	4¾
Coal	0	5½	79	10¼
Coal and bands	0	3¼	80	1½
Coal	0	4	80	5½
White parting	0	0¼	80	5¾
Coal	0	4¼	80	10
Coal and bands	0	6¼	81	4¼
Coal	0	5¼	81	9½
White band	0	1	81	10½
Coal	0	0½	81	11
White band	0	0½	81	11½
Black band	0	1¼	82	0¾
Coal	0	1	82	1¾
Dark band	0	4¾	82	6½
Coal and white parting	0	1¼	82	7¾
Coal and white parting	0	0½	82	8¼
Coal and white parting	1	8	84	4¼
Band	0	2½	84	6¾
Coal	0	0½	84	7¼
Band	0	0½	84	7¾
Fireclay	0	8	85	3¾
Sandy fireclay	2	10	88	1¾
Bastard fireclay	1	4	89	5¾
Coal	0	2	89	7¾
Fireclay	4	6	94	1¾
Light sandy shale	4	4	98	5¾
Dark sandy shale	0	4	98	9¾
Blue shale	6	9	105	6¾
Dark shale	1	10	107	4¾
Dark stained sandstone	4	1	111	5¾
Clean sandstone	8	2	119	7¾
Sandstone and post	13	4½	133	0¼
Shale	2	11	135	11¼
Light sandstone full of coal seams	0	9	136	8¼
Blue shale	5	4	142	0¼
Black hard shale	1	1	143	1¼
Dark stained sandstone	4	7	147	8¼
Dark and blue shales	3	1	150	9¼
Hard dark brittle shale	3	1	153	10¼
Dark sandstone	1	5	155	3¼
Clean sandstone	3	5	158	8¼
Clean firm sandstone	10	8	169	4¼
Firm grey sandstone	14	4½	183	8¾
Dark shale	5	0	188	8¾

	STRATA. ft.	ins.	TOTAL. ft.	ins.
Sandstone	0	4½	189	1¼
Coal	0	2	189	3¼
Shale	0	8½	189	11¾
Coal	0	0½	190	0¼
Blue shale	0	6	190	6¼
Sandstone	0	6	191	0¼
Shale	1	1	192	1¼
Sandstone	1	6	193	7¼
Shale	0	10	194	5¼
Coal	0	6½	194	11¾
Sandstone	1	5	196	4¾
Dark shale	0	10½	197	3¼
Mottled shale	0	7	197	10¼
Coal	0	1	197	11¼
Band	0	1	198	0¼
Coal and shale	0	2	198	2¼
Dark shale	0	3	198	5¼
Coal	2	6½	200	11¾
Band	0	3	201	2¾
Black bass	0	2½	201	5¼
Coal	0	3½	201	8¾
Shales, mottled and dark	4	2	205	10¾
Fine-grained sandstone, very hard	3	6	209	4¾
Light blue shale, very firm	2	11	212	3¾
Very hard white shale	0	7	212	10¾
Coal, poor quality	0	11	213	9¾
Very hard black shale	0	10	214	7¾
Light shale	0	2	215	9¾
Coal	0	5½	216	3¼
Shale	1	4	217	7¼
Coal	0	1	217	8¼
Very hard black shale	0	4	218	0¼
Coal	0	1	218	1¼
Sandy shale	4	0	222	1¼
Firm sandstone	3	11	226	0¼
Shale	0	7	226	7¼
Black shale and coal	0	9	227	4¼
Light sandy shale	3	3½	230	7¾
Black shale and coal	0	6	231	1¾
Sandy shale	1	4	232	5¾
Dark mottled shale	0	6	232	11¾
Dark shale	0	2	233	1¾
Hard grey sandstone	8	4	241	5¾
Greenstone	5	8	247	1¾

Appendix IV.

Seymour No. 4 bore; total depth, 892ft. 3in.

1888.	STRATA. ft.	ins.	TOTAL. ft.	ins.
Surface clay and drift	5	0	5	0
Yellow and grey sandstone	3	4	8	4
Hard black shale	0	4	8	8
Grey sandstone with coal stains	33	1	41	9
Hard dark curly shale	1	3	43	0
Conglomerate	3	8	36	8
Hard dark brittle conglomerate	4	0	50	8
Hard curly shale	0	8	51	4
Sandstone with coal stains	2	10	54	2
Conglomerate	1	7	55	9
Clean sandstone	40	9	96	6
Conglomerate, shale and sandstone	2	3	98	9
Sandstone	11	3	110	0
Blue shale	5	3½	115	3½
Black shale	2	7	117	10½
Blue greasy shale	1	4	119	2½
Sandy shale and bastard fireclay	14	7½	133	10
Sandstone	1	0	134	10
Black shale and coal	1	5½	136	3½
Coal and bands	0	9½	137	1
Fine-grained sandstone	1	2	138	3
Shale and bastard fireclay	4	8	142	11
Coal	0	2	143	1
Brown sandy shale	1	5	144	6
Sandy shale	7	5½	151	11½
Black shale	0	3	152	2½
Coal	0	1	152	3½
Blue shale	5	3	157	6½
Dark shale	1	1	158	7½
Sandstone, coal-stained	7	8	166	3½
Sandstone and post	6	9	173	0½
Sandstone	2	1	175	1½
Grey post	12	8	187	9½
Blue shale	6	1½	193	11
Black clod	0	1	194	0
Coal	0	6	194	6
Black shale	3	8	198	2
Sandstone, coal-stained	0	11	199	1

1888.	STRATA. ft.	ins.	TOTAL. ft.	ins.
Blue shale	0	9	199	10
Sandstone	0	11	200	9
Blue shale	2	7	203	4
Sandstone, coal-stained	4	3	207	7
Black shale	2	4	209	11
Dark sandstone	9	0	218	11
Clean sandstone	18	6	237	5
Firm sandy shale	1	6	238	11
Blue shale	1	6	240	5
Shale, with ½ inch of coal	9	6	249	11
Mottled shale and coal seams	1	2	251	1
Brown shale	2	3	253	4
Hard blue shale	1	6	254	10
Conglomerate	5	4½	260	2½
Dark shale	0	5	260	7½
Coal	0	2	260	9½
Conglomerate	2	6	263	3½
Coal	1	5	264	8½
Brown shale	1	8	266	4½
Conglomerate	3	5	269	9½
Black shale and coal	0	3½	270	1
Blue sandy shale	1	9	271	10
Fine-grained sandstone	3	7	275	5
Blue shale	1	4	276	9
Coal	0	0½	276	9½
Dark blue shale	2	8	279	5½
Coa	1	8	281	1½
Coal, showing grey matter	0	1½	281	3
Coal	0	8	281	11
Soft black stone	0	1½	282	0½
White band	0	0½	282	1
Coal, bright	0	2	282	3
Band ½ in., coal ½ in.	0	1	282	4
Dark and blue shale	8	0	290	4
Bastard fireclay	2	0	292	4
Coal	0	0½	292	4½
Dark and blue shale	10	6	302	10½
Grey sandstone, very jointy	5	0	307	10½
White sandstone	3	0	310	10½
Conglomerate, spotted with pyrites	3	6	314	4½
Green sandstone	9	0	323	41½
Pebbles and veins of carbonate of lime	2	3½	325	8
Conglomerate, with pebbles	5	2	330	10
Grey sandstone	5	3	336	1
Shale, coal-stained	0	10	336	11

1888	STRATA. ft.	ins	TOTAL. ft.	ins.
Sandstone, coal-stained	4	0	340	11
Conglomerate	1	0	341	11
Firm mud shale, with pebbles, some quartz	12	4½	354	3½
Fireclay	0	5	354	8½
Mud shale, traces of coal	10	4½	365	1
Mud shale, no traces of coal	20	1½	385	2½
Mud shale, minute fossils	77	6½	462	9
Green sandstone, with pebbles	22	10	485	7
Limestone, fossils	9	9	495	4
Rock, like granite	0	10	496	2
Hard limestone, fossils	123	3	619	5
Blue limestone	125	10	745	3
Fine-grained sandstone	42	8½	787	11½
Sandstone shale and conglomerate	16	8½	804	8
Shale and conglomerate	2	3	806	11
Coarse-grained sandstone, few coal markings	9	6	816	5
Very coarse sandstone, patches conglomerate, no coal marks	20	10½	837	3½
Conglomerate and rotten granite boulders	54	11½	892	3

Appendix V.

Seymour No. 5 bore; Douglas River; total depth, 645ft. 1¼in.

1888.	STRATA. ft.	ins.	TOTAL. ft.	ins.
Surface shaft	44	0	44	0
Sandstone and clay	11	6	55	6
Sandstone and black clod	7	6	63	0
Clod and hard brittle shale	12	0	75	0
Light sandy shale	17	0	92	0
Fine-grained sandstone	4	9	96	9
Coal, inferior quality	0	5	97	2
Light shale	20	7	117	9
Fine-grained sandstone	14	3	132	0
Shale	6	7	138	7
Free-boring sandstone, showing thin coal pipes	33	1	171	8
Dark shale and clod with coal veins	4	0	175	8
Fireclay	3	6	179	2
Sandy shale	6	5	185	7
Sandstone	1	0	186	7
Shale	2	3	188	10
Sandstone, some showing coal stains	49	0	238	4
Coal	0	1½	238	5½
Sandstone, with coal pipes and stains	225	4	463	9½
Sandstone, much cleaner	90	8	554	5½
Coal seam, only 8 inches clean coal	1	6	555	11½
Fine-grained sandstone and sandy shale	57	2	613	1½
Coal	0	4	613	5½
Brown band	0	2	613	7½
Coal	1	1	614	8½
Band	0	2	614	10½
Coal	0	1	614	11½
Parting	0	0¼	614	11¾
Coal	0	2½	615	2¼
White band	0	1	615	3¼
Coal	0	10	616	1¼
White band	0	3	616	4¼
Coal	1	0	617	4¼
Hard sandy shale, showing fern impressions	27	9	645	1¼

Appendix VI.

Analyses of Tasmanian Mesozoic Coal.

	Water.	Volatile Hydro-carbon.	Fixed Carbon.	Ash.	Sulphur.	Analyst.
	Per cent.	Per cent.	Per cnt .	Per cent.	Per cent.	
Mount Nicholas	6·45	36·55	48·57	8·43	...	W. F. Ward
Ditto	3·80	32·20	49·17	14·83	...	Ditto
Ditto	7·6	35·75	50·00	7·25	...	Ditto
Ditto	5·1	33·00	46·00	15·90	0·60	E. W. Woodgate
Fingal	8·0	31·20	42·30	18·50	...	W. F. Ward
Bicheno	3·8	33·90	54·20	8·10	...	—
Sandfly	2·2	24·90	60·00	12·00	0·90	W. F. Ward
Ditto	6·5	25·43	62·59	4·60	0·88	Ditto
Douglas River V.	5·5	29·20	48·10	17·20	0·05	E. W. Woodgate
Ditto	4·5	27·10	52·00	16·40	...	W. F. Ward
Fosbrooke's Gully, Llandaff	2·25	33·75	55·50	8·50	...	A. Allom
Coal Creek D. Douglas River	5·5	30·90	50·80	12·30	0·50	W. F. Ward
Douglas River, Outer Mine	5·7	21·40	49·60	23·30	...	Ditto
,, Seam below V	5·5	24·60	49·60	20·30	...	Ditto
Steep Creek A., Llandaff	4·0	27·00	56·20	12·80	...	A. Allom
Pike's Creek, ditto	2·4	34·70	50·20	12·00	...	W. F. Ward
Steep Creek, top seam, ditto	3·1	25·20	42·90	28·80	...	Ditto
,, ,, bottom seam, ditto	4·1	24·60	41·50	29·80	...	Ditto
Steep Creek Tunnel	4·3	31·90	57·30	5·80	...	Ditto
Gully into Steep Creek, Llandaff	1·6	25·60	48·30	24·50	...	Ditto
Pike's Shaft, Hume's Lease, ditto	3·8	26·40	35·40	34·40	...	Ditto
Barber's Creek, Llandaff	3·4	18·80	44·40	33·40	...	Ditto
Ditto	3·0	20·20	49·80	27·00	...	Ditto
Ditto	6·4	23·40	43·60	26·60	...	Ditto
Board's Gully K, Llandaff	2·45	32·73	53·00	11·82	0·76	W. Dods
Glen Gala	7·00	9·70	19·20	64·10	...	W. F. Ward
Newcastle, New South Wales	2·75	34·17	57·22	4·64	1·22	— Dixon
Newcastle, England	28·93	...	71 11	1·08	0·88	J. A. Phillips

REPORT ON THE RECENT DISCOVERY OF CANNEL COAL IN THE PARISH OF PREOLENNA, AND UPON THE NEW VICTORY COPPER MINE NEAR THE ARTHUR RIVER.

Government Geologist's Office,
Launceston, 9th November, 1901.

SIR,

ACTING on instructions received from Mr. W. H. Twelvetrees, Government Geologist, I left Launceston on the 15th of August to examine and report upon a recent discovery of coal which has been made in the Parish of Preolenna, in the County of Wellington, on the North-West Coast of Tasmania. The examination was made while I was *en route* for the West Coast, and was, in consequence, a hurried one. Since then, urgent demands have been made on my time, and I have found it impossible to forward the following Report before now.

The coal seams were discovered by a party who were engaged in cutting the new pack-track from the end of the Calder Road to the Arthur River. The distance by this route to the spot where the seams were first found is nearly 19 miles, but they have since been picked up a mile and a half nearer Wynyard, the outcrop running almost parallel with the track; as the crow flies, it is from 14 to 15 miles from the Coast. The Arthur River is about six miles beyond the coal discovery. It is very probable that the seams may yet be picked up three or four miles nearer Wynyard, in the fall towards the Inglis River, but this country has not yet been prospected.

The new pack-track from the end of the Calder Road has been cut out, and formed where absolutely necessary. It is exceedingly steep in places, and would become boggy if

much traffic passed along it. At present, it is a new track, and is very fair travelling.

Appended to this Report is an ideal section of the country between Wynyard and the Arthur River. The diagram is introduced more with the object of illustrating my remarks upon the general geological features of the district than of conveying an accurate idea of the relative distribution of the various formations. As I have already stated, my visit was a hurried one, and did not permit of an exhaustive examination; moreover, the country is very heavily timbered, and is covered by a great depth of surface-soil, so that it is often impossible, from a superficial examination, to tell the nature of the underlying rock. On the whole, however, I believe the diagram gives a fair idea of the geology of the district, and, for the purposes of the present Report, will be useful. I will now describe the various formations, in order of age.

Cambro-Silurian and Pre-Cambrian Systems.—These are the oldest rocks in the district, and are found underlying all the other formations. They consist of highly-inc ined slates, quartzites, and metamorphic schists. The greater part of them belong. probably, to the Silurian system, but, as there are no fossils present, I think it best to follow Mr. A. Montgomery's example, and refer to them as Cambro-Silurian. In the valley of the Arthur River there is a highly-metamorphic quartz-schist, which, from its lithological characters, I should judge to be Pre-Cambrian. These old rocks outcrop in the bottom of all the deeper valleys of the district, such as those of the Calder and Inglis rivers, and, also, in many places along the sea-beach. As in other parts of Tasmania, where these old rocks occur, they have been proved to be mineral-bearing. Alluvial gold is pretty widely distributed throughout the district, and a considerable quantity has been won from the valleys of the Calder and Inglis rivers. At the New Victory Mine, in the va.ley of the Arthur River, copper ores occur, an account of which will be found in the present report. These old sedimentary rocks are penetrated in places by eruptive rocks; granite is said to be exposed in the valley of the Inglis River, some five miles south of the place where the track crosses this stream. I had no opportunity of seeing this occurrence personally, but my informant was very positive as to the correctness of the information. In the Arthur River, the New Victory Copper Mine is connected with a mass of pyroxenite; this rock will be referred to again when describing the occurrence of copper ores.

The "Wynyard Formation."—Next in age to these old metamorphic rocks comes what Mr. Montgomery has named the "Wynyard Formation." I encountered this formation in several places on my journey, but had no opportunity of studying it exhaustively. I will, therefore, quote from Mr. Montgomery's report on the "Mineral Fields of the Gawler River, Penguin, &c.," 1895.

"To the south of Wynyard, the formation is seen over rather an extensive area between the Inglis and the Cam rivers, and, as far back as the Campbell Range and Arthur River. It is to be seen best in the deep gullies of the creeks running through the district, the tops of the spurs between them being formed of more recent basalt. Beds of conglomerate are very prominent in the series, often containing large boulders of quartz, quartzite, metamorphic sandstones and slates, schist, red granite, and porphyry, with, occasionally, fossiliferous sandstones from the upper Silurian system. These boulders are usually enclosed in a mudstone matrix. Beds of mudstone (argillaceous sandstone), containing numerous small pebbles, are also common, and there are also thick beds of laminated slates and shales and of white and yellowish sandstones (freestones). Some of the shales and sandstones are very soft. On the beach, under the Eocene beds, there are very slight signs of curvature in the bedding-planes of the slate of this formation, but not more than might, perhaps, be due to slight irregularities in the original deposition of the sediments, and, generally, throughout the district, the strata lie very flat. In lithological character and bedding they very closely resemble those of our Permo-Carboniferous and Mesozoic coal measures. The material is not nearly so much indurated as that of the Dial Range formation; the joints do not cut through the pebbles in the conglomerates, as a rule, and, so far as I have observed, there is an entire absence of felsitic tuffs and other volcanic matter. The formation, however, seems remarkably destitute of fossils, not a trace of one being observed during my examination of it, though search was constantly being made for them."

Mr. Montgomery then goes on to discuss the age of the "Wynyard Formation," and, arguing from the general similarity of the material, and from the fact that several pieces of excellent coal had been picked up on the beach in the vicinity of Wynyard, comes to the conclusion that it may possibly form the base of the coal measures, and that "higher up in it the fossiliferous beds and the coal seam may yet be found. Both for scientific and commercial purposes, search for them is desirable."

Mr. Montgomery's prognostications have turned out to be quite correct. Some miles inland, the "Wynyard Formation" is overlaid conformably by the fossiliferous shales and sandstones of the permo-carboniferous system (the Mersey coal measures), and the coal seam which shed the fragments has been discovered. There is now little reason to doubt that the "Wynyard Formation" forms the base of the Permo-Carboniferous system.

The Permo-Carboniferous System.—The only good exposure of the strata of this system which I found was in the bed of a creek, locally known as the Jenny Creek, an affluent of the Inglis River. It was in the bed of this creek that the coal seam was first discovered. The creek flows at right angles to the line of section taken in the diagram. I followed this creek down for about 400 feet in vertical distance, without reaching the "Wynyard Formation," or the underlying Cambro-Silurian rocks. The strata consists of shales and sandstones, for the most part firmly consolidated. Fossils are not abundant, but one bed of shale, very rich in impressions of fenestella, has been cut through in a cutting on the track, and no doubt others might be found with a little search. The extent of the formation is, at present, somewhat doubtful; it apparently extends from the valley of the Inglis to the Arthur River, as shown in the diagram. I am also inclined to think it extends westward for a considerable distance. The strike of the strata is about 30° E. of N., and the dip from 2° or 3° to 15° to the N.W.

The Eocene System.—A small but exceedingly interesting deposit of marine beds, belonging to the Eocene System, is exposed in a cliff section at Freestone Cove, near the Town of Wynyard. They are very full of fossils, and have been exhaustively studied by Mr. R. M. Johnston, who describes them at length in his "Geology of Tasmania." More recently, their palæontology has been thoroughly worked out by Mr. J. Dennant and the late Professor Ralph Tate. The deposit is small in area, and is covered by basalt, which has no doubt been the means of preserving the beds from denudation. It is probable that other patches of the same formation exist in the district, but they are either covered with later Tertiary gravels or have not yet been observed.

Palæogene Strata.—Large areas of country south of Wynyard are covered by gravels and clays belonging to the later Tertiary Period. These are often interbedded with or covered by sheets of basalt. Many deposits of these gravels

are found along the North and East Coasts of Tasmania. They prove that a period, first of subsidence, and afterwards of elevation, took place after the Eocene Period, accompanied by overflows of basalt. These beds occasionally contain seams of lignite. Mr. John Broomhall showed me a specimen of lignite from Abel's Farm, five miles from Wynyard; there are, he tells me, six seams within a depth of 10 feet, the largest of which would measure 8 inches in thickness. The lignite is of no commercial value.

The Palœogene gravels and basalt are found capping the Permo-Carboniferous beds in the Preolenna district, and I think it possible that, in a north-westerly direction from the line of section of the diagram, they may be completely covered by these gravels. It is also possible that there are terrace-deposits in the valley of the Inglis River. Where they occur, these deposits would prevent the coal measures from out-cropping, and this may account for the fact that they have so long remained undiscovered.

The New Cannel Coal.

The new discovery of cannel coal was made near the nine-mile peg on the track from the end of the Calder Road to the Arthur River, in the bed of a creek flowing into the Inglis River. There are three seams exposed here, of which the upper one is the largest, and, undoubtedly, the best. The outcrops have been traced along the side of the hill for about a mile and a half, but very little work of any kind has been done upon them. It is to be regretted that at least a few days' work had not been done before my visit. Had the seams been opened up for a few feet, it would have been possible, not only to form a more accurate idea of the width of the seams, but also to obtain better and more representative samples for analysis. The upper seam, which is, I think, the only one of commercial importance, is from 20 to 22 inches in thickness. It may be a little more in places, but I think this will represent a fair average. There are two classes of coal in this seam, both of which we may provisionally call cannel coal, for they are both very rich in gas, though it is probable that neither of them will be found to conform strictly with the recognised definition of cannel coal. The first-class coal closely resembles the cannel coal which has been found in large fragments at Barn Bluff, the source of which has not yet been discovered; and it is also very closely allied to the Boghead mineral, kerosene shale, or cannel coal of New South Wales. In colour, it varies from brownish black to black; lustre, resinous to dull; fracture, conchoidal. It is extremely tough, and difficult to break

under the hammer, but only slightly sectile. The powdered mineral is dark or brownish black; it burns somewhat feebly on the application of a match, but, when heated in a fire, burns very readily, with a long flame, much smoke, and a rather faintly-bituminous odour. Sometimes it is devoid of all traces of stratification, being quite dense, and resembling pitch; other specimens show distinct lines of stratification, and these bear a stronger resemblance to an oil shale than a cannel coal. It is possible that the lines of stratification will disappear, as is the case with the New South Wales mineral, when depth is gained, as they are probably brought into prominence by weathering.

The second-class coal is jet black in colour; lustre, resinous to slightly vitrious. The colour of the powdered mineral is dark brown. It burns readily, with much flame and smoke, and with a strongly bituminous odour. Lines of stratification are distinct. It is evidently not homogeneous, and appears to be made up of laminæ of slightly varying composition. The relative quantities of these two coals seem to vary in the seam. Where first discovered, the seam is mostly composed of the second-class coal, and from this place I took a bulk sample (Sample No. 1) from a couple of hundredweight of coal which had been taken out. A good deal of coal had been taken away from this heap before my visit, and, as it is only natural that the best pieces should be selected to take away, it is probable that this sample is somewhat below the average of the seam at this point. Another exposure has been found about a quarter of a mile to the north-east of the above locality; here the seam appears to consist principally of the first-class coal, though I was, unfortunately, only able to get at the upper nine inches of the seam. Of this, I took a bulk sample (Sample 2). A third exposure has been found about a mile and a half north-east of the first locality; here the seam is seen in the bottom of a small creek. I obtained a large lump from the top of the seam at this place, from which I took a third sample (Sample 3). The coal was principally of the kind I have described as second-class, with seams of the first-class coal in it.

These three samples were submitted to Mr. W. F. Ward, Government Analyst, for analysis, with the following results:—

	Moisture.	Ash.	Gases lost at red heat.	Fixed Carbon.	Character of Coke.
Sample No. 1...	1·2	5·8	42·0	51·0	Firm.
„ No. 2...	2·2	3·5	65·8	28·5	Rather tender.
„ No. 3...	1·1	8·8	47·9	42·2	Tender.

Gases lost at red heat include half the sulphur present in the coal, the remainder being volatile hydro-carbons. The sulphur content was not estimated, but it is not likely to be high. In the Barn Bluff cannel it amounted to only 0·7%, and it is probably not greater in this coal. These results may be regarded as very satisfactory, especially that of No. 2 sample. The valuable constituents of these coals consist in the volatile hydro-carbons. They may be used in two ways, firstly, in the manufacture of gas, where they are of great value to mix with other poorer coals, in order to increase the illuminating power of the gas; or, secondly, in the manufacture of quite a number of products, such, for example, as illuminating oils, paraffin, benzine, aniline dyes, &c. Of these, the second is the highest use to which coal of this class can be put, but their application to either of these uses can only be determined by experiments carried out on considerable quantities of the product by a qualified expert. In New South Wales, where there is a considerable industry in mining these oil shales, the product is used for both purposes. The highest-grade material is shipped to Great Britain, there to be treated for the various oil-products. A large quantity is also treated locally for oils, &c., and a third portion is used for increasing the illuminating power of ordinary coal gas.

With the object of affording a comparison of the Preolenna cannel with other high-grade coals, the following Table is introduced. It is taken from Liversidge's "Minerals of New South Wales," and the analyses of the Barn Bluff and Preolenna coals have been added:—

Locality.	Moisture.	Volatile Hydro-Carbons.	Fixed Carbon.	Ash.	Sulphur.	Specific Gravity.
Joadja Creek, N.S.W.....	0·44	83·861	8·035	7·075	0·589	1·054
Hartley Vale, „	...	82·50	6·50	11·0	...	...
Joadja Creek, „	0·04	82·123	7·160	10·340	0·337	1·229
Hartley Vale, „	...	82·24	4·97	12·79	...	1·052
Joadja Creek, „	0·41	77·07	12·13	10·27	0·12	1·098
Joadja Creek, „	1·16	73·364	15·765	9·175	0·536	1·103
Cannel, Mold Flints, England	...	72·08	21·91	6·01	...	...
Murrurundi, N.S.W.	1·165	71·882	6·467	19·936	0·549	...
Torbanite, Scotland.....	...	71·17	7·65	21·18	...	1·170
Cannel Coal „	...	69·77	10·45	19·78	...	...
Torbanite, „	0·720	69·695	9·045	20·540	...	1·316
Greta, N.S.W.	0·48	61·18	25·13	13·21	...	...
Albertite, New Brunswick.....	...	57·490	42·086	0·424	...	1·105
Greta, N.S.W.	1·475	53·798	27·946	15·870	0·911	1·130
Cannel Coal, Wigan, England	1·464	45·900	45·519	7·117	...	1·259
Barn Bluff, Tasmania.....	0·2	52·8	42·4	4·3	0·7	1·13
Preolenna, Tasmania, No. 1 ...	1·2	42·0	51·0	5·8	...	...
Ditto, ditto, No. 2	2·2	65·8	28·5	3·5	...	1·13–1·2
Ditto, ditto, No. 3	1·1	47·9	42·2	8·8	...	...

From the above Table, it will be seen that Sample 2, the first-class Preolenna cannel, is only beaten, as far as its contents in volatile hydro-carbons are concerned, by the high-grade kerosene shale of New South Wales (the richest coal in the world), by the Torbanite of Scotland, and by one English cannel, that of Mold Flints. It is higher by 13% than the Barn Bluff cannel, which Mr. A. Montgomery has described as "one of the very best cannel coals for gas-making purposes in the whole world."

The actual value of the coal, both for gas-making and oil-making purposes, can only be determined by very exhaustive experiments on considerable amounts of the material. These have not yet been made for the Preolenna cannel, but they have, in part, been carried out in the case of the Barn Bluff coal, with very satisfactory results. Considering the great similarity in the two coals, I think we are quite safe in assuming that the composition of the hydro-carbons will be essentially the same in both cases, *i.e.*, the valuable products contained in it will probably be equal in quality and greater in quantity than the Barn Bluff coal. As giving an idea of the market value of the coal, it will be interesting to quote the estimate which Mr. Cleminshaw, of Launceston, made for Mr. A. Montgomery of the market value, in Launceston, of the Barn Bluff coal, when used for gas-making purposes, without any consideration of the by-products. This estimate amounted to 50*s.* a ton. As the Preolenna coal contains 13% more volatile hydro-carbon than the Barn Bluff sample, we may presume that its value will be even higher than this, and there is a further possibility that its value for oil-making may exceed its value for gas-making.

The second-class cannel, though it cannot be classed among the high-grade cannels, is still a very valuable coal. It would probably not pay to export this coal for the manufacture of oils, supposing it to be adapted for that purpose, as the freight would be too heavy; but it would probably find a ready sale for the purpose of increasing the illuminating power of ordinary coal-gas, or it might pay to erect works locally for the extraction of the oils. These points can only be determined after the coal has been examined by specially-qualified experts. As a coking coal it may also have a considerable value. I could not form any idea of the relative quantities of the two classes of coals in the seam. The proportion probably varies considerably at different points, and it will be only after the seam has been opened up at a number of places that this can be determined. In one of the three places where the seam was exposed there was certainly nine

inches of first-class cannel, and there is probably more. The total width of the seam at this place was 22 inches.

The seam should first be opened up at a number of places, with the object of determining the relative proportions of the two qualities of coal present. Short tunnels should be made into the seam in order to determine accurately its size, and several small parcels should be got out and sent to a qualified expert, with the object of ascertaining the quantity and value of the various products contained in them. At the same time prospecting should be vigorously carried on in the district along the line of outcrop of the seam. It probably varies both in size and quality, and it is unlikely that the richest spot should be that which was first discovered. It is very possible that the seam may be picked up in the valley of the Inglis River, in which case it will be several miles nearer the seaport than where it is now uncovered. The dip of the seam appears to be towards the north-west, at varying angles, from 2° or 3° up to 15°. In this direction the country does not fall nearly so rapidly as it does towards the south-east, so that the seam may be expected to live for a considerable distance in this direction before out-cropping. The country is covered with very dense scrub, a lot of bauera and horizontal being present, so that prospecting in this direction will be a difficult matter. Still, the possibilities of a valuable discovery being made are amply sufficient to warrant the work being undertaken.

As already pointed out, the country in this direction may be covered by Tertiary gravels or basalt. In that case, the seams will not outcrop, and their existence below the surface can only be determined by boring. This work should not be undertaken until an accurate geological survey has been made.

Should the seam open up favourably, there would be no difficulty in connecting the field with the seaport of Wynyard. A tramway route could be got along the valley of the Inglis River, and would reach Wynyard in a distance of about 18 miles. In this respect the district is exceptionally favourably situated.

I think the discovery is a very important one, and may be the means of adding another valuable mining field to Tasmania.

The New Victory Copper Mine.

This mine is situated in the valley of the Arthur River, about six miles south-west of the coal discovery. The river flows at this place a little west of north, and the mine is situated on the eastern bank of the river.

The most striking feature in the mine is a massive belt of white crystalline dolomite (carbonate of lime and magnesia), striking about 30° east of north, and forming the contact between a mass of pyroxenite and highly-laminated quartz-schist. The dolomite does not cross the river, though it comes down to the water's edge. Here it is some 50 or 60 feet in thickness, but half a mile further north it has widened out to a mass many hundreds of feet in thickness. How far it extends in a northerly direction I did not learn. To the west of the dolomite there is a mass of pyroxenite, a heavy, dark-green, massive rock, consisting essentially of pyroxene. This is one of the ultra-basic eruptive rocks, and compared with other eruptive rocks, is characterised by a very low percentage of silica and alumina, and a high percentage of magnesia. In the vicinity of the dolomite, this rock is in a highly-decomposed condition, and is only recognisable as the altered pyroxenite by a gradual passing over from the one to the other, and by occasional patches of less decomposed rock, which occur in the altered zone. The most highly decomposed portions of the rock consist of bands of yellow, red, and brown kaolin and clayey matter, much oxide of iron, and patches of a fine white powdery substance, which I take to be amorphous silica. The pyroxenite is often highly charged with iron pyrites, and I think there can be no doubt that the origin of the dolomite is directly connected with the eruptive rock. Crystalline dolomite of a similar nature occurs in several other localities in Tasmania, associated with similar rocks. Among these may be mentioned the belt of dolomite at the Comet and South Comet Mines, at Dundas, associated with serpentine; the dolomite gangue of the lode at the Magnet Mine in websterite; and the dolomite gangue of the old Madam Melba and Kapi mines, in serpentine and gabbro, at North Dundas. In all these instances we have a similar crystalline dolomite associated with ultra-basic rocks, rich in magnesia.

The rock forming the eastern wall of the belt of dolomite is a highly metamorphic crystalline quartz-mica schist. It strikes about north and south, and dips to the east at angles varying from 25° to 40°. Much of this country is highly charged with mineral matter, and some large gossan formations are to be seen on the surface, but nothing has, so far, been done to prove their value. The deposit of copper ore is situated on the eastern bank of the Arthur River. It is associated with some bands of black crystalline hematite, and, apparently, forms a contact lode between the dolomite and the schist. The copper ores consist of malachite, chalcopyrite, and bonite and chalcocite, distributed through the

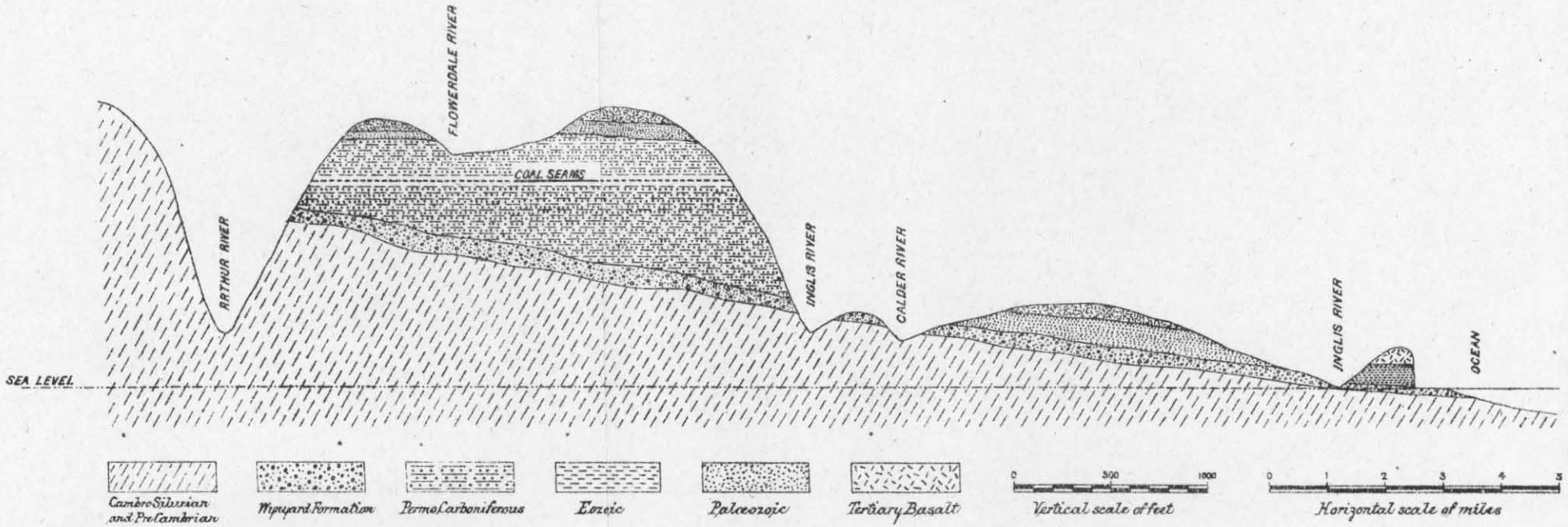
dolomite gangue of the lode. Assays of the ore have been very satisfactory; one sample, tested at the Zeehan School of Mines, yielded 22·4% of copper, 8 ozs. 3 dwts. 8 grs. silver, and 10 dwts. 4 grs. gold. Several other assays have been obtained, with similar results, the gold contents being especially satisfactory. Unfortunately, the length of the shoot was very small, for nearly all the copper ore was broken down in the entrance to the tunnel, which was put in at the contact, in order to explore the deposit. At this point the country is very much broken to the east of the dolomite, and the tunnel was driven in the broken country, for about 30 feet, in preference to the harder dolomite. The course of the tunnel was then turned to the west, with the object of intersecting the lode. The dolomite was entered, and the seams of crystalline hematite cut; apparently, there was no copper in the lode at this point, for it was passed through unheeded, and the tunnel was continued as a crosscut across the dolomite. Presently, a vugh in the dolomite was intersected, and this was followed for a considerable distance, apparently under the impression that it was the lode. Unfortunately, I was not able to see the veins of hematite where they were cut in the tunnel, for the latter was closely timbered at this point, but I understand they were cut close to the margin of the dolomite. There seems to be no reason for thinking that the hematite does not form part of the lode, and, this being the case, the veins of hematite should have been followed when cut in the tunnel, whether copper was present or not; certainly, the vugh which was followed by the tunnel has no connection with the lode. The dolomite is probably traversed in all directions by such vughs as this. They are formed by the dissolving action of water travelling through what were once small cracks, but which have been gradually widened until they have now become cavities of considerable dimensions. A curious feature, which should be mentioned, is the presence of a warm spring which was cut in the tunnel. The water is about blood-heat, and evidently contains much carbonate of lime and carbonic acid; it contains no sulphides in solution. The water has evidently travelled for a considerable depth underground, through the vughs in the dolomite, hence, its high temperature.

The work which has been done, so far, has proved very little. It has proved that the shoot which has been discovered was very limited in length, but, practically, nothing has been done to ascertain if other shoots of ore occur on the same line of lode. Lodes at the contact of soluble rocks, such as limestone or dolomite, are often patchy, but they also often contain big bonanzas of very valuable ore; and, con-

IDEAL SECTION
FREESTONE COVE TO ARTHUR RIVER

BEARING 30° WEST OF NORTH

Geo. A. Waller
Ass't Gov't Geologist



5 cm

sidering that we have here a contact lode, proved to contain, at least, some rich ore, I think it is well worth a fair trial. The possibility of striking a good lode along the contact is considerably strengthened when we take the surrounding circumstances into consideration. The whole country is very highly mineralised, but the mineral matter in the country is not concentrated. Before we can have a payable ore-deposit, the metals must be found in a much more highly concentrated form than we find them in the country, and the question arises—Where is the most likely place for concentrations to take place? There can be no doubt as to the answer to this question. The most likely place lies at the contact of the dolomite with less soluble rocks. Such concentrations we know to have taken place to some extent along the contact of the dolomite and the schist, and it remains for the miner to prove whether other larger and richer deposits exist on the same line of lode. I think it is well worth while driving along the contact of the dolomite and schist from the present tunnel; at the same time surface work should not be neglected. I should recommend a series of trenches to be put across the contact of the dolomite and schist for a considerable distance up the hill, at distances of from 50 to 100 feet apart. These would probably cut any shoot which lived up to the surface, and, for the same expenditure, a greater length of the contact could be explored. On the other hand the underground work is the more thorough, and the shoot, when cut, is more likely to be rich in valuable metals than when cut in a trench on the surface. Underground work, therefore, must by no means be neglected.

On the west side of the dolomite there is another lode. It consists of a pyrites formation, about 14 feet in width, consisting of bands of iron pyrites and country rock. Assays of some of this pyrites are said to have gone as high as 12 dwts. of gold per ton, but the sample which I took from here, and which was assayed by Mr. W. F. Ward, Government Analyst, only yielded a trace of gold. Two tunnels have been driven through the decomposed rock on the west side of the dolomite, apparently, with the object of cutting this formation, but neither of them has been continued far enough, as the contact has not been reached in either case. As the country is very soft here, and driving is cheap, I think it would be worth while to extend one of these tunnels up to the contact of the dolomite; this would prove the character of the lode in a very short time.

In conclusion, I may say that, although the results so far obtained have been of a very disappointing nature, I cannot

regard the work done as having affected the prospects of the mine to any considerable extent, for the reason that it has been expended principally in the wrong direction. The indications are, in my opinion, very favourable, and, if work is carried out on the lines I have indicated, I think there is a good chance of payable deposits being discovered.

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

GEORGE A. WALLER,
Assistant Government Geologist.

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

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

Government Geologist's Office,
Launceston, 7th December, 1901.

SIR,

I HAVE the honour to report having, in accordance with your instructions, visited the Blue Tier Tin District, in August last, devoting from the 16th to the 27th of the month to its examination.

The productive mines at work were the Anchor, the Australian, the Liberator; the Crystal Hill was preparing for active work; the Laffer, below Lottah, was searching for its lode; at Beale's show, at Mt. Michael, sluicing was going on. Work was not proceeding at the Cambria, the Moon, Haley's Lease, nor the Lottah. Since my return, I have heard that a little sluicing is going on at the Lease.

The Blue Tier is the mountainous boss, or range of granite, which occupies that part of north-eastern Tasmania situate between the Ringarooma River and the East coast line. It rises to a height of 2585 feet above sea-level. The top is comparatively flat or undulating, and covered with timber, alternating with open stretches of moorland. I may say the heights given in this Report are from aneroid readings only, but appear to correspond, approximately, with some of those cited by other visitors. I give the following stations:—

	Feet above sea-level
Crown of Tier, just above Poimena ...	2585
Poimena Township	2435
Liberator Mine, top of face...	1700
Cambria shaft	1700
Crystal Hill Camp...	1460
Liberator battery	1340
Crystal Creek Bridge...	1280
Laffer Mine	1000
Anchor Mine battery...	850

The Tier has been examined by former Government Geologists, Mr. G. Thureau and Mr. Alex. Montgomery, M.A., and their instructive reports should be consulted. The titles of these are:—"Report on the Blue Tier Mining District and its Tin Deposits, Feb., 1886, by G.

Thureau" ; "Report on the Blue Tier Tin Field, Nov., 1889, by Alex. Montgomery" ; "Report on the Tin Mines at the Blue Tier, County of Dorset, Jan., 1893, by Alex. Montgomery."

This year, Mr. K. L. Rahbek was deputed by the Government to examine the Tier, and report upon the possibility of conserving water for the supply of the large mines in the district. He has reported that, by constructing a large power-reservoir on the Wheal Tasman flat, on the top of the Tier, or, rather, just on the edge of the northern fall, with a water depth of 30 feet at weir, a water spread of 200 acres, and a capacity of 134,000,000 cubic feet, 13 sluice-heads (one Tasmanian sluice-head = 24·168 cubic feet per minute), giving 375·4 actual horse-power, can be continuously supplied, first, to the four mines, the Moon, the Australian, the Crystal Hill, the Liberator, and then re-collected and forwarded to the Anchor (unmixed with any water used for dressing), giving that mine 187·2 actual horse-power. The cost of construction of the power-reservoir, with feeder reservoirs, races, and auxiliary works is estimated by Mr. Rahbek at £94,000.

I understand that the principal object of my examination of the Tier this time was to supply you with information as to the extent of the deposits of tin-ore, for consideration in connection with the above water scheme. Before giving the results of my inspection of the different mines, I invite your attention to the following brief description of the geology of this mountain range.

The granite of which the Tier is composed is that which, with textural and slight mineralogical variations, is the basement rock of the whole of the East Coast of Tasmania. At the close of the Silurian period it consolidated upon intrusion, at great depths, into the Silurian slates and sandstones. The extent to which the latter have been metamorphosed and mineralised by the invading granite can be well studied along the zone of contact, near St. Helens.

At the Tier it is a rather coarse-grained porphyritic granite, with large crystals of felspar, an inch in length, scattered through it; grey, white, or pink in colour. Its mineral constitutents are felspar, quartz, dark magnesian mica (biotite), and a little silvery potash mica (muscovite). Sometimes the white mica is quite absent; its abundance seems to depend upon the presence of tin-ore. At George's Bay, the granite contains a larger proportion of quartz and less felspar than upon the Tier.

The first element to crystallise was the mica, then the felspar, finally the quartz. This is shown by crystals of mica occurring enclosed in the felspars, and by the residual silica filling the interstices or spaces between the well-formed crystals of felspar. So far, all are agreed. The differences of opinion begin when we consider the portion of the granite which carries the tin-ore. This is not coarse as the ordinary granite; it is more even-grained, and is not porphyritic. The dark mica goes through a series of changes into silvery and greenish-white mica, muscovite (non-pleochroic). The change is first into a dark bronzy mica, and, finally, as the iron becomes gradually abstracted, into the white potash variety. This alteration can be observed under the microscope in one and the same crystal, which is partly iron-magnesia and partly potash. Often the felspar decays to kaolin, and the rock becomes softer, or there is extreme silification, and the rock grows much harder. The magnesia liberated in the decomposition of the dark mica is re-deposited as talc, which gives a greenish tinge to much of the tin granite; the felspathic material remains behind, to some extent, as kaolin. The new minerals developed in this variety of granite are cassiterite, wolframite, scheelite, fluorite, molybdenite, galena, copper pyrites. The iron pyrites may be original. No axinite has been yet found at the granite contact; this is no doubt owing to the absence of lime. Tourmaline is rare. Sapphires and topaz are found in the stanniferous gravels, and have probably been released from pegmatitic veins.

This tin-bearing granite has been labelled with different names, such as quartzose porphyrite, aplite, and, most frequently of all, quartz porphyry. Parts of the mass correspond with some varieties of the tin-bearing granite at Altenberg, in Saxony, called zwitter-rock, or stockwerk porphyry, only the latter usually has a good deal of topaz in it. Zwitter-rock is sometimes a greisen (quartz + mica), with very finely disseminated tin-ore; sometimes the mica is absent. The mica itself is a greenish fluoric potash-iron variety, which, together with topaz, has replaced the felspar. At other times the rock is nearly all quartz, and dark in colour, resembling the more quartzose varieties of the Blue Tier tin-granite. Typical zwitter-rock contains—quartz 50 %, mica 37 %, topaz 12 %, cassiterite 0·40 to 0·5 %. Varieties without mica consist of 70 % to 71 % quartz, 27 to 28 % topaz, and 1·4 to 1·5 % cassiterite. Zwitter is essentially a modified granite, resulting from a process of greisenisation, which has started from cracks and fissures.

Mr. Thureau and Mr. Montgomery looked upon the Blue Tier tin-bearing rock as an intrusive dyke traversing the country granite. Prof. Ulrich, on the other hand, regarded it as a stockwork or mineralised zone of the granite mass. When able men differ like this, it may be taken as certain that there is something to be said on both sides of the question.

The most dyke-like occurrence which I saw was on Haley's Lease, on the old Blue Tier Company's ground, not far from Mr. Ogilvie's camp. In the race a dyke-like band of tinstone is exposed for a width of two chains, running through the porphyritic country granite, from which it is separated by a small pegmatitic vein. Further east a smaller band of soft tinstone, 1 foot wide, traverses the granite, and has quite sharply-defined boundaries. Still further east, a wider vein of tinstone is seen, also separated from granite by a pegmatitic facing. I have alluded to this stanniferous variety of granite as tinstone, but am not sure that it is the best term, as it is also used elsewhere for cassiterite, the ore of tin. The above occurrences cannot be considered as conclusive, for they are associated with pegmatite veins, which may have been the mineralising channels.

The two strongest objections to the dyke theory are:—
1. The irregular boundaries of the tin-bearing granite;
2. Its occurrence in the form of floors.

1. By referring to the annexed map, a fair idea may be formed of the shapeless development of the tin-bearing rock-mass. At the Anchor Mine it disappears to the N. and E., under a capping of country dark mica granite, a very singular thing if it is a dyke. To the N.W. and W. the Anchor stone extends to the Crystal Creek, passing under some country granite on the E. side of the road bridge; then, W. of the creek, the altered granite, at first non-stanniferous, and then tin-bearing, continues west through the tin properties of the Crystal Hill and Liberator Companies, merging into ordinary country granite at the Working Miners' Creek, on the western boundary of the Liberator. Again, from the Crystal Hill, a narrow strip of tin granite extends at right angles to its previous direction, due north through the Australian sections and Haley's Lease, across the Wyniford to Beales' sections at Mt. Michael, spreading out like a fan as it approaches the Wyniford, and, apparently, connecting with the Moon property on the east. In the middle of the Crystal Hill sections, some of the unaltered country granite has survived. The

irregularity of the contour of the formation seems irreconcilable with a dyke origin, and, in addition, the general structure of the stone differs from that of elvan dykes. The latter are generally coarsest in the middle, and finer-grained near the sides.

Apart from elvans, wide granite dykes often traverse granite masses, but in the present case there is no parallelism of the sides of the formation—no walls, nor anything to suggest that the tin stone is the filling of a fissure.

2. There is a very striking indication of floors in the Anchor Mine. The tinstone in the old eastern workings lies under the barren country granite, which ascends the hill thence to Lottah (see Fig. 1, at the end of this Report); a flat seam of quartz and bronzy mica, with a few large felspars, forms a horizontal floor separating the tin-bearing stone below from the coarse (here decomposed) granite above. A face of about 30 feet of the latter is exposed at this bench. Just below the seam is some white quartz and coarse tin, and, within six inches of it, I noticed a large felspar crystal quite enclosed in the tinstone; this was evidently due to the influence of the dividing seam. We have here a good example of a horizontal boundary or floor. Practically the same phenomenon is repeated in the top workings of the mine, where dark mica granite rests upon the tinstone, and has to be stripped before the latter can be worked. This granite overburden may be expected to decrease towards the west, and increase towards the east. I infer this from the fact that the modified stone rises about 400 feet to the road in a north-westerly direction, while northwards it is hidden beneath the huge granite mass which ascends from Lottah to Poimena. On Haley's Lease, at the old McGough's tunnel-pit, 1400 feet above the Anchor face, the country granite (also decomposed) occurs overlying the tin-rock, as shown in Fig. 2, at the end of this Report.

All over the field fluorite is associated in small quantities with the tin granite, colouring and facing joint-planes, as well as permeating the substance of the rock. There are large patches of this violet mineral in the rock at the Liberator. I found it also in the stone at the Anchor and Australian Mines. We know that there are good reasons for believing that tin ascended as a fluoride, and, if so, the resulting fluorine compounds formed powerful agents in the decomposition of granite, and its conversion into the modified rock, which carries the tin-ore. It is not surprising, therefore, to find the granite silicified, its mica

altered, secondary talc abundant, chlorite also present derived from liberated magnesia, and fluorine minerals developed. In the No. 2 trench at the Crystal Hill Mine, there is an interesting development of pale green fluor-apatite in prisms, in hard reddish tin granite.

If the fluoride ascended through the channels afforded by the jointings of the granite, and was in quantity sufficient to permeate the rock for some distance on each side, or on one side only, as the case might be, altering its constitution, and depositing the tin-ore, the origin of the present stanniferous deposit may be realised without resorting to injected or intrusive material. A proof of this process, to some extent, is the nearly universal incipient greisenisation of the granite wherever it is tin-bearing, and the restrictions of the tin-ore to greisenised granite. As a rule, the greisenisation is not complete; there is generally more or less felspar undergoing alteration into muscovite. Completed greisenisation consists in the elimination of the felspar from the granite, accompanied by a silicification of the rock, and a large development of muscovite and lithia mica. As mentioned, there is a notable accession of such minerals as tin, tourmaline, fluorite, &c. The change is brought about by vaporous (pneumatolytic) "after action" of cooling granite, the vapours and solutions ascending through crevices, &c., into the already cooled upper zone of rock, and slowly pervading and corroding the whole mass, and modifying its nature, as described above.

This conversion of country granite into tin granite, in certain zones, produces an appearance of the latter being an intrusion, but, upon the above theory, while the introduction of the tin was subsequent to the formation of the granite, the latter is still in place, and has not been subjected to any movement or disturbance.

The frequent occurrence of veins and druses of pegmatite, *i.e.*, segregations of large crystals of intergrown quartz and felspar, accompanied by crystals of mica and coarse tin-ore, also illustrates the "after action" of the granite involved in the deposition of tin. These pegmatites may be seen everywhere, *e.g.*, on Haley's Lease, at the summit of the Tier; in the face at the Liberator Mine; notably at the Laffer Mine; at the Anchor Mine; and on the hill-side going down from Lottah to the Laffer.

While, for the present, I think that the theory of intrusion lacks the support which the greisenisation theory possesses, I consider the question of permanence in depth is unaffected by either hypothesis. The solutions carrying

tin and its associated vapours have ascended from unknown depths, and, within the zone of deposition, there is no known reason why concentrations should not be equally rich at one horizon as at another. The deposition may be assumed to have been governed by the physical conditions existing at the time. We know that the tin granite on the Tier is 1500 feet higher than that at the Anchor, and 1100 feet above the Don face at the Australian; and this ore zone may be safely reckoned upon as descending beyond the depth accessible to mining.

Dykes.—There are a few dykes of eruptive rock, which traverse the granite. These are basic, and have usually been taken for Tertiary basalt, which they greatly resemble. Microscopical examination shows them to be dykes of diabase. [Constituents = plagioclase felspar + augite, the latter greatly chloritised: structure = diabasic. No olivine.] There is a dyke of this kind, about 50 feet wide, in the granite, crossing the road S. of Lottah at the Horseshoe bend, between Lottah and the Anchor manager's house, and said to be traceable eastwards for 3 or 4 miles. Stones belonging to the same dyke are seen on the track near the office at the Anchor Mine.

I saw a wide dyke of similar stone on Haley's Lease, a little north of Ogilvie's camp. There is another one on the Lease about 30 chains further north. These dykes are all roughly parallel, taking a N.E.-S.W. direction. They are of Mesozoic age, consequently younger than the deposits of tin-ore, and have no bearing whatever upon its deposition.

Distribution and Grade of Ore.—The quality of the tin-ore from the Blue Tier mines is excellent. The average of the whole district is about 72%, some of the produce reaching a higher figure. The ore is remarkably free from iron; in some of it, however, traces of copper are present.

There seems to be no rule for making use of the distribution of the ore in the tin-granite (*Germ.* Zinngranit). I could see nothing to show whether the tin has been concentrated in the middle of the formation more than towards the margins, or *vice versâ*. The patches are quite irregular, and will, I believe, be found to be more dependent upon the natural fissuring of the rock than upon any law of segregation. In some places the stone is rich and heavy; elsewhere, practically barren. Taking the formation as a whole, the probabilities are that the ore contents will range from a shade under $\frac{3}{8}$ to about $\frac{5}{8}$ of 1% black tin. An average of $\frac{1}{2}$% ought to be expected from most of the mines.

The percentages ruling at the different mines are:—At the Anchor, about ⅜%, passing all stone through the mill; Australian, ¾ to nearly 1%; Liberator ranges from ½ to nearly 1%, averages ⅝ to ¾%; Haley's Lease used to yield ⅔%; the Moon, ¾ to 1¼%. At the new Crystal Hill Mine, now being opened out, I took samples from each face indiscriminately, without picking or seeing whether any tin was visible or not, and the total assay was 0·6% metallic tin, or (at 70%) 0·85% tin-ore. Large deposits of ¾% stone undoubtedly exist, but then, again, poorer areas come in to reduce the average, which, from all appearances, is in the neighbourhood of ½%, taking the Tier as a whole.

The Anchor stone appears to be the lowest on the list, and in the district it is generally considered the poorest stuff. I fancy this is largely owing to the fact that the mine is being operated upon a large scale, and that the stone is not selected, but broken down from the faces and passed through the battery just as it comes. It is certain that if the other mines commenced to clear away the whole of their formation without selecting promising places at which to attack the deposit, the per cent. yield would be somewhat reduced.

Anchor Mine.

This is the most important and best equipped mine in the district. It is situated just to the S.W. of Lottah, on the slope of the hill above the Groom River. It was reported upon by Mr. Thureau in 1886, and again by Mr. Montgomery in 1889 and 1893. Work has been carried on here for over 20 years intermittently, but until the present management took the mine in hand, imperfect and costly methods have been the rule. Prior to the end of 1892, 30,734 tons were crushed, returning 288 tons tin-ore, equal to ·937%, but, with work on a larger scale, the average yield of the stone has decreased. For the 21 months ending June, 1901, 111,167 tons stone have been crushed for 434 tons tin-ore, equal to 0·39%. The company's ground covers 315 acres, but the actual work of winning ore is, so far, confined to an area of about 12 chains square, which is being slowly enlarged as the upper face advances north into the hill. The formation, or matrix, of the ore is the tin-granite described above. Generally, the felspar of the granite has not been wholly removed, and the rock is not very hard. In the Pentridge face, however, the rock is quartzose, and excessively hard; so hard that it has been taken for lode-stuff.

It belongs, however, to the same formation as the other. This eastern face carries good stone, of a quality near 1%. Twelve feet below it, 100 tons of tinstone were taken out by Mr. Mitchell, yielding 2% tin-ore. A tunnel has been driven 150 feet into this hard rock, and 75 tons of stone, taken out for a trial, gave 1% tin-ore.

The faces now being worked are 10 or 12 chains west of the above workings, and extend up the hill for a vertical distance of about 200 feet. No. 1, the lower face, forms a crescent 300 feet in length by 55 feet in height. The whole of the rock is broken down and trucked to the stone-breaker without selection, for all of it contains tin. Green mica and talc give a greenish tinge to the rock. A little fluor-spar accompanies quartz leaders; no bismuth or galena has been observed, only a little copper pyrites. Special concentrations of ore may be seen in floors of the greisenised rock and in nests. The principal joints and seams run E.W. and N.S.; minor ones traverse the rock in all directions. Tin is always looked for in and near the seams.

No. 2 face is about 150 feet above No. 1, and No. 3 is 50 feet above No. 2. I ought to say that 35 feet below No. 1 a tunnel has been driven for 250 feet, and 50 tons of stone were taken out and raised by horse-power to the stone breaks, and returned a good yield at the battery. It may be added that in the No. 1 face the stone on the whole keeps the same in quality from top to bottom, with, of course, richer and poorer patches occasionally.

No. 3, the uppermost face, has more stripping than the others, and the tin formation is covered by about 18 feet of country-granite, of which there is only a little in the N.W. corner of No. 2 face, and none at all lower down in No. 1 face. The tinstone in the upper face is of the usual character, except that it carries more leaders of stanniferous quartz.

A new epoch in the history of the mine commenced when the present general manager, Mr. R. Mitchell, took charge of the work, and readjusted the dressing plant. New faces were opened, and the property was prospected, both by tunnels and boring, with the diamond-drill. In 1899 nine bores were put down, five of which are in advance of No. 1 face, three being near the old eastern workings, and No. 9 600 feet further north. As a general result, the bores show that the rock is variable as a tin-carrier. The ground to the north of the upper face has not been tested by boring, as, before starting there, the drill was required by the Government.

The dressing-sheds contain two 50-head batteries, with 1000 lbs. stamps and accompanying classifiers, jigs, vanners, settlers, and buddles; the dressing is automatic and efficient. With full water supply, the 100 stamps will crush 100,000 tons of stone a year; but, unfortunately, for want of water, the 100-head have never run for long continuously, and the average number running last year was only 34. The management claims that when in full work the ore can be raised and treated for 2*s*. 6*d*. per ton of stone. The average hands on the pay-list for the past twelve months have been 112, and for full work not more than about 30 additional would be required. It is easy to see how desirable it is to obtain water-power sufficient for driving the complete plant. I was told that the question of transmission of power by electricity had been considered, with unfavourable conclusions.

The company have water-rights for 48 head, and, if that amount of water could be obtained, there would be no difficulty in driving the whole of the crushing and dressing plant. The new race, when completed, will extend 39 miles to the South George River; the first section goes 26 miles to the North George, tapping Waratah Creek, &c., on the way, and the remaining 13 miles to the South George will be constructed subsequently. In this way, it is hoped that ample power will be provided; whether this hope will be realised remains to be seen.

From the above, it will be seen now that the thing needed to make this property a success is an assured water supply at all seasons; provided, of course, that the tin-contents of the stone do not fall to a percentage which can no longer be extracted profitably. The manager assured me that he can pay expenses with 50 head of stamps; and, if this be so, it not only speaks volumes for the economical handling and efficient treatment of the material, but is also suggestive of the return which may be anticipated when the full 100 head are running continuously. What is done here may also be done at other mines in the district if the same care and skill are exercised.

Assuming the grade of ore to continue, and it seems safe to do this, the quantities necessary for success may be reasonably considered as existing. The ground for some depth below the lowest face and between the lowest and the top faces has been proved by the diamond-drill to be tin-bearing. Of course, in this area there are poor patches as well as good ones, but there is no doubt of the tin-bearing formation existing continuously north and south between

the faces for a total horizontal distance of 8 chains, and I think it may be legitimately accepted that the per cent. value of the stone for that distance will not be less than that shown by the battery returns the last few years, viz., 0·39%. The width of the formation has been proved for about 12 chains, but there is a good deal of broken ground, and, in my calculation of quantities which may be reckoned upon, I have confined myself to the width of the present workings, viz., 4 chains, leaving on one side the eastern ground, the value of which cannot be easily estimated. The eastern ground will probably swell the total output, but I am stating a minimum for the information of the Department, not a maximum for the gratification of shareholders. The proved block of stone to be taken out will then measure 8 chains long by 4 chains wide by 0 to 200 feet high, which (with a sp. gr. 2·67 × 62·425 = 166·67 lbs. per cubic foot) will total 1,037,142 tons, or, allowing 20% for barren interspaces, 829,714 tons tin-bearing stone. This quantity will suffice to feed 100 head of stamps continuously for eight years, and the tin-ore contents at 0·309% would be 2563 tons. This output can be increased by the produce of the eastern workings, but most of all by the advance of the faces into the hill north of the present upper workings. The eastern workings cannot be extended far to the east without coming under a heavy cap of country-granite; still, the ground explored up to date there will give a large output. Again, in the principal workings every additional chain of width taken in the face means nearly 200,000 tons more of material, or a couple of years' more work between the levels of existing faces.

A question of interest is whether the tin-granite will rise with the hill, or the overburden of barren granite increase, as the work advances. From my examination of the country surrounding the workings, I am led to believe that the overburden will be heavier east and north of the present works, but that it will decrease towards the west and north-west. Tin-granite is seen on the road N.W. of the mine and 500 feet above the lowest face, and I believe the future development of the mine will disclose a continuous vertical section of 500 feet; but whether it will all be payable stone cannot be ascertained beforehand, except partially, by use of the diamond-drill. The tunnel below the lowest face has also shown that very good tin-bearing stone is going underfoot. The full quantity of stanniferous rock existing on the property cannot be estimated without making as-

sumptions unverifiable in the present stage of development. It is not known, for instance, how far the percentage of tin may fall in the zones of rock which have not yet been proved; and, without further boring, it is not absolutely certain that concealed floors of barren granite may not interrupt the continuity of the formation here and there. But if, after extending the present faces right across the property, the ground throughout proves good enough to send to the battery, then, I estimate, there is stone enough on the company's sections to keep the mill going continuously for between 40 and 50 years.

The present low-grade of the stone treated, compared with crushings in previous years, is just sufficient to cause some anxiety as to the future; but I believe it will bear a further slight fall in the percentage, and still pay. Such fall would possibly be met by a correspondingly slight reduction of mining cost in handling full quantities of stone. The tin-market, too, must be considered; the last two years it has been favourable, and there are no signs of any serious permanent fall, but an unexpected change might dislocate working results for a time.

The other mines on the Tier will do well to note the experience of the Anchor. One lesson to be learned is that mining, or, as it is here, quarrying, must be accompanied by properly-arranged dressing plant and efficient dressing. The saving of the ore is as important as its mining.

If the new race fulfils the hopes which are formed of its capacity, then the Anchor Mine will be in an independent position as regards water supply; but experience with long partly-flumed races has invariably shown that great loss of water takes place, and it may be that the 187 horse-power promised in Mr. Rahbek's distribution scheme will prove a welcome addition. One thing is very clear. Unless the Anchor gets the full power necessary to drive its machinery (estimated by Mr. Rahbek at 275 h.p.), it will never pay dividends. It appears to possess enough ore-bearing stone to utilise any quantity of water that can be brought to the mill. It occupies an important position among the surrounding mines, and, if it can be brought to a dividend-paying state, the field will receive a great stimulus.

Australian Mine.

Australian Tin-Mining Company, No Liability.—The battery is about 1¼ mile W. of Lottah, and the property extends up the hill northwards to a height of 1000 feet

above the creek at its base. The old upper face, the Puzzle, is about 600 feet above the battery; the lower, the Don face, which is the one now being worked, is a little lower than the mill, with which it is connected by a tram 23 chains in length.

The formation is the tin-granite, a continuation of the Crystal Hill stone on the south, and connects with the same rock on the summit of the Tier, running through Haley's Lease and across the Wyniford to Mount Michael. From its apparent narrowness, it has been surmised to be a dyke of intrusive rock, but I have already explained my reasons for regarding it as a zone of altered granite. At the base of the hill it expands into a ⌊ shaped mass, one arm of the ⌊ extending W. to the Liberator, the other arm to the Anchor, a form incomprehensible on the dyke theory, but natural enough on the supposition that the permeation of the rock proceeded from joint planes. To explain the expansion, it used to be supposed that a lode runs E. and W. through the formation.

There is no essential difference between the formation at the Puzzle face and that at the Don. No systematic work has been done in the way of testing the ground between the two faces. The probability is that all the intervening rock is tin-bearing. Why it has not been prospected, and faces opened up, is incomprehensible.

The two faces at the top of the hill (Puzzle) have been abandoned since 1899 in favour of the Don workings at the bottom. The rock at the Puzzle faces is a greenish micaceous variety of the tin-granite merging into a more felspathic kind. It contains some iron and copper pyrites, and nests of crystals of mica, and some of it is very hard. The faces are about 60 feet high. When work ceased here, the published accounts show that the stone was returning ⅔% tin-ore. The first returns were 1½%, and the disappointment at subsequent crushings failing to maintain this yield serves to indicate the altogether erroneous conception of the nature of this huge stock of stone. Selected crushings are no guide to the value of the deposit as a whole.

Meantime, at the end of 1898 the Don claim at the base of the hill was taken over, after trying 25 tons of the stone in the battery, with the usual result of an abnormally-high return, viz., nearly 2% tin-ore. The next crushing, however, returned about 1%, and, during the first half-year in 1899, 2206 tons of stone were crushed for 20 tons, equal to

0·90% ore. In 1900, a poor patch of stone was encountered, which threw the average back to nearly ½%; but this year the yield has come up again, as follows:—

1st six months, to 28th February, 773 tons stone...	¾ per cent.
2nd six months, to 31st August, 1075 tons stone....	0·93 per cent.

This is a high percentage for the district, but not high enough to counterbalance the drawbacks which exist in connection with the handling and treatment of the stone at this mine. It seems safe to reckon that the Don face, as a whole, is capable of returning about ¾% tin-ore per ton of stone. I have no doubt, however, that work on a large scale, and including other parts of the property, would involve some decrease in the percentage yield. The average smelting works assay of the ore is published at 73%.

Fresh capital has been introduced into the undertaking this year, and the machinery repaired and overhauled. This work was going on at the time of my visit, when the battery, a 30-head one, was, consequently, idle. The motive-power is steam, and there was no means of substituting water-power in winter, when there is a good supply. This defect is being remedied by providing a Pelton wheel. Other drawbacks are irremediable without entirely new plant.

The Don faces are about 45 feet in height, the upper 15 feet of which are composed of rather barren rock, called the overburden. This is rejected in working, and the rest is sent to the battery. On the present restricted scale of working, only the selected stuff pays to treat, but, on a large scale, it is a question whether it would not pay to put the overburden through also, for there is no real difference between this and the lower part of the face; the latter is only richer in tin. Whether the overburden really will increase as the formation goes into the hill cannot yet be stated, though appearances point that way. On the other hand, stanniferous stone crops out higher up, towards the N.W. This "Don" formation has been proved for 4 chains in width by two faces.

On the top of the hill, good stone has been disclosed by prospecting north of the Puzzle face, and, I believe, tin-bearing rock could be uncovered all the way down the mountain-side. Mr. Rahbek's scheme provides 100·5 horse-power for the Australian Mine, and this, he estimates, is nearly double what is required for the mill.

The mine has been grievously mismanaged in previous years, but it is, nevertheless, a property which has the elements of future prosperity. The work which has been car-

ried on has failed to do justice to the property. Large quantities of stone exist, and could, with an efficient mill, be treated profitably.

I have to thank Mr. J. W. Palmer, the former manager, for showing me the faces, and Mr. Hugh Dempster, the present manager, for facilitating my examination.

Liberator Mine.

This property covers 120 acres, 6 miles W. of the Anchor. As far back as 1892, Mr. Montgomery found some prospecting work going on, in the form of surface-sluicing and shallow-shaft sinking, at the top of the hill. In 1896, the undertaking came into the hands of the Anchor Mine proprietors, who have since expended about £30,000 in developing it. Work on the present scale was started in the winter of 1898, but crushing has been intermittent from insufficient water supply; in fact, taking the whole year round, the supply is less than half what is required. In the dry season, consequently, crushing has had to be stopped. The supply is being increased by a new race bringing water 7 miles 57 chains from George Creek to supplement the quantity hitherto derived from the Groom River and its branches. When I was at the mine, about 4 heads of water were being got from the new race, and 3 from the Groom, which is about sufficient for all purposes; but the dry season will still present a difficulty.

The mine has a neat and efficient battery of 20 head of stampers, each full weight, 1000 lbs. Pelton and breast-wheels (2 feet breast, 10 feet diameter) actuate the machinery, which includes 8 jigs, 9 vanners, 2 buddles, besides electric light plant. With full water supply this battery could crush from 18,000 to 20,000 tons of stone per annum, and that is about as much as the present tramway can conveniently convey. If the motive-power for the mill were equal to this scale of work, a wonderful improvement on the present turnover would result. In 1899, only 3000 tons stone were crushed, averaging $\frac{3}{4}$% tin-ore; in 1900, 3100 tons stone were crushed, averaging $\frac{5}{8}$% tin-ore. The stone goes to the battery without selecting, and the ore is dressed up to about 73%; the range has been from 72·3 to 73·8%. Some of the rock crushes easily, but some is very hard. As a rule, the softer rock yields the most tin. To enforce how essential it is to base calculations for permanent work upon large quantities, I may instance this mine, in which a day's crushing will sometimes return nearly 1%, and the next day only $\frac{1}{2}$%. Fig. 3 at the end

of this report is a sketch of the main face. Two faces have been opened up at the top of the hill, about 300 feet above the mill. The main face is 31 feet in height, and has been worked down in benches to an enclosed floor. Exit is obtained by a short tunnel, through which the stone is trammed to the inclined-way and run down to the battery.

The stone is the same tin-granite as prevails at the Anchor, though much of it is somewhat harder. This is marked 6 in sketch. The hard stone in the lower 15 feet contains nests of tin-ore; one crystal weighing 9 lbs. has been found in it. Some molybdenite is present, and fluor-spar is often associated with it in nests, as a rule pervading the granite mass generally, and not in definite veins. Patches of flour-stained rock (C) prospect very fairly for tin. The stone is richer in the neighbourhood of seams (A); the appearances suggest the diffusion of the tin along horizontal floors rather than in vertical zones. In one of the quarries large tin-crystals are found in nests of good-sized crystals of quartz.

A third face, a little west of the others, is rather iron-stained and oxidised in the seams and joints. Fluor-spar here covers large faces of the rock, and molybdenite is freely disseminated throughout the stone in minute scales. Work had been suspended in this face from fear of contamination by iron, but, as the assays have returned 68·6% tin, it is intended to resume operations.

On the section north-east of the battery, as much as 150 tons of ore are said to have been taken from the creek in the old days.

North of the faces, for about 40 feet, the surface of the ground has been stripped to the bedrock, and prospecting-holes have been sunk. The faces cannot attain greater height, owing to their position on the top of the hill.

On the western section, about a third of the way down the hill, some prospecting work has been done in tin-granite, and the result is rather encouraging. These are called No. 4 workings, and the stone is softer than that in the upper faces, much resembling the formation at the Crystal Hill. Ten bores have been put down into the rock for 5 ft. 6 in. to 6 feet; a small pit has also been sunk 9 feet, and a drill-hole bored in the bottom for 4 feet. The prospects from the shaft go about 1%, and the average from the bores was, I am told, ¾%. It is proposed to send down the stone from here by a shoot to junction with the tramway from the Cambria Mine.

The tin-country is evidently continuous from the Crystal Hill, but none has been seen to the west of the Liberator ground beyond Working Miners' Creek. The ground between the present face and the battery does not seem to have been prospected at all, but I believe that a little work done upon it would show that faces equal to the present ones could be started much nearer to the mill. This is what is required to make the mine a success, namely, an extension of the scale of working. The stone is harder than the general run of stone at the Anchor, and the quantity broken from the face daily is about 3 tons per man, breaking and trucking; consequently, the mining cost must be higher than at the Anchor; but this could be greatly reduced by increasing the output.

At present this is a small mine, working intermittently, with a straitened water supply. The new race is expected to remedy the latter drawback, and it certainly will do this, at least partially. With increased water, the output must be raised, in order to bring the mine into a healthy condition. Mr. Rahbek's scheme provides for giving this mine 100 horse-power, which would be far beyond all possible requirements. Exploratory work must be kept up, and additional faces opened, if the mine is to lead any other than a lingering existence. It is a property of distinct promise; it is in the same great tin-bearing formation in which the Anchor, Crystal Hill, and Australian are situated. The per cent. yield of the portion worked has been equal to any of the others, and there is every reason to believe that, if it were opened out more extensively, and the necessary water were available, it would justify the hopes of its proprietors more thoroughly than it can be expected to do under present conditions. Mr. Jas. Scott, mining manager, kindly showed me around.

Crystal Hill.

The Crystal Hill Tin-Mining Company, No Liability.—This property comprises 130 acres, south of the Australian Company's Mine, and between the Liberator and Anchor properties. The hill comprised in the sections consists of the tin-granite of the district, most of which at the surface is tin-bearing to a greater or less extent. When I was there, a battery of 10 stampers was being erected, which it was intended to drive by steam-power, storing water for dressing by means of two or three dams. Mr. Rahbek's programme would supply this company with 3 sluice-heads, giving 91·2 horse-power.

The present battery is altogether too small for permanent exploitation of the deposit, as, even after making allowance for the stuff being softer than obtains at most of the other mines, I do not think the crushing-power will exceed 15,000 tons per annum.

There is a fair area of stanniferous ground, though there are portions which, apparently, would not pay to work. The main source of supply for the battery is the western hill, which, for a length of about 18 chains, has been trenched and cut into at five points, the highest about 80 feet above the lowest. The backs obtainable above the battery tramway appear to be 80 to 90 feet. The stone is very favourable for crushing. Faces can be opened easily, and there is no difficulty in conveying the stone to the battery.

Tests have been made of the quality of the stone from time to time, the most reliable results from this part of the ground being about 1%. I sampled the five faces just mentioned in a perfectly fair and indiscriminate manner, without any selection or examination of the stone, and my material, when assayed by Mr. W. F. Ward, the Government Analyst, returned 0·6% metallic tin, or 0·856% tin-ore. I feel some confidence in this yield as a fair average of the stone which is accessible. It is true that parts of the deposit will be found exceeding 1%, but poorer patches may also be looked for, which will reduce the average yield. The ground cannot be thoroughly prospected without the diamond-drill, but, so far as surface-indications go, the stone compares well with that of any of the surrounding mines. Its nature tallies most of all with the stone of the neighbouring Australia Mine. The quality will certainly vary, as may be seen already at the surface in different parts of the property, but the formation, as a whole, will not cut out in depth, and, if the undertaking is wisely managed on an adequate scale, I anticipate a prosperous future for it. I will now describe the other points which I examined.

Gaunt's Shaft Face, No. 3.—This is on a low saddle, east of the camp, and has yielded the best stone on the mine. A cut has been made into the stone about 6 feet deep, but its width has not been proved. A small shaft, between 15 and 20 feet deep, has been sunk, only a few yards ahead of the cutting, and has gone about 8 feet deeper than the latter. Water prevented my seeing the bottom, so I cannot say whether the rich stone of the cutting continues into it; but I understand the quality was irregular. The tramway can be taken round to this face, and the deposit will

certainly be found useful for mixing with the general stone, and keeping up the desired average. The quartz-leader, or indicator, here is the strongest which there is on the property. On all these mines the tin-granite is intersected by thin stringers, or veins, of quartz, running in all directions. The miner looks upon these as indicators of tin, and searches for them before breaking any ground. They may be seen very plainly developed on the Crystal Hill and Liberator sections; in fact, wherever the formation is tin-bearing.

The other workings, east of the camp, are somewhat removed from the battery, and are not available unless a cutting or tunnel is made through the saddle of the hill. For some of them a lower battery-site would have to be chosen.

Apatite Trench.—This is No. 2 of the eastern workings, and has been cut 8 feet for a length of 12 feet, yielding good specimens of tin-stone. The rock is reddish and somewhat peculiar, being a mixture of felspar (orthoclase and plagioclase) and apatite. The latter (fluo-phosphate of calcium) is abundant, in the form of pale green hexagonal prisms. Its occurrence is, undoubtedly, connected with the introduction of tin. Nothing has been done at this point beyond simply exposing the stone.

Elvan Trench, No. 1.—This is still further east, and cannot be worked to supply the present battery, but it shows that the tin-formation continues over a wide area. It has been driven about 60 feet into the hill, crossing an elvan dyke 14 feet behind the end. The dyke is composed of $1\frac{1}{2}$ feet of soft granular granite, of much the same nature as the country-rock, with about 4 feet of clay towards each side. It stands vertical, and runs E. and W. No tin was found in the trench until after passing through the elvan, and then a fair quantity of payable stone was met with. Near this trench the country has been stripped to the bed rock, exposing greisen with crystals of tin-ore. Here, as elsewhere, quartz leaders form indicators.

No. 5.—This is a small cut on the north side of the hill, above the road, opposite the Australian, in yellowish soft granite, containing a little fine tin. It had only just been opened, indications having been found while grubbing an old tree.

No. 4.—This consists of workings $\frac{1}{4}$ mile W. of the camp, and is a large formation of rather soft stone, in which an excavation has been made, 23 feet deep, and a tunnel driven. The softest part has been sluiced, and over a ton of tin said

to have been taken out of it. From the size of the excavation, I should judge that yield to represent about ¾% tin-ore. The ground worked is reported to have been irregular in quality, but tin-bearing all through.

The extreme eastern and extreme western portions of this property will probably be left alone for the present, and attention concentrated on the central part. The trial which will be given it by the small battery will test the superficial part of the deposit, and will most likely induce the owners to try more extensive work by-and-by. The mine has several good points; plenty of stone, ample timber and firewood; the stone is of easy nature for crushing, can be mined cheaply, and the main road is close at hand. The only drawback is the necessity for using steam. To develop into a permanent concern, work must be undertaken on a larger scale than contemplated at present. The stone will have to be taken just as it is, and treated for what it is worth. It will, no doubt, be found to vary in quality, the same as at the other mines on the field, but in the ore-zone there is every chance of its maintaining a payable average, even working with steam, and *a fortiori* with water, if the water conservation scheme on the Tier is initiated. I have to thank Mr. E. Hall and Mr. J. Stott, mining manager, for attentions during my visit.

Tin Properties on the Summit of the Tier.

Similar tin-bearing stone to that which is worked at the Anchor, Australian, Liberator, and Crystal Hill, is found at the top of the Blue Tier, 1700 feet above the Anchor Mine. An uninterrupted connection can be traced up the hill to the Puzzle, and then right through Haley's Lease to Beale's at Mount Michael. A similar connection cannot be made out between the Anchor and the Full Moon, as a body of country-granite caps the Anchor deposit northwards; but the Moon is apparently a higher floor of the tin-bearing stone, and has probably a lateral connection with the stone on Haley's Lease.

The tin-stone passes right through the crest of the Tier, and is worked also on the northern brow. There are three properties here which are worth attention, and form three natural groups, capable of being worked as separate mining propositions, but, from their elevated position on the watershed, they cannot be developed so easily as the mines which are lower down. Indeed, the problem of their profitable

exploitation is one for the engineer. Nevertheless, there is every appearance of a great store of tin-bearing stone upon this lofty plateau, and the means of utilising it demands consideration.

Haley's Lease.—Mr. J. Ogilvie showed me this property, which, I understand, comprises 180 acres, viz.:—Ogilvie, 80 acres; Johnston, 20 acres; Gee, 80 acres. There is a continuous run of tin-granite from the top of the Tier northwards to the head of the Wyniford River. The connection of the stone with the Australian sections to the south has been proved by the work done on the old Crowther's and Ethel sections. At surface the tin-bearing rock is not very wide. It forms a strip 1 to 3 chains wide on the Lease, and this has caused it to be regarded as a dyke. I prefer to regard it rather as granite impregnated with tin, and altered on one or both sides of a vertical joint plane. This plane is not even always vertical, and hence we cannot tell how far the tin-bearing rock may extend laterally underground. There is some evidence of such extension eastwards from Haley's Lease into the Full Moon property.

On the south section of the Lease (Ogilvie's section) we have country-granite on both the east and west boundaries, the strip of tin-stone running through the middle of the section. I saw some workings in yellow soft felspathic tinstone, to a depth of 25 feet, carrying good tin. The formation here is between 2 and 3 chains wide. Very good prospects were obtained. On the western wall, a rich seam was worked as alluvial, so long as it was sufficiently soft; when it hardened, it was abandoned. The ground here is patchy, and might possibly average anything between ½ and ¾%. Further north (south of main workings) a soft formation has been worked on the east wall, proving very good. As a rule, this upper floor of tin-granite on the Tier is more felspathic and less quartzose than the stone in the mines below. At the main workings there are two large pits excavated, the first to 30 feet; the second, a few yards further north, is 40 feet deep, from which the stuff went down through a pass to the branch tunnel below. The tin-stone comes to the surface in massive, jointed blocks. Its width does not appear to be proved at this point, and I shall not be surprised if it is found to join the Full Moon run of stone to the east. The tunnel level is 40 feet above the old battery floor; by cutting down a few chains below the camp, several feet more might be gained, and I was told that a good deal more backs could be got by cutting for nearly

half a mile further. This cutting would drain the mine to its present level, but any increase in depth will necessitate pumping. Mr. Montgomery suggested that the water pumped up might be used for dressing. If water-power is to be used, a battery will have to be erected lower down the Wyniford. Other plans of working the mine are more problematical, such as tunnelling through to the soutnern fall above the Australian, or connecting with the Lottah tunnel, *viâ* the Moon properties. In the old days, mining and concentrating cost 6*s.* 6*d.* per ton, and the stone, according to the company's accounts, averaged ·6486% black tin, assaying from 65·8% to 73%. With improved plant and management, the cost could now be reduced considerably, but it would not, I think, be wise to reckon on a higher percentage yield from the stone. On the contrary, with an augmented output, the tendency would be towards a diminution of the average.

The holders of the Lease properties regard the flat, a mile lower down to the N.W. (the site, I believe, of Mr. Rahbek's proposed compensation reservoir on the Wyniford fall), as the place where water could be conserved for their battery. They consider that a long low tunnel from that side would give them a hundred feet additional backs.

Just N. of the camp, a dyke of diabase (dolerite), formerly supposed to be Tertiary basalt, crosses the formation in a N.E.-S.W. direction.

The tin-stone continues without a break through Johnston's and Gee's sections to the Wyniford River, and has been trenched across at several points. On Gee's section a 30-feet shaft was sunk on what was always considered to be rich stone, but had to be stopped, owing to insufficient pumping-power. There is none of the stone left now at surface, it having all been carted away and crushed. The formation-rock is the soft greenish variety of the Australian and Crystal Hill tin-granite. A long open drive was begun from the Wyniford, and driven south, as an approach to an adit to connect with the shaft at a depth of 50 or 60 feet; but this work was never completed. It is rather singular that no ore was got from the drive.

There is, apparently, not the great mass of tin-stone on this property that there is at the mines on the southern slope of the Tier, but the average yield will be nearly the same, and there is enough ground to make the group well worth attention. I firmly believe that the underground extension of the formation is likely to be more considerable than can be judged by the development at surface.

Beale's Property.—This ground is about 1½ mile north of the Wyniford River, and is worked at present on a small scale by Mr. Robt. Beales. The rock at the base and on the slopes of Mount Michael (or Macmichael, as it is sometimes called) is of precisely the same character as that of the other mines on the Tier, a soft greenish tin-granite. Little Mount Michael lies to the west, and this tin-bearing ground occupies the area between the two mounts, as well as entering into the composition of the peaks themselves. The distance between the two mountains is about ¼ mile. The tin-stone, being soft, has weathered away, and provided material for sluicing, and this is being carried on down to the hard bedrock. A shaft has been sunk over 20 feet deep, but stopped, owing to water. I saw some nice pieces of tin-stone among the rock stacked at the mouth of the shaft, but cannot report as to the nature of the ground at the bottom. Judging from the pile of stone, I should say the quality is variable—sometimes good, sometimes poor—similar to what obtains in the other mines of the district. There is evidently a fair quantity of tin-stone on the property, and every likelihood of the quality being equal to that of its neighbours. The tin-ground is wider than on Haley's Lease, and offers in that way more scope for continuous working, but the situation is more remote, being farther over the northern fall of the Tier. The ground falls on the south to the Wyniford, and on the north to Cotton's Creek. I did not visit the latter, and am uncertain how the mine could be best worked. I was told the tin-ore usually goes 72%, and has been as high as 73 and 74%.

The Moon Properties.

These are now under offer in London. The mine suspended operations on the failure of the Van Diemen's Land Bank. Mr. Kirwan kindly accompanied me round the property, which shows signs of a good deal of work having been carried on in former days. It is situated N.E. of Poimena, just outside the township, and on the north fall of the Tier. Crushing returns formerly were at first 0·75 to 3%, and finally an average of 1·25% ore, but crushing was not continued very long, as operations were not profitable. A good deal of driving was done from the 120-feet shaft. The ground at surface is granite, but tin-stone was found lower down, said to be the richest on the Tier. I am unable to say whether this stone was the massive tin-granite or quartz-vein stuff, of which a lot is seen lying about. Tin-bearing quartz-veins and leaders intersect the Moon ground,

and have been worked for tin, and the excavations in all directions on these veins look now like old races. Some of the stone resembles that of the Lottah lodes, and also carries a little molybdenite. The long drive, I was told, has gone 600 or 700 feet towards the Lottah Mine. The long level at the Lottah has been driven 900 feet; consequently, to connect the two sets of workings, 2300 feet more driving would be required, and the present idea of the Moon promoters is that the connection should be made, and the ore sent through the tunnel to a battery to be erected at the Lottah end. The lower tunnel at the Lottah is about 500 feet lower than the Moon drive, the upper one only 250 feet lower. It is hoped that the Haley's Lease Mines would also send their stone through the same tunnel, and thus supply continuous work for a large battery. I am afraid this anticipation will be found difficult of realisation. The stone will never pay to bring that distance, and the ¾-mile tunnel will not admit of steady, rapid delivery of the output of two or three mines. The Moon people, I am of opinion, would find its carrying capacity taxed to the utmost to keep their own battery regularly supplied. There are two other ways of working, each of which, I believe, is preferable, provided work is carried on upon an adequate scale. One is by steam, pure and simple. This was done formerly, but at a ruinous expense, mainly on account of the small quantities treated. The other is by electricity as a motive-power, generated by water from the Wyniford basin. It might be possible to select a convenient site for a mill, to serve both the Haley's Lease and Moon properties.

Vertical contacts of tin-stone with country-granite, divided from the latter by vein-quartz, are seen in the Moon workings, but it is also apparent that the tin-stone forms a floor under the ordinary granite. A run of stone about 3 chains wide passes S.W. to connect with the stone on Haley's Lease, and my interpretation of the occurrences is that the tin-granite exists all over the Moon and Lease area in a floor below the country-granite, the dyke-like exposures only marking vertical planes at right angles to the main floors. Upon this point, those beginning work ought to assure themselves by systematic boring. By this they would mark out definitely the area of tin-bearing stone, and ascertain whether it continues to a reasonable depth, without any serious interruption. Neglect of this precaution would be inexcusable.

The Moon ground abounds in rich patches. From first to last, the mine cannot have produced less than 1000 tons

of tin-ore, but battery work was carried on upon far too small a scale to admit of success, especially under the local conditions of steam and haulage. They worked the deposit down to a low level, and then had to lift all material to the battery.

The fact cannot be disguised that these Upper Tier properties are disadvantageously situated for work, being on the northern brow of the hill, and at such a great elevation that the backs are trifling and water supply inadequate, or, to say the least, inconvenient. In the case of each property, the method of working will require careful consideration before entering upon any outlay. As, however, the tin-stone is undoubtedly present, the claims will certainly be worked sooner or later. My own opinion is that the Haley's Lease and Beales' properties will be worked by water on the northern fall, and the Moon by steam or electricity. The success or otherwise of the mines lower down near Lottah will, without question, powerfully affect, and, perhaps, wholly determine for a long time, the fate of the upper ones.

Lottah Mine.—This is situate 500 feet above Lottah, and has been idle for a long time. It was described by Mr. Montgomery, in his 1889 report, and alluded to again by him in 1893, as a promising mine abandoned when ready to begin stoping. The lode is well-known as containing excellent ore, and it is a wonder that no further attempt has been made to test it.

Laffer Mine.—This is a small exploratory mine east of the township. Three small drives are being put into the hill-side in pegmatite dyke-rock, which has yielded some coarse tin-ore. Owing to floods, no one was working on the afternoon that I was there, and I only saw the two lower tunnels. The lower tunnel is first driven in decayed granite, and then into a dyke of pegmatitic quartz and felspar, and the upper one begins in a felspathic-clay formation containing white mica. Some tin-ore has come out of this tunnel in soft pegmatitic rock, associated with greisen; but the drive appears now to have gone through into the country-granite. Some stones very rich in tin may be picked up on the hill-side, and the endeavour is naturally being made to find their source. When this is found, I believe it will prove to be connected with the coarse pegmatite formation. Some

rich bands may be discovered, but they are not likely to be wide. The men are sticking pluckily to their little venture, and it is to be hoped that they will be successful.

Cambria Mine.—Mr. Jas. Scott also kindly accompanied me to this mine, which is on the southern fall of the Little Plain, 1 mile S.W. of the Liberator. The property is held by the Anchor Company's directors. The ground is traversed by the ravines which form the head of Waratah Creek. Lode-work was started over 10 years ago, but has been intermittent, and nothing was being done at the time of my visit.

The sections are outside the Lottah zone of tin-granite, the country being the ordinary porphyritic granite overlaid towards the north by Tertiary basalt.

In the northern part of the long section (1510) a shaft has been sunk, and short drives opened out east and west on the lode, but no stone has been crushed. Judging from the surface-pile, the lode consists of a dark-grey mica-quartz rock, containing a white quartz seam or seams. Tin appears in the quartz, but none is visible in the micaceous lode-rock. Talc and arseniate of iron give a greenish hue to parts of the rock. From here a N. and S. lode outcrops down the hill. This consists of seven or eight veins of quartz, about a foot apart, and from 1 inch to 4 inches wide, faced with very coarse tin-crystals, associated with radiating talc. The lode has been laid bare by stripping. Lower down, still on the long section, a tunnel has been driven for the intersection of the E. and W. lode with the N. and S. one. The intersection was reached, but the former lode not properly tested. Some 60 tons have been taken out and crushed at the Liberator battery, but as I understand the ore was not treated separately, results cannot be stated precisely. The yield was believed to be from $\frac{3}{4}$ to 1%. The tram connecting with the Liberator is a long one, $4\frac{1}{4}$ to $4\frac{1}{2}$ miles, and the idea was that 30 or 40 tons a day could be conveyed, whereas the actual quantity was only 6 tons.

Some of the vein-stone is over a foot wide. The quartz is vitreous, and carries coarse tin, yellowish-green flakes and rosettes of talc, occasional iron and copper pyrites, and fluor-stains. The proportion of copper pyrites appears occasionally to be unpleasantly great, but it is not intimately mixed with the tin. At the intersection the lode was good, and specimens up to 10% value were obtainable, but the N. and S. lode cannot be described as payable. In the quartzose

lode-matter patches of granite occur. Probably the quartz-veins represent the fissure, and the quartzose bands are the wall-rock of altered granite, as shown in Fig. 4 at the end of this Report.

Lower down the hill, to the S.E., a good deal of sluicing has been done on the E. and W. lode. From this line of lode I was told that 500 tons of tin-ore are reported to have been won altogether. The lode is crossed at all angles by numerous veins of quartz and kaolin, which carry good tin-ore. The line of soft ground along its outcrop has been sluiced away, leaving a deep cutting 20 to 25 feet. Continuing E. on surface, the lode is 3 feet wide, with veins of quartz, as represented in Fig. 5 at end of Report. A little further N. is a lode outcrop, 18 inches to 2 feet wide, N.W.-S.E., which will cross the others. A little E. is another parallel lode. The whole series of lodes cross each other, the most important intersections being somewhere near the shaft. The rich patches of ore will almost certainly be found at the intersections, and from the tin already won by washing and other trials, there would seem to be a good number of such concentrations. Whether the concentrations are numerous enough to pay for underground mining can only be proved by more extended trial. I would advise that the tramway be improved, and the E. and W. lode be given a thorough mining trial before incurring any expense for the provision of a battery. A moderate amount of judicious expenditure will soon show whether the lode is payable, and, if it proves to be so, there are fair facilities for milling. I think, however, that for a long time to come, it will be found more feasible to tram the stuff to the Liberator battery, notwithstanding the distance.

There are good facilities for adit-driving, and deep work will be required to prove the mine thoroughly, for the ore concentrations will have to be followed down, if the mine is to be a permanent one.

Russell's Wolfram Mine.—I visited this small mine, which had been started on Russell's section, between Lottah and Poimena, about 500 feet above the former township. It is reached by ascending the Poimena Road from Lottah, and then striking west into the bush a little way.

I saw three openings into the lode, at intervals of 6 and 15 chains. A tunnel was driven, about 20 years ago, for tin-ore, and at over 100 feet intersected the lode about 25

feet from the surface. A drive N.E. for 15 or 20 feet has followed the lode, which consists of reef-quartz 3 to 6 inches wide, containing scattered patches and crystals of wolframite (tungstate of iron and manganese), with which iron and copper pyrites are associated. Some tin is said to occur in the lode, but I did not find any. The crystals of wolframite are often faced with azurite and green carbonate of copper, and extensive azurite-staining is seen on the footwall of the lode in the drive. The quartz is the clean vitreous variety usual in the tin-fields. The country-rock is porphyritic granite.

This tunnel is driven into a hill-spur, and levels on the course of the lode would come under diminished backs, and southwards would, in fact, emerge into daylight. There is no use whatever in extending the present level.

Fifteen chains further N. a trench about 6 feet deep has been cut across the cap of the same lode. The detritus from the softened and disintegrated capping yields, by washing, small lumps and grains of wolfram from the size of a pea down to that of coarse tin-ore. The lode outcrop, including 4 inches of hardened wall-rock, is about 15 inches wide, dipping south 1 in 6 or 7. Section of this is shown in Fig. 6 at end of this Report.

Six chains further N.E. the lode has been exposed again by a cut about 7 feet deep. The outcrop is in soft decomposed granite; on the footwall side, an inch or two of quartz is visible, and in the middle is soft decomposed lode-stuff, which, when washed, showed a few grains of wolfram. The cut is not deep enough to expose the lode properly.

From the tunnel I took samples fairly representing the quality of stone which one may expect to meet with, *i.e.*, of wolfram-bearing stone. These were assayed by Mr. W. F. Ward, the Government Analyst, who reports:—Wolfram contents, 5%; analysis of wolfram, tungsten trioxide, 62·2%; manganous oxide (MnO), 5·4%.

Tungsten trioxide (WO_3) is known as tungstic acid, and the selling value of wolfram-ore is based upon the percentage of acid which it contains. Recent quotations are £28 for 72% ore, and at the time of my inspection it was understood that 70% ore would realise £20 per ton; but a vein averaging only 3 inches, with only 5% of wolfram, will not pay to work, besides which objectionable elements are present, such as accessory copper pyrites, and the reported tin-ore.

If the mine were to be worked, a low tunnel would have to be driven about 100 feet below the open cut, and ex-

tended 200 feet, to cut the vein, and open out on same N. and S. The work is purely speculative, the indications are not encouraging, and I should not like to hold out hopes of success.

St. Helens District.

Stony Ford Mine.—This is a small tin-mine, about a mile W. of St. Helens, owned by the Anchor Company. At the time of my visit an open crosscut drive had just reached the lode, which is of a singular nature—one not observed hitherto elsewhere in the State. The mine is just south of the Golden Fleece Rivulet, and in the angle formed by the road and rivulet. The country is granite, of the type prevalent round St. Helens, with dark mica and much quartz, and on either side of the lode it is converted into a dark quartzo-felspathic capel or wall-rock. This wall-rock is about 3 feet wide on the east side of the lode; a little of it exists also on the W. side. It merges gradually into the granite, with no clean wall of division, and appears, in fact, to be altered granite. The tin-bearing rock cannot be described as a lode, but was not exposed fully enough for me to be quite sure as to its relations to the encasing granite. It is a band of quartz-chlorite rock, charged with pink garnets, iron pyrites, a little blende and copper pyrites occasionally, and tin oxide. I took a bag of samples from the different ore-heaps, and the result of assay by Mr. W. F Ward, Government Analyst, was 2% metallic tin. Sketch of the section of the lode is given in Figure 7 at the end of the report. There is a line of this garnetiferous schist (the rock is sometimes quite schistose) running through the granite-country east and west. I was told that some eight years ago 3 tons of similar lode-stuff was sent away for crushing, and gave a high return of tin-ore.

There is some, I believe, south of Jason's Gates, and some on Houston and Miller's section east and adjoining Stony Ford, and Mr. Henry Grant took me to a couple of exposures of it in the granite alongside the main road, on Lord's property, ½ mile E. of the St. Helen's Bridge. Here the green schist is thoroughly encased in and mixed with the country-granite. The two exposures were 100 feet apart. (See Figure 8.)

The most feasible explanation of the occurrence is that it is in the contact zone of the granite with the slates and sandstones of the neighbouring Silurian country. Crossing the Golden Fleece Rivulet, a chain or two north of the mine, a contact of granite with quartz schist occurs, and

in the drive itself there are twisted pieces of hornstone in the country-granite east of the "lode," making it pretty clear that the phenomena are those of contact, as might be guessed from the garnet. The granite in the drive is seamed and faced and mixed with hornstone contact-rock, grey in colour, dense, and of flinty aspect, often in large massive heads. It may be imagined that the contact-line formed a channel for the ascent of the stanniferous solutions which deposited their contents in the schist, the granite being altered at the same time on each side to the hard "capel," or wall-rock.

A long open drive has been driven 120 feet to cut the lode, which had just been reached when I visited the mine. Surface stripping had exposed the lode for 250 feet to the west. Just where the drive impinged upon the lode, a shaft had been sunk 27 feet from surface, but was not empty. At the bottom the garnet rock is said to be 4 feet wide; this I could not verify. Too great hopes must not be entertained of this deposit descending regularly to any great depth, as it is not a main contact, but looks more likely to be torn off and included fragments of schist a little distance off from the general line of granite contact. This, of course, does not exclude the existence of small connecting-channels between the different patches of schist, but it may form a drawback to economical mining.

Westwards, on the other side of the little creek, another shaft has been sunk 22 feet in soft granite, to cut the lode on its underlie, but has been discontinued in favour of stoping the lode from the surface down to 24 feet, all along its course as far as the shaft. In this way all the easily-accessible lode-stuff will be removed, but no greater depth can be gained without sinking. Shaft-sinking is absolutely necessary, both for proving and working this lode. As said above, the chances are that the deposit is an irregular one, varying in width, perhaps pinching out for a time. If this occurs, it must be followed down to a greater depth; a timid policy will be out of place in developing this mine. The indications at present are good, and the percentage of ore is very fair and encouraging. The proprietors have an undertaking here which is a legitimate opening for enterprise. Before putting up a battery, I would advise deeper work in opening out the mine.

Silver Echo Mine.—This mine near St. Helens has been recently reported upon by Mr. G. A. Waller, Assistant Government Geologist, and it is unnecessary for me to do

MAP OF TIN COUNTRY ON BLUE-TIER

Scale 20 10 0 10 20 30 40 50 60 Chains

Granite — Tin granite formation

5 cm

T.S.G.

W. H. Twelvetrees
Government Geologist
7 Dec. 1901

LITTLE MT MICHAEL
BEALES SHAFT
MOUNT MICHAEL
WYNIFORD RIVER
PROPOSED COMPENSATION RESERVOIR
PROPOSED POWER RESERVOIR
MOUNT GEORGE
W.F. Stephens
SHAFT
DYKE
QUARTZ
LEASE
E.C.R.L. Heton
M.GON
TUNNEL
POWER
FEEDERS
PROPOSED RACE FROM
PROP. FEEDER RESERVOIRS
POIMENA
HALEY'S
A.C. Stephens
LODE
A. Simpson pur.
LOTTAH TUNNEL
RANSOM RIVER
MARIE LOUISE CREEK
AUSTRALIAN TIN MINING Co N.L.
A.H. Hodge
C. Duncombe
J. Russell
WORKS
W. Latham
CRYSTAL HILL T.M. Co N.L.
LIBERATOR T.M.
E. Hall
E. Gaunt
A. Woolley
LOTTAH
DYKE
ANCHOR T.M.
ANCHOR TIN MINE L.TD
CRYSTAL CREEK
GROOM RIVER
SHAFT
A. Deedes & A. Lee
CAMBRIA TIN MINE
W. Grant
W. Littlechild
P. Haley

FIGURE 1

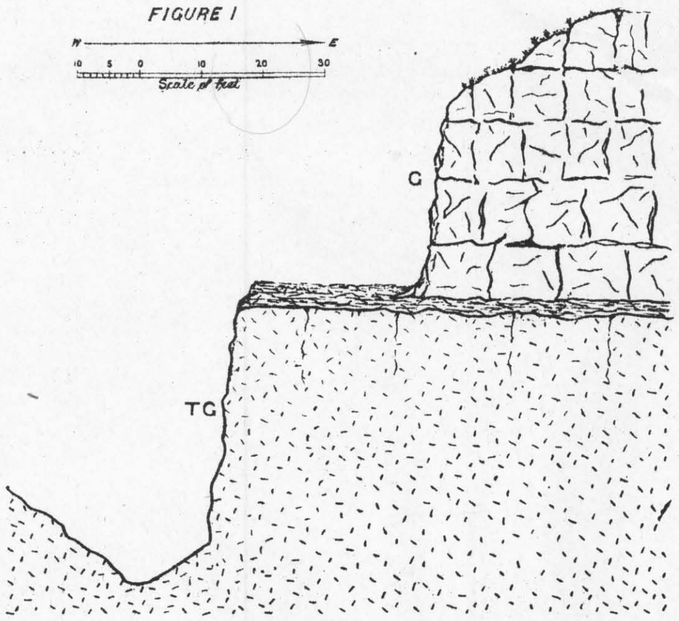


FIGURE 2

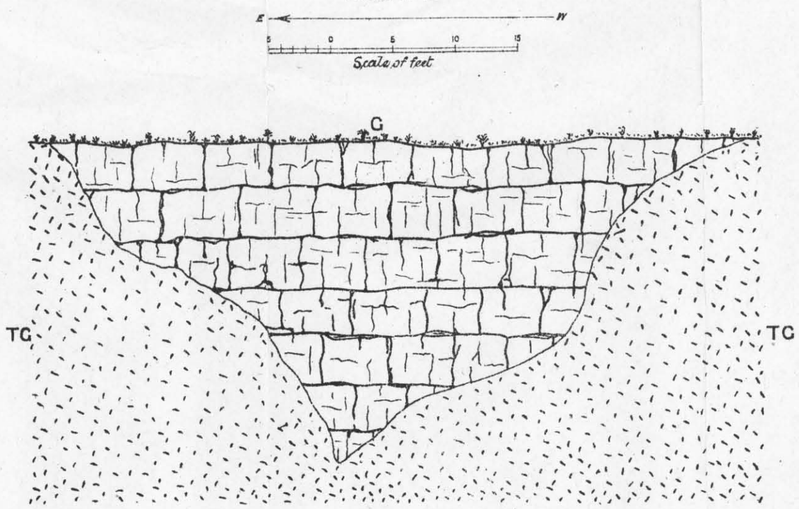
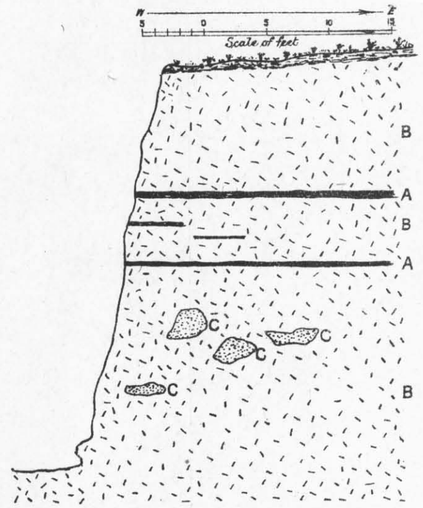


FIGURE 3



5 cm

FIGURE 4

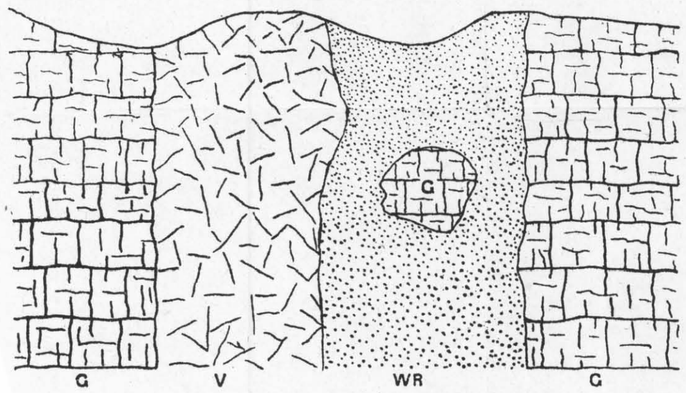


FIGURE 5

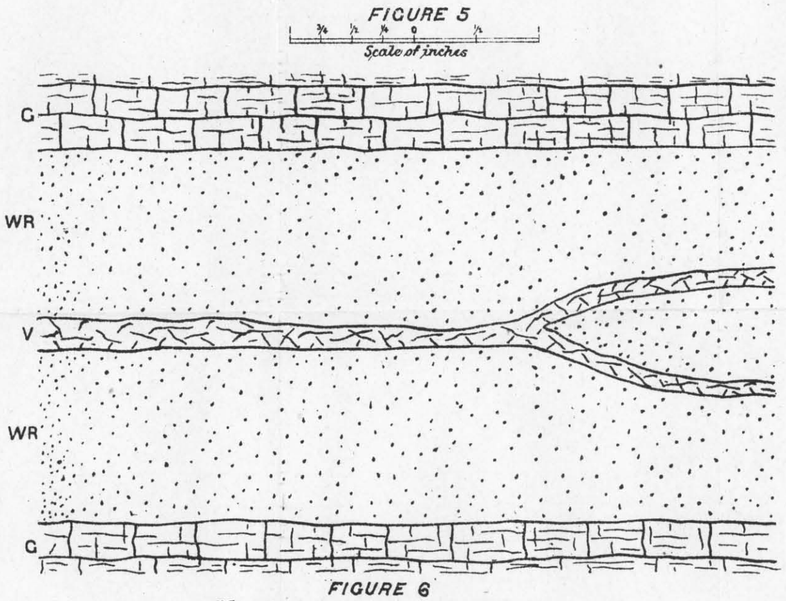


FIGURE 6

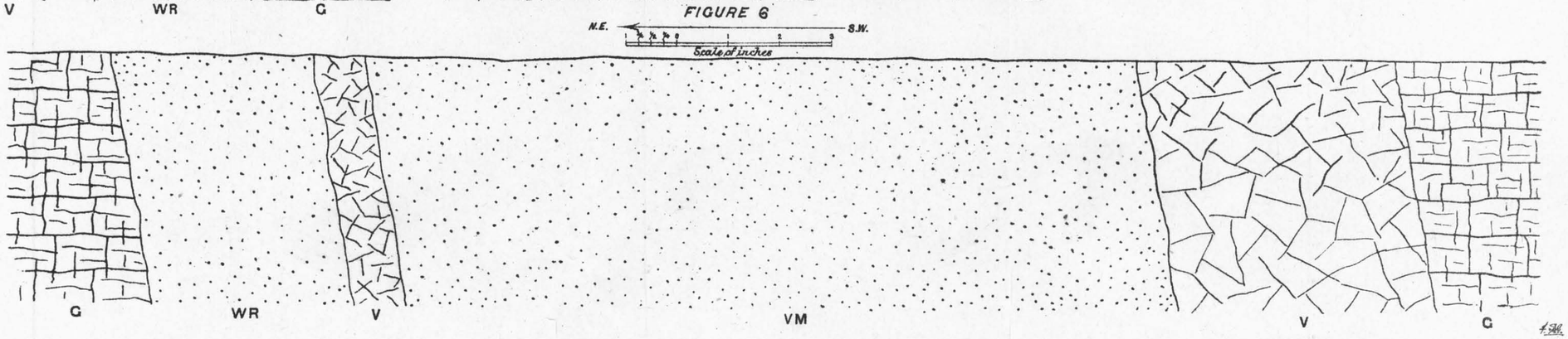


FIGURE 7

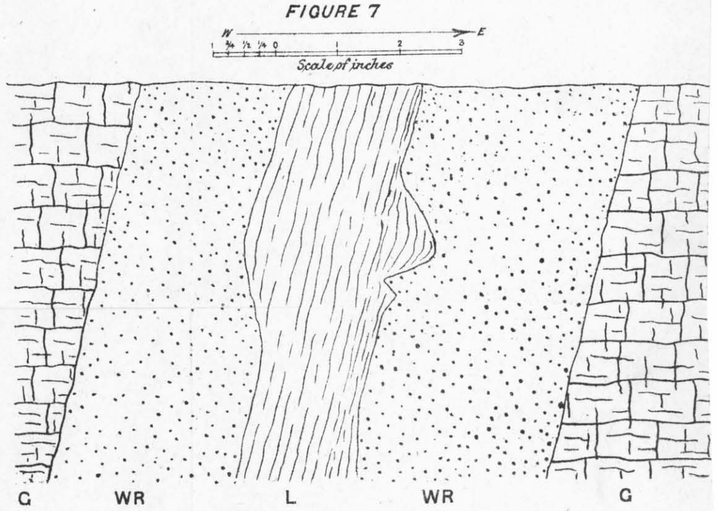


FIGURE 8

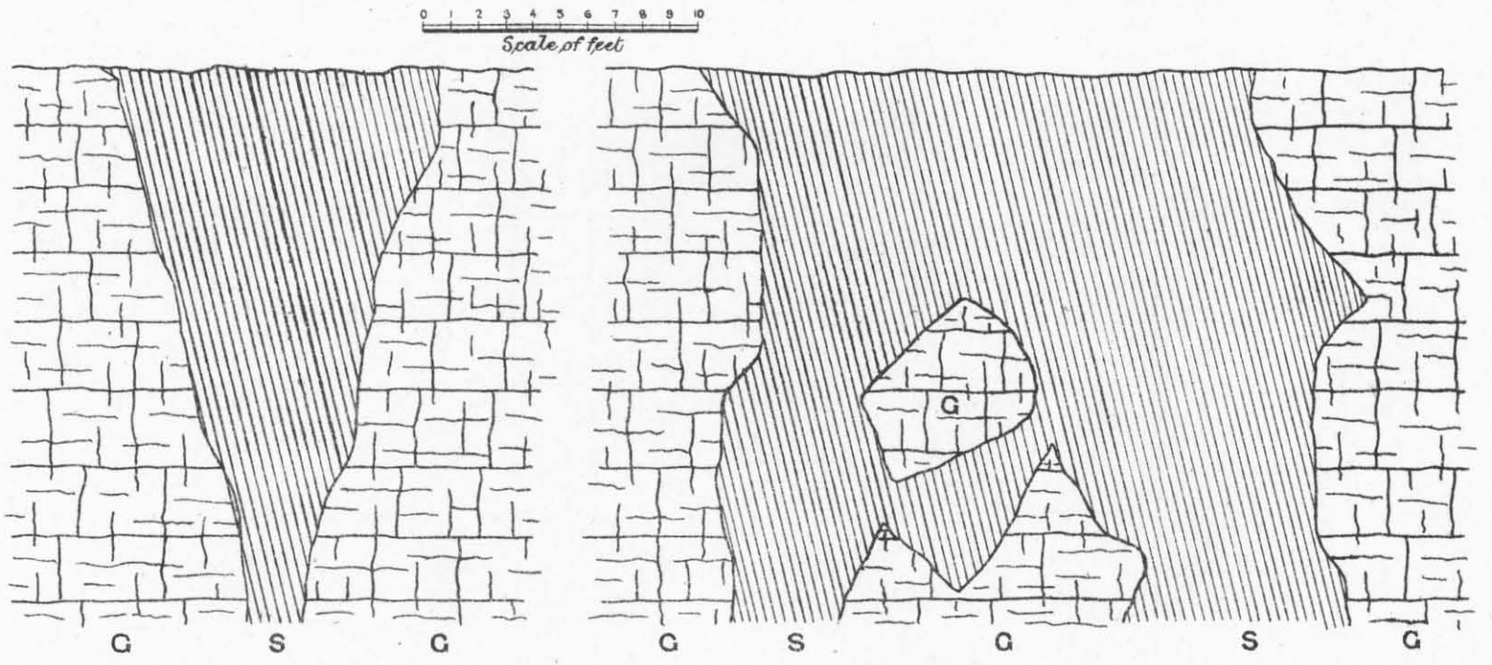
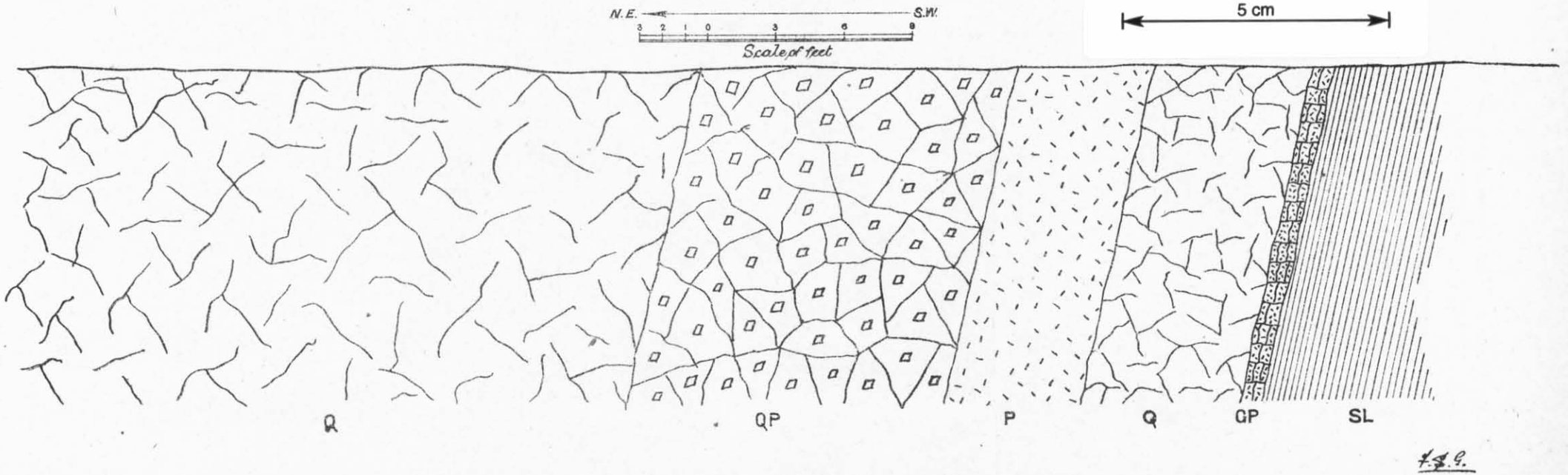


FIGURE 9



more than confirm his account generally. I am afraid that at present it is more interesting geologically than important from an economical point of view.

The lode is in metamorphosed Silurian slate, running N. 20° E., and is of great width. The whole of it has not been uncovered, and the width is, consequently, undefined. A width of 50 or 60 feet may be assumed. Its composition is peculiar. The footwall portion for about a foot is granite-porphyry dyke-rock (porphyritic felspar—orthoclase and plagioclase—dark mica and quartz. The groundmass is quartz and muscovite). This merges into quartz for 7 feet, which is then replaced by 6 feet of pyrrhotite, the latter developing into quartz and chlorite on its margin. To the east of this the lode consists of quartz, with pyrites for 14 feet, and then bluish-white quartz for some 30 feet or thereabouts. I give a section of the lode in Figure 9. The pyrrhotite part carries some golden (lithia ?) mica; pyrite, copper pyrites, and marcasite also figure in it. The reported 15 dwts. gold per ton is said to have come from the latter mineral. Tourmaline occurs also. A small vein crossing the approach to the tunnel is said to have given good assays in copper and up to 5 ozs. silver; and, in the tunnel, a succession of quartz-veins, with a little native copper, crosses the lode. Though tin might reasonably be expected to be present, it has not been found yet, and there is hardly any inducement to expend much in opening it up. Still, not very much is known of the real nature of the lode, and until some further work is done upon it there will always be uncertainty as to its possible value.

Conclusion.

In drawing these observations to a close, I may emphasise the fact that on the Blue Tier we have a large area of tin-bearing rock, sufficient to keep several mines going for a good many years, supposing only that the tin-stone continues a very little below already-proved depths. If it descends indefinitely, there is enough stope for generations. If the dyke theory of its occurrence be correct, there is no reason why it should not persist to a great depth; if the floor theory is the right one, it will still descend to any required depth, but is liable to interruptions from barren horizons. The different companies interested may be recommended to prove their ground by boring before launching out into great works.

Considerable portions of this area may be safely expected to yield ½% of tin-ore; experience at the Anchor end of the ground has shown that the bulk there is worth about ⅓%. If, as is claimed by the Anchor Company, such stone can be treated profitably, there is no doubt that immense quantities await extraction. It is well, however, to bear in mind that, with such low-grade material, the margin, or difference, between profit and loss is extremely small, and no engineering or mining mistakes are admissible.

The development of the mines appears to be governed by the water-power available. There is a lamentable deficiency of this. Steam makes up for it imperfectly. The real solution of the difficulty lies in an efficient scheme for the conservation of the natural supplies of water. With adequate water, the district would, without question, be a busy tin-producing centre. It is a productive district as it is, but its production is intermittent, being dependent upon the rainfall.

For myself, I entertain high hopes of the future of the Tier. It is true the ground needs testing on a large scale by boring, but it has been broken into already at several points here and there, and a good deal of it has been proved by actual work. We have good ore-ground at its base; there is also good ground at its summit, and there is every reason to believe that in the intervening space there are large quantities of similar stone. This mountain range, in my opinion, forms a practically permanent asset of the State.

I have the honour to be,

Sir,

Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

W. H. WALLACE, ESQ.,
Secretary for Mines, Hobart.

EXPLANATION OF FIGURES.

FIG. 1.—Tinstone underlying granite in eastern workings at Anchor Mine. TG = tinstone or tin-granite; G = ordinary country granite.

FIG. 2.—Tinstone underlying granite on Haley's Lease; TG = tin-granite; G = ordinary granite.

FIG. 3.—Section of face at Liberator Mine; A = seams or joints; B = tin-granite; C = fluorine patches.

FIG. 4.—Section of lode, Cambria Mine. G = granite; V = vein-stone (quartz); WR = wall-rock.

FIG. 5.—Plan of lode, Cambria Mine. G = granite; V = quartz-vein; WR = wall-rock.

FIG. 6.—Section of Wolfram lode, Russell's Section. G = granite; WR = wall-rock; V = quartz-vein; VM = vein-matter.

FIG. 7.—Section of lode at Stony Ford Tin Mine. G = granite; L = lode, garnetiferous schist; WR = wall-rock, capel.

FIG. 8.—Section of garnetiferous schists in granite at St. Helens. G = granite; S = green quartz-chlorite schist with garnets.

FIG. 9.—Section of lode at Silver Echo Mine. SL = slate; Q = quartz; P = pyrrhotite; QP = quartz with pyrites; GP = dyke of granite-porphyry.

REPORT ON COAL SEAMS AT THORNEDALE, NEAR THOMPSON'S MARSHES, AND THE JUBILEE COLLIERY, NEAR ST. MARYS.

Government Geologist's Office,
Launceston, 12th December, 1901.

As instructed by you, I visited St. Marys on 31st August to examine some coal seams in the neighbourhood of that township. These were at the Jubilee Mine, in the eastern part of the Mt. Nicholas Range, three miles north of St. Marys, and at Thornedale, near Thompson's Marshes, seven miles south.

Jubilee Mine.

This is situate on the S.E. flank of the Nicholas Range, 1800 feet above sea-level. The seam is in the Upper Mesozoic sandstone, which forms the slope of the mountain. The measures certainly continue for some distance ahead of the mine works, as over 100 yards in advance are sandstone cliffs, where the ground rises rapidly. The surface of the mountain is so thickly covered with detritus from the columnar diabase (dolerite) on the summit, that it is impossible, as a general rule, to see to what height the coal measure sandstones really continue, but, from the horizons at which they have been observed elsewhere in the range, I think it quite probable that they persist to within two or three hundred feet of the summit. Their boundary is obscured everywhere by talus, but the abrupt appearance of columnar igneous rock suggests a junction of the two formations at the base of the columns. The crown of the mountain consists of a columnar ridge of the basic trap or greenstone rock, called diabase (or dolerite). The same rock crowns the Tier on the south side of the Break of Day Valley, Mt. Logie (or Elephant), and St. Patrick's Peak. I quote the latter on the excellent authority of a former Government Geologist, Chas. Gould, and have marked it on the map accordingly. No mining works on Mt. Nicholas have yet proceeded far enough to test the question whether the coal measures continue underneath the eruptive rock, or whether the latter will cut them off. From the sections

afforded further south by streams which have carved their channels down through the diabase to the sandstone beds below, I am disposed to think that the coal measures will pass below the eruptive cap for some distance before they are cut off by the filled fissure, which was the channel of escape for the molten mass. This opinion is fortified by the appearance of the valley between Mt. Nicholas on the north, and the Tier on the south, where similar phenomena are repeated. On the south side of the valley the sandstones flank the greenstone-crowned Tier, producing irresistibly the conviction that the valley is one of denudation, and that the sandstones and diabase once extended across it. In due time, this valley will be worn down to the Permo-Carboniferous strata, which are below its present floor, and afterwards those, too, will be removed by the ceaseless agencies of nature, and the underlying Silurian slates will be exposed. Gould's fault, which brings up Silurian and Upper Palaeozoic strata against the Mesozoic, and cuts off the coal measures to the east, is to the east of the Jubilee Mine, and does not affect the seam on the property. This fault runs S. to St. Marys, passing S.W. of township, and continues S.E. to Seymour.

At the Jubilee, a tunnel has been driven N.W. into the hill for about 180 feet, on a well-developed seam, dipping very gently in the same direction. I took sections at two different places, as under:—

In the face, roof concealed—

	ft.	ins.
Clean coal	2	2
Parting	1	4
Clean coal	1	3
Parting	0	1
Clean coal, 1 ft. 8 ins. &	2	0
	6	10

In tunnel, roof concealed—

	ft.	ins.
Clean coal	3	1
Parting	1	5
Clean Coal	1	0
Parting	0	1
Clean coal	2	0
	7	7

At short distances, headings have been driven E. 66 ft., 36 ft. and 30 ft. long. In these drives we can see that the upper parting is maintained. The coal there is stained by surface waters. I take no notice of the coal in these shallow drifts, as it suffers deterioration from being within the range of moisture from the surface. The lower band parts easily from the coal, and thins out towards the east.

The coal is black and clean; lustre, dull to brilliant, with shining layers throughout. The texture is dense, and fracture cubical. It has an occasional efflorescence of iron sulphate. The analysis, made in the Government Laboratory, by Mr. W. F. Ward, is—

Fixed Carbon. Per cent.	Gases. Per cent.	Ash. Per cent.	Water. Per cent.	
45·7	29·2	18·9	6·2	Coke, crumbly.

Published analyses of coal from other seams on the range give—

Fixed Carbon. Per cent.	Gases. Per cent.	Ash. Per cent.	Water. Per cent.
48·5 to 50	32·2 to 36·5	7·25 to 14·83	3·8 to 7·6;

consequently, in the Jubilee coal the fixed carbon and gas are a little lower, and the ash a little higher, than the seams further west. The quality may improve somewhat a little further in, seeing that the present tunnel is not 30 feet below the surface. The coal burns well in the open grate, leaving a fairly clean ash, as Tasmanian coals go, and does not splutter. It ought to command a ready sale for household and steam purposes.

It is now being won on a small scale, carted to St. Marys, and sold freely in Launceston. This mode of conveyance to St. Marys restricts the output. A tramway will have to be constructed, connecting the mine with the Fingal railway; this will be about three miles in length. The colliery will then be in direct communication with State markets.

Just now, when federation has brought with it inter-colonial free trade, is a trying time for our collieries, and new ventures are apt to meet with a somewhat hesitating reception. The existing industry will have to be fostered, and every encouragement given to open up new sources of supply. The Jubilee seam has every appearance of being able to support a healthy mine.

Thornedale Seams.

These are situated 7 miles S.E. of St. Marys by road, and 6 miles N.W. of the coastal township of Seymour as the

crow flies. Going out from St. Marys we pass over Silurian strata, which form a narrow strip between the granite of the East Coast and the Mesozoic sandstones of the Break o'Day Plain. We pass a little distance east of the site of the boring trial, at Harefield, in this plain. The boring results were instructive, though not economically valuable. The drill went down 264 ft. through Mesozoic sandstone, and then 313 ft. through the fossiliferous shales, conglomerates, sandstones, upper marine Fenestella limestone of the Permo-Carboniferous system, and 97 ft. 9 ins. through the Lower Coal Measures strata, striking Silurian slates at 674 ft. 9 ins. From this we know that the Upper Coal Measures strata descend nearly 300 ft. below the plain, and, as they ascend Mt. Nicholas about 800 ft., their known thickness is somewhere in the neighbourhood of 1100 feet.

Mt. Logie (Elephant), on the east, forms a N. and S. ridge a mile long. This is also capped with diabase, and fringed with Mesozoic sandstones and Permo-Carboniferous limestones. Beyond this, on the east, granite stretches away to the coast-line. This fringe of Upper Palaeozoic and Mesozoic strata is a characteristic accompaniment of diabase-crowned mountains all over the Island, and, to my mind, is susceptible of only one interpretation. Why should these strata always be associated with the greenstone, even when the latter (as, for instance, St. Patrick's Peak) forms mountains in areas of granite? I take it to be that the fringe has survived, because it has not long been deprived of its protective cover of eruptive rock.

On the road to Thornedale, which, south of Logie, passes over the Mesozoic sandstones which skirt the Tier, a dyke of diabase is seen traversing the sandstone, and ascending the Tier. It would be interesting to follow this dyke up the hill, and observe how it connects with the eruptive sheet above.

The property at Thornedale consists of three 200-acre Sections, in the name of E. C. James, Nos. 5358, 5344, 5345-93M. The road enters the upper section at about 1400 ft. above sea-level. The highest seam of coal is about 1200 ft. above the sea, and the lowest, 1000 ft.; from 300 to 500 ft. below the principal seams on Mt. Nicholas, but, nearly on the same level as some lower seams on that range.

The sections are wholly in the Upper Coal Measures' sandstones, regarded as broadly equivalent to the Jura of Europe, or the Rajmahal of the Indian gondwana system. These sandstones are characteristically soft, felspathic in nature, and greenish-grey in tint, of a type readily

recognised wherever occurring in Tasmania. I observed indistinct impressions of the fossil plant *Zeugophyllites* in some shale or underclod found below the tunnel in the low seam. Coal measures of this period have been the most productive in the State.

Descending the hill towards the east, a thin scattering of water-worn pebbles of quartz, sandstone, and granite may be seen. The fact that no pebbles of diabase are noticeable, makes it improbable that this drift represents the remains of a raised beach. It most likely has resulted from the release of stones from a conglomerate bed. The surface of all the sections is strewn more or less with boulders and fragments of columnar diabase. The creeks and ravines are sometimes veritably choked with this *débris*, and the fragments are, occasionally, of enormous size, attaining a weight of many tons. These blocks may be seen embedded in the soil, from which they project, and may be easily mistaken for bosses of rock *in sitû*. The soil in which they lie covers solid sandstone beds. There does not appear to be any diabase *in sitû* on the property, and the sandstone beds are nowhere disturbed by eruptive rock.

I saw three sets of seams on the claim. The lowest outcrop is just inside the northern boundary-line of the northern section (No. 5358), where it is seen in the side of a small creek. A short tunnel was driven on it twelve years ago; first, for 27 ft. S.E., then, turning S.W., for 12 ft. The seam is 2 ft. 3 ins. to 2 ft. 7 ins. thick, with a half-inch striped clay parting. It is, as nearly as possible, horizontal. The western end of the drive has not been left quite clear by the last workers, and I could not measure the full thickness of the seam there; the face requires squaring down to see whether the thickness is maintained. The roof is sandstone, the floor dark clod. The seam is free from deleterious bands, and is the best looking on the claim. The samples which I took were fair average ones, and yielded the following results when analysed by Mr. W. F. Ward, Government Analyst:—

Fixed Carbon.	Gases.	Ash.	Water.	
Per cent.	Per cent.	Per cent.	Per cent.	
56·5	31·6	7	4·9	Coke, fairly firm.

This is a very good quality, and compares well with the coal on the Nicholas Range. The coal is black; lustre, dull, with shining faces and layers; structure, dense; fracture,

GEOLOGICAL SKETCH-MAP COUNTRY NEAR ST MARYS

Scale 40 20 0 40 80 120 Chains

5 cm

- Alluvium
- Tertiary basalt
- Mesozoic diabase (dolerite)
- Mesozoic sandstones and shales
- Permo-carboniferous strata
- Granite
- Silurian slates

W.H. Twelvetrees
Gov.t Geologist
12 Dec.r 1901

JUBILEE COAL MINE
MOUNT NICHOLAS RANGE
Mt NICHOLAS COAL MINE
CORNWALL COAL MINE
GARDINERS CREEK
ST PATRICKS HEAD
FOUR MILE CREEK
RIVULET
MARGISONS CREEK
ST MARYS RAILWAY STATION
ST MARYS
FINGAL RAILWAY
ST PATRICKS CREEK
BREAK O'DAY RIVER
HAREFIELD BORE
MOUNT LOUIE
LIGHTWOOD RIVULET
5358 93M
E.C. James
5344 93M
5343 93M
E.C. James
THORNEDALE
PICANINI CREEK
PICANINI POINT
DOCTORS CREEK
SEYMOUR

tabular to cubic; no pyrites; a fairly heavy coal. The drawback is the thinness of the seam. The aim would have to be to utilise it for blending with the produce of the other seams. If a thicker seam of this quality could be found on the property, it would materially assist matters. The fact that a seam of this quality does exist should stimulate search.

The intermediate, or large seam, crops out on Section 5344, about half a mile south-east of the preceding, and about 100 ft. higher up the mountain. A tunnel has been driven in it for 40 ft. S. 50° W. It has fallen in at the entrance, which is now an open approach. The seam is a double one, comprising an upper and a lower portion, separated by a band of clay 4 ft. 5 ins. thick, with thin partings and layers of coal. The bottom seam, which is the brightest, measures 4 ft. 9 ins. thick; the top one is 5 ft. 7ins.; but I could not examine this upper portion without a ladder, except near the entrance, where the weathering makes any examination unreliable. The roof is sandstone, the floor a kind of pipe-clay. Samples of the 4 ft. 9 ins. have been assayed in the Government Laboratory, with the following result:—

F. Carbon. Per cent.	Gases, &c. Per cent.	Ash. Per cent.	Water. Per cent.	
48·7	23·3	23·5	4·5	Powder only slightly coherent

This coal is duller in lustre than that of the seam previously described. Its fracture is rectangular, also uneven; structure, dense; has a white iron sulphate efflorescence. It is better in appearance than the coal above the 4 ft. 5 in. band. The ash is high, which is unfortunate, as the seam is the most important one in respect of size. Some further work ought to be done on this, and tests made up of the coal further in the hill. These daylight cuts are very unsatisfactory data for conclusions. It is highly necessary to push the work well into cover, beyond the reach of surface-water. More reliable tests can then be made. The hill forms a spur running S.E., about six miles N.W. of Seymour, and I should not think that the descent would offer any great difficulty. Bullock-drays have been got up to this level, and this would be the point of departure for a tramway to Seymour.

The third or upper seam is half a mile further south-east, and 100 ft. higher than the preceding one. It is exposed in

the bed of a creek on the eastern fall of the mountain, on Section 5343, about 20 chains south of the north boundary-line, and the same distance from the east boundary. It measures 4 ft. 2 ins. thick, and the roof is not shown, as the seam crops out just below the surface soil. The floor is not exposed either, as the seam passes downwards into clay bands and coal streaks too poor to work. The descending section is—

Soil, with coal—

	ft.	ins.
Parting	0	1
Coal	1	1
White clay parting	0	3
Coal	1	6
Parting	0	1
Coal	1	4
	4	4

Mr. W. F. Ward's assay of this coal, in the Government laboratories, returned the following result:—

F. Carbon. Per cent.	Gases, &c. Per cent.	Ash. Per cent.	Water. Per cent.	
44·9	27·2	21·5	6·4	Coke somewhat powdery.

This is not such a good-looking coal as in the other seams, but still of fair quality, though the ash is somewhat high. Partakes somewhat of the nature of splint coal, and would answer for household purposes. It is a heavy variety, with brilliant black layers; breaks in cubes, is hardened in places, and then has an irregular fracture, inclined to be sub-conchoidal. In one place it has a stony roll, with a little pyrites. Wherever it is hardened, it does not soil the fingers. This occurrence is not quite so promising as the other outcrops, but no work has been done on it yet, and the seam is not fully exposed.

Taking the property as a whole, and in its present undeveloped state, the large intermediate seam is substantially the measure of its value. The others are likely to be of subsidiary importance, and may possibly be used as adjuncts to help the main output. The big seam is an important one, but requires developing. It would no doubt have been worked before now, but for the position of

the property with respect to harbour facilities. The drawbacks of Seymour, as a place of shipment, do not enter within the scope of my Report. If Seymour can be used, it will be the outlet for this district.

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

W. H. TWELVETREES,
Government Geologist.

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

REPORT ON THE OCCURRENCE OF COAL NEAR CATAMARAN RIVER, RECHERCHE BAY.

(One Plan.)

Government Geologist's Office,
Launceston, 20th February, 1902.

SIR,

I HAVE the honour to report that, in accordance with your instructions, I examined the seam of coal near Catamaran Creek, Recherche Bay, on the 4th January. Ordinarily, only barges of 60 or 70 tons burden make the voyage, but I had the advantage of a special trip by the s.s. *Nubeena*, with the Honourable the Minister of Mines and others. The ordinary barges, I understand, draw about 6 feet, and go alongside the wharf, where there are 9 feet of water at high tide. A little way out from the mouth of the river there is deep water, and harbour works would be necessary in the event of a large trade. For the present, these would probably not be required.

Recherche numbers 50 or 60 inhabitants, about half of whom are employed at Messrs. M'Dougall's sawmills. It is the most southerly settlement down the Channel. The bay, from its position, is sheltered from westerly storms, but is fully exposed to weather from the south-east. The dangerous-looking reefs out at sea, in front of the bay, carry in their significant names reminders of several disastrous wrecks.

Due west from the bay the country is flat for about a mile, and is not more than 50 to 80 feet above the sea; it then rises into spurs of a coastal range of hills.

GEOLOGY.

Some of the reefs at sea are known to consist of diabase (dolerite), and the same rock is seen at sea-level at Recherche itself. The flat land and the lower part of the hills, however, are formed of sandstone, crowned on the summits by diabase. The same problem as that which constantly confronts the observer in other parts of the Island is present here, viz., whether these sandstones pass below the diabase caps, or whether they are abruptly cut off by an intrusive mass. My observations so far lead me to conclude that

both of these phenomena have occurred in different localities, and that each case must stand on its own merits. At Recherche, I could see nothing to guide me in forming an opinion as to what happened there. Intrusive dykes have been reported by Dr. Milligan to the south of Recherche, but these are quite compatible with the diabase on the mountain top overspreading the coal measure sandstones.

A belt of sandstone appears to fringe the coast from Southport to Recherche. Coal seams and carbonaceous markings are contained in these beds, and the impressions of fossil plants point to some of them being the lower members of the Mesozoic. The Southport and Ida Bay strata, containing *Pecopteris lunensis* (R. M. Johnston), *Vertebraria australis* (M'Coy), plentifully [at Southport], and *Zeugophyllites elongatus* (Morris), sparingly [at Ida Bay], seem almost to be passage-beds between the Permo-Carboniferous and Mesozoic, or, perhaps, the lowest beds of the Mesozoic. The beds at Recherche are a step higher, being decisively Mesozoic, as they contain the characteristic plants of the Upper Coal Measures in Tasmania. Mr. R. M. Johnston on this occasion quickly collected from the spoil heap *Thinnfeldia odontopteroides, var. obtusifolia* (R. M. J.), *Zeugophyllites elongatus* (Morris), and *Phyllotheca australis* (Brongt.); and Mr. M'Dougall gave me a fine specimen of the first-named plant.

The following table will give an idea of the geological horizons of these beds:—

		Fossil Plants.
Upper Mesozoic	Recherche Coal	Thinnfeldia odontopteroides. var. obtusifolia (R. M. J.) Zeugophyllites elongatus (Morris) Phyllotheca australis (Brongt)
Lower Mesozoic	Ida Bay Coal	Pecopteris lunensis (R. M. J.) Zeugophyllites elongatus (Morris) Vertebraria australis (M'Coy)
	Lower Sandstones	Vertebraria australis (M'Coy)
Permo-Carboniferous	Southport Coal	Pecopteris lunensis (R. M. J.) Vertebraria australis (M'Coy)
	Mt. Cygnet Coal	Vertebraria australis (M'Coy) Gangamopteris spatulata (M'Coy)

The exact position of the Southport beds is, perhaps, still doubtful, but, at any rate, that of the Recherche seams is well established. The characteristic plants of the Lower Coal Measures, *Glossopteris* and *Gangamopteris*, are absent, while *Thinnfeldia* and *Zeugophyllites*, the Upper Coal Measure plants, are present.

Description of Seam.

The seam which I visited at Recherche is situated on Section 5248-93M, 317 acres, in the name of Major Lloyd Hood, north of and adjoining Catamaran River. It has been opened upon by a couple of shafts, a little over a mile due west of the harbour. The track to it is an easy one, along an old abandoned wooden tramway, formerly used for conveying timber to Messrs. M'Dougall's sawmill. One shaft was under water, and had, I was told, been sunk for the purpose of draining the other, which had been cleaned out for this visit. The latter had been sunk to the floor of the first coal seam, a depth of 21 feet, and presented the following section, as far as I could identify it in the wet weather which prevailed at the time:—

Soil	11 ft. 6 inches	
Coal		10 inches.
Dark matter, undetermined	1 ft.	2 ,,
Coal, mixed with clay		4 ,,
Clay		3 ,,
Soft mixture		2 ,,
Coal		6 ,,
Parting		2 ,,
Coal		3 ,,
Splint coal		3 ,,
Coal	1 ft.	11 ,,
Parting		½ ,,
Coal		9 ,,
Band		3 ,,
Clean coal	2 ft.	8 ,,
	9 ft.	6½ ,,
Clay said to be	8 ft.	
Coal said to be	7 ft.	
Total	24 ft.	6½ inches

In the above 9 ft. 6 in. seam I believe there will be found to be, approximately, 6 feet of workable coal; the rest is clayey and dirty, or shaly. I was informed that a second seam exists 8 feet lower down, and has been proved by a drill to 7 feet thickness.

The coal in the upper part of the top seam is decidedly inferior in quality to that of the layers which rest upon the

clay floor. This is what might have been expected, as the sandstone roof is here absent, and the soft soil offers no obstruction to the downward percolation of water, which must necessarily affect the upper layers of coal injuriously. As the standing water had only been recently bailed from the shaft, I do not consider the samples which I caused to be broken from the seam can give quite fair criteria of the quality, but they were amply sufficient for comparison with many other assays of Tasmanian coal seams examined under similar conditions.

From the samples, which were broken from the seam in the presence of the Honourable the Minister of Mines, I selected a block large enough for a fair assay, and one which, in its solidity and variety of structure, fairly represented the average quality of the seam. The coal was dull black, with some shining layers passing through it. It has been assayed by Mr. W. F. Ward, Government Analyst, who has reported as follows:—

"The coal was evidently 'weathered,' which has probably lessened its coking qualities and increased the moisture. Different portions of the lump varied greatly in appearance. It was therefore sampled in two separate portions, with results following:—

	Top. Per cent.	Bottom. Per cent.	
Fixed carbon.....	65·8	66·7	Coke
Ash (white and very light)	8·2	8·6	Coke
Gases, &c., lost at red heat	21·0	20·3	
Moisture lost at 212° F....	5·0	4·4	

The 'top' coal gave a soft and powdery residue after heating, the 'bottom' coal coked partially, the low ash is a hopeful feature; sulphur was not determined, but judging by the colour of the ash this should be small; a determination of this constituent in a weathered sample is of no value."

The coal was broken in large pieces from the 2 ft. 8 in. layer at the bottom of the shaft, and the "weathering" referred to by the Analyst may have been due to the weather-side of the sample. The edge of the seam has no doubt been exposed to the water for many months. Although some parts of the sample were dull and others shining, the analysis shows very little practical difference in composition.

It is gratifying to see such a small percentage of ash, while the proportion of fixed carbon is higher than in most Tasmanian coals. It exceeds that of Mt. Nicholas by 15 to 20

units. The nearest approach to it is the Sandfly coal. An analysis of that coal (upper seam) is stated in the Tasmanian Official Record, 1892, p. 118, as—

Water.	Vol. Hydro-carbons.	Fixed Carbon.	Ash.	Sulphur.
5·0	23·8	62·2	8·7	0·8

which approximates in constitution to that of the Catamaran Creek.

As might be anticipated, the high percentage of fixed carbon in this coal causes it to give out a good heat on an open fire.

The steam-raising values of different coals may be calculated from their composition, and hence analyses are highly useful in furnishing an idea of the results to be expected from subsequent trials. It is satisfactory to find in the present instance that the assay results have been confirmed by small working tests by several individuals and companies.

Mr. F. H. Piesse, Manager of the Huon, Channel, and Peninsula Steamship Co., Limited, Hobart, informs me that ten bags of this coal was used on the s.s. *Nubeena*, and the results were so satisfactory that an order was given for twenty tons, which, unfortunately, could not be delivered.

Messrs. O'May Bros., steamship owners, Hobart, report to me that they ran the s.s. *Victory* for one day with the coal, which burned very well indeed. They describe it as a good steaming coal, leaving a nice white ash.

The Hon. W. G. Gibson, M.L.C., writes to me in reply to my enquiries: "Two bags of this coal were burned in my furnace, but this could not be said to be a test or trial worth having. However, it certainly burned very well indeed, and we considered it much superior to any other Tasmanian coal we have have had to deal with."

The quality therefore appears to be highly encouraging. Two further questions are, how much coal is likely to be available, and how is it to be worked?

The limits of the sandstone system are visible with difficulty, owing to the scrub and humus which conceal the bed-rock, and would take some time to ascertain, but I believe that it may extend a good way up the hill before meeting with the diabase. A fair-sized area is no doubt available for working.

About three-quarters of a mile north of what I may call the main shaft, another shaft has been sunk through 33 ft. of sandstone, when water prevented further work. This is over the hilltop, to the north of the present shaft.

SKETCH MAP
OF
COAL COUNTRY AT CATAMARAN RIVER

5 cm

Scale 10 5 0 10 17 Chains

Mesozoic diabase

Mesozoic sandstone

Shafts on coal-seam

W.H. Twelvetrees Govt Geol.
20 Feb 1902

F.S.

5248 93M 317ac.
Major Lloyd Hood

M. Driscoll pur.

DEEP CREEK

R. Finn pur.

W.C. and J.H.M.c Dougall pur.

W.C. M.c Dougall pur.

RECHERCHE BAY

LOW FLATS

MILL

JETTY

OLD TRAMWAY

OLD TRAMWAY

COVERED WITH SCRUB

CATAMARAN RIVER

It is no doubt a continuation of the same measures, and the same seams will probably be found on that side of the hill at a somewhat deeper level, owing to the dip of the strata a little north of west, at an angle of from 6° to 8°.

Another shaft has been sunk half a mile south, but without getting coal.

From the direction of the dip and the proximity of the seam to surface at the main shaft, the same seam cannot be struck nearer to the shore line, but ought to be found in the hills both north and south. Unfortunately, where it has been opened upon it is too near the surface to have a good working roof, and the hill plunges north with the dip of the seam. The latter cannot be expected to gain cover until it has traversed the small valley to the north, and passed under the base of the hill, where the sandstone will protect it. To attempt to follow it along its dip will mean endless trouble with water; though, as a ready make-shift method, this plan seemed to recommend itself to some of those interested, as enabling coal to be got out at once to help pay for development expenses, until the value of the seam is better proved. This is a matter which must be left to those immediately concerned; but for permanent work, shaft-sinking on the northern hill will have to be resorted to.

The occurrence of a lower seam—the alleged 7-ft. seam—below the clay in the bottom of the shaft is encouraging. It is apparently a part of the upper seam, from which it is parted merely by clay.

Before going to any substantial expense in laying out work, the ground ought to be judiciously prospected by boring, for the purpose both of testing the extension of the known seams and their freedom from injurious alteration by the eruptive rock, and also of seeing whether any fresh ones exist in still more favourable positions for working. The locality where the present seam is exposed is well situated with regard to the shore; a tramway of less than a couple of miles would connect it with the wharf, but the distance could be decreased by the discovery of a seam below the flat country traversed by the old tramway. Against such advantage, however, must be placed the drawback of water, of which this low land must hold large quantities.

Altogether, the undertaking has the elements of success. The coal appears to be suitable for domestic and steaming purposes; the position of the field on the shores of an ocean highway and within 60 miles waterway from Hobart is a highly important feature. The only drawback is that the

work will be shaft-mining; but coal ought to be able to bear that cost here, as it does elsewhere. I must repeat that proper precautions should be taken to ascertain by boring the extension and character of the seams before the owners commit themselves to any heavy expenditure on permanent works. First prospecting, then vigorous development. With these, I see no reason why this new coal field should not soon occupy an important position as a producer.

Under the conditions of my visit, no survey was possible, but the annexed sketch map indicates the locality and general geology.

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

W. H. TWELVETREES,
Government Geologist.

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

REPORT ON THE TIN ORE DEPOSITS OF NORTH DUNDAS.

[Two Plans.]

Zeehan, 8th March, 1902.

SIR,

IN pursuance of your instructions, I have almost completed my examination of the North-East Dundas District, and have now the honour to present the following Report on the Tin Ore Deposits of North Dundas. A further report on the other mines of the district will be forwarded in a few weeks' time. Neither of these reports will enter fully into the details of the geology of the district, for, although a considerable proportion of my time has been occupied in collecting general geological information, and in compiling a geological sketch map of the district, it is thought advisable to delay the publication of this matter until my examination of the other important mining centres has been completed, when a more comprehensive account of the geology of the West Coast will be possible than would be the case if each district were described separately.

Most of the deposits of tin ore are situated in about the centre of the North-East Dundas District. The sedimentary rock consists mostly of slates or shales, which are, for the most part, considerably altered and indurated by contact with igneous rocks. The latter consist of quartz-tourmaline porphyry, gabbro, and serpentine; the latter being an alteration product of peridotite, with which it is often associated. These rocks occur in masses and dykes, often of considerable size, and are distributed widely throughout the district. In the vicinity of the tourmaline porphyry the slates have often been converted into a tourmaline-bearing rock, and this is also the case to some extent with regard to the gabbro, proving that the latter is older than the tourmaline porphyry. The tourmaline porphyry sometimes forms dykes in the serpentine and gabbro.

The Penzance Tin Mining Company, No Liability.

This company holds Sections 5093-93M and 5094-93M, having a total area of 131 acres. Very little work of any kind has been done on these sections. They are situated on

the north-eastern slope of the Commonwealth Hill. On the western section the country is principally composed of quartz-tourmaline porphyry, while on the eastern section most of the country is gabbro and serpentine, with some indurated slate in the north-western, and some tourmaline-quartz porphyry in the south-western portions. No tin deposits have as yet been discovered on the sections, though there are good reasons for believing that they exist. North and adjoining the western section (5093-93M), is J. S. Karlson's 5-acre lease (5063-93M), which is being worked for alluvial tin. The tin is found in the beds of two small creeks, which have their source within the Penzance Company's ground, so that it is certain that the source of the tin is within these sections. Most of Karlson's tin is very coarse, and a considerable proportion consists of large nuggets from 5 to 14 lbs. in weight, which are rich enough to break up and bag without further treatment. Many of these nuggets are found attached to fragments or blocks of tourmaline porphyry, and in some cases the complete section of the original tin vein is preserved in the nuggets. One very large nugget, which has also certainly been derived from a tin vein in these sections, was found several years ago, when the track from the Confidence Saddle to the Commonwealth Mine was being made. This nugget, which weighs about 19 cwts., was purchased by the Tasmanian Government, and is now in the Museum, Hobart. Judging from these nuggets, the tin veins must vary from an inch or two up to 18 or 20 inches in thickness, and their contents must be exceptionally rich in tin.

The two sections are at present covered by dense bush, and before anything effective can be done in the way of prospecting, this will have to be burned off. Some of the ground appears to be covered by a rather deep talus of of porphyry blocks, and this portion will be very difficult to prospect. However, when the bush is burnt off, it will then be possible to see where the ground is not covered by this talus, and this portion should first be thoroughly prospected by careful loaming and trenching. If this portion does not prove to contain tin veins, then they must be looked for below the talus of porphyry blocks. This can only be done by deep costeans, and possibly may require tunnelling. The prospecting should be confined to the porphyry and slate country. Tin is not at all likely to occur in the gabbro or serpentine.

I believe that the possibilities of finding payable tin veins on the Penzance Company's ground, and especially on the

western section, are really good. A considerable amount of alluvial tin has already been won, which has undoubtedly been derived from veins in this ground, and probably a little intelligent prospecting would be successful in locating them. The veins will probably prove to be patchy, but, certainly, they will be rich.

The Mount Lyell Copper Estates Co., Limited.

This company has been engaged for some time in prospecting two sections, which are situated west and adjoining the Penzance Company's ground. Nos. 3754-93M and 3870-93M, charted in the name of W. Connor. The country consists principally of indurated and metamorphosed slate, which is broken through by a number of dykes of tourmaline-quartz porphyry. These dykes are branches from the main mass of porphyry which is situated on the Penzance Company's western section. They vary from a few inches up to 2 or 3 chains in width, and their general course is east and west. Often the slate is highly impregnated with tourmaline, pyrites, and magnetite, and the latter mineral occurs in veins in the indurated slates. In the south-western portion of the northern section and the north-western portion of the southern section there is an outcrop of gabbro, containing some tourmaline. The latter has certainly been derived from the tourmaline-quartz porphyry. In the south-eastern portion of the southern section the country is serpentine. The most important workings are situated in the south-eastern portion of the northern section (No. 3754-93M). Just south of one of the larger dykes of tourmaline porphyry there is a large gossan blow, which first attracted attention. In the rubble from this blow good prospects of tin were obtained, and it was decided to test the formation in depth. The outcrop is situated on the brow and side of a very steep hill, and its course is somewhat irregular. It is intersected by a fault or plane of movement which strikes at an angle of 60° W. of N., and dips steeply to the north-east. This was at first taken to be the wall of the lode, and a tunnel was put in from a lower level to cut it. The tunnel started from the dyke of tourmaline porphyry already mentioned, and was driven on a course of S. 13° E. (pocket compass reading). In the approach of the tunnel the southern wall of the dyke is exposed, and in the vicinity of the contact the country, which is decomposed and contains much gossanous matter, contains numerous blebs of tin oxide. The tunnel passed through this decomposed country for a

distance of 35 feet, when hard indurated slate was met with. The course of the tunnel was not altered, but continued for another 85 feet, through hard slate, containing a little pyrites, tourmaline, and a very small percentage of tin oxide. A plane of movement was intersected which it is thought may be the same as that seen on the surface, but, if this is the case, its strike has altered considerably; otherwise, it is about in the right position. This was driven on for about 30 feet in an easterly direction without any further development taking place. As nothing which could be regarded as the continuation of the Big Blow was discovered at this point, attention was directed to the formation which had been passed through in the approach and the first 55 feet of the tunnel. A cross-cut was put in, 55 feet from the entrance of the tunnel on a course of N. 72° E. (approximately), and passed through a decomposed country and gossan formation for a distance of 30 feet, when the hanging wall was met with. This consists of hard indurated slate highly impregnated with tourmaline and magnetite. This gossan formation carries tin in seams through it, and is now believed to be the true lode, though it is poor in tin at this point. The strike, as far as can be estimated at present, is about 20° west of north, and the dip 50° to 60° to the east. This strike and dip, allowing for the slope of the hill, accounts fairly well for the position and irregular shape of the outcrop at the surface, and I think there is now little doubt that the true position of the lode has been located. Since this work was done, discoveries have been made on the surface which have given further support to this theory. A trench was made along the brow of the hill, and in the supposed line of lode a rich tin-bearing formation was cut. It consists of tourmalinised slate with a good deal of vein-quartz, and some of it is very rich in tin, visible crystals being quite plentiful. Mr. T. Brannan, the Mining Manager, tells me that a bulk sample from 3 feet 6 inches of lode matter returned 7% of metallic tin. This formation has been again cut in a trench about a chain further north, and the strike proved to be the same as that of the formation cut in the entrance of the tunnel. This lode is certainly worth further testing, and I was surprised to learn that the company had temporarily suspended operations. The lode could be quickly tested by continuing the most southerly of the eastern crosscuts from the main tunnel. This should intersect the lode within 10 or 15 feet, and it should then be driven on south in order to get below the rich ore which has been cut on the surface.

There are several other lode formations on the property carrying a little tin, but the lode which has been described is much the most important, and I think that, for the present, work should be confined to opening up this.

The Cornwall Tin Mining Company, No Liability.

Section 5101-93M, 80 acres. This mine is situated on the northern slope of the Commonwealth Hill, and the mine workings are close to the northern boundary, and almost at the base of the hill.

There is a large pyritic tin-bearing formation exposed here in several trenches and open cuts, both on the Cornwall Company's section and on the old Commonwealth section, which is north and adjoining. All of these exposures are within a radius of about 100 feet, but it is not yet quite certain that they are on the same deposit. The exposures are, however, of the same nature, and if not portions of one and the same body, they are certainly very intimately connected with one another. It will probably require some more underground work before their relations can be finally determined.

On the hillside, about 50 feet from the northern boundary of the section, a large pyritic and gossan formation has been exposed in a trench. From this trench a prospecting tunnel has been driven on a course of S. 43° E. for a distance of 43 feet. This passes through highly decomposed country for about 20 feet, and then through a stanniferous gossan formation. Some of the latter is very rich in tin; two dishes, which were washed for me, yielding about 1½ lbs. to the dish. Some of the best of this gossan has been already mined. The dirt had to be wheeled for a considerable distance to water, and must have been rich to pay for this treatment. The end of the tunnel is in dense pyrrhotite, but the deposit has not been further tested at this point. Twenty feet north of the entrance of this tunnel an open face has been excavated in a decomposed pyrites formation carrying tin; to the west of the pyrites is a band of gossan carrying small seams of tin, and on the dump pieces of tin oxide up to 3 inches in diameter may be found.

About 20 feet vertically below the prospecting tunnel, which has been already described, a second tunnel has been recently driven, in which important developments have taken place. The tunnel was commenced on a course of S. 34° E., and, at about 40 feet from the entrance, a vein of decomposed axinite was cut. This is evidently the same as an axinite vein which had been trenched along on the Commonwealth

section for a distance of 120 feet. The nearest point in this trench is 185 feet from the point where the axinite vein was cut in the tunnel. Its strike is 15° W. of N., dipping 1 in 5 to the west, the vein carries arsenical pyrites, some pyrrhotite, and copper pyrites, but, apparently, no tin. It was passed through by the tunnel, which was continued on the same course for a further distance of 40 feet, making 80 feet from the entrance. Here, a slide was met with striking 35° E. of N., and dipping to the south-east. The course of the tunnel was altered to S. 10° W., and after being extended for 20 feet in this direction the axinite vein was again cut. When the axinite was broken through, it was found that the hanging (western) wall was composed of stanniferous pyrites. It was therefore decided to again alter the course of the tunnel, and to follow the axinite vein. In doing so the hanging wall was broken down, and the foot wall left standing. The axinite vein has been followed up for a distance of 52 feet on a bearing of S. 15° E. After a very few feet of driving, the foot-wall, as well as the hanging wall, came into stanniferous pyrites, and has continued up to the end of the drive in this mineral. The pyrites of the foot-wall, however, gave place to a hard indurated shale or hornstone at a distance of 45 feet from the point where it was first struck. The quality or the pyrites forming the foot-wall of the axinite vein is not known, for it has not been broken into, but all the hanging wall stone which was taken out has been stacked at the mouth of the tunnel, and can be examined in daylight. It is seen to be composed of fine bands of pyrites, pyrrhotite, and indurated slate, with seams of tin oxide through it. I could not get a good observation of the strike of the seams of ore in the tunnel, but I am told by Mr. Borley, the Mine Manager, that, when the tunnel was being driven, it was observed to be about 50° E. of N., and the dip to the south. The banded nature of the ore is very remarkable. The tin oxide occurs in seams from $\frac{1}{8}$ of an inch up to several inches in thickness, and is sometimes practically solid; generally, however, it is distributed in small grains throughout the pyrites. The tin oxide is not visible in all the stone, and possibly some of it may not be stanniferous, but in a pyritic ore like this much of the tin is certain to be invisible. I did not attempt to take any sample, because, to take a reliable sample of a big heap of hard roughly-broken ore like this would have involved much more time and labour than were at my disposal. Mr. Borley, the Mine Manager, has had a number of samples

tested, and estimates the heap to bulk between 6 and 7% of metallic tin. Certainly, samples might be selected from the heap which would go anything up to 40 or 50%.

Geologically, the deposit is of very great interest. The banded nature of the pyrites, pyrrhotite, tin oxide, and indurated slate at once pronounces the deposit to be formed through metasomatic replacement of a rather finely laminated shale, the whole structure of the original shale being beautifully preserved in the dense ore. It is evident that the bed of shale was impregnated by mineralising waters or vapours, which attacked the more soluble layers and, taking up the material of the shale into solution, deposited the pyrites and tin oxide in its place. It is a well recognised fact that tin deposits are intimately connected with granite intrusions. During the consolidation of the granite, it is believed that emanations of metal-bearing vapours or highly heated waters are given off, of very high chemical activity. The solutions attack and dissolve certain constituents of the rocks, and deposit mineral matter in their place. The solutions contain certain elements known as "mineralising agents," of which fluorine and boron are the commonest. These are believed to play a most important part in the process, and minerals containing these elements are almost always found associated with deposits of tin ores. At the Cornwall Mine we have a boron mineral in the axinite, with which the deposit is associated, while at the Commonwealth Mine the mineral fluorite occurs, though I have not heard of its being discovered in connection with the deposit which is now being dealt with. It will, however, probably be found to occur here also. It is known that granitic rocks (namely, tourmaline-quartz porphyry) occur in the vicinity of the deposits. It is further known that stanniferous and boron emanations have taken place from this rock, for the tin veins in porphyry on the Penzance Company's section are proof of the former; and the tourmalinisation of the slates and gabbro in the vicinity of the porphyry are proof of the latter, tourmaline being another mineral which contains boron. There can therefore be no reasonable doubt as to the main facts of the origin of the deposit; but there is still some doubt as to the path which the vapours or heated waters took in ascending from the granitic hearth. This point is of the greatest importance to the miner, because it is along this path that he must look for the continuation of the deposit. The question is, did the vapours ascend along the planes of sedimentation of the shale, or did they come up along some

fault-fissure and attack such beds of favourable shale as this fissure intersected? At present I am inclined to think that the latter has been the case, though I cannot regard this as being finally settled. The axinite vein along which the tunnel has been driven is certainly the filling of a fault-fissure. Where first cut, the hanging wall of the axinite vein was composed of ore, and the foot-wall of slate. When driven on for a few feet, ore came in on the hanging wall as well as on the foot-wall, while, after 45 feet of driving, the ore gave place to indurated shale on the hanging wall, but the foot-wall remained in ore as far as the tunnel was driven—a further six feet.

This evidence is capable of two interpretations:—

1st. The axinite vein might be regarded as a cross course faulting the lode, the hanging wall having been thrown to the north. In this case the fault took place *after* the pyritic tin ore was deposited;

2nd. The axinite vein might be regarded as the filling of the fissure which had served as a channel for the mineralising solutions. In this case the faulting must have taken place *before* the tin ore was deposited. The selective action of the solutions for the favourable beds would account for the present position of the ore on either side of the axinite vein.

My reason for thinking that the latter is the more likely is based on the following facts:—Several other axinite veins are known in the district, all of them being associated with bodies of pyrites and pyrrhotite, though it is true all of these have not been proved to be stanniferous. This shows that the axinite is in some way very closely connected with the pyrites bodies; for, although it is possible that accident might bring them together in one place, it is not possible for this accident to be repeated three or four times over in the same district. The only explanation which appears to me to account for the facts of the association of the pyritic bodies and the axinite is that both solutions have ascended through the same fissures.

At the Cornwall Mine I think, therefore, we may assume as a working theory that the solutions ascended along the fault-fissure now filled with axinite, and that from this fissure they attacked and replaced the most porous or the most soluble beds or layers of shale. How far along the planes of sedimentation the mineralising solutions travelled is, of course, impossible to say, and this should be one of the

first things which the company should set about to determine. I think that the first thing to be done should be to sample the ore body very thoroughly. I would suggest that this be done in the following manner:—Two chalk lines should be drawn along the side of the tunnel, about six inches apart, and the space between them divided up by vertical lines into sections of 2 or 3 feet in length. Canvas or bags should then be laid in the bottom of the tunnel, and the whole of the surface of the stone gadded or chiselled off between the two chalk lines. The chips from each section should then be carefully collected, and assayed separately. This process will no doubt involve a considerable amount of labour, but when it is done it will be known definitely what the ore is worth, and how the tin is distributed. The importance of accurate and exhaustive sampling of these big pyritic bodies cannot be overestimated, because, without it, work is practically being carried on in the dark. If the sampling is carried out after the method outlined above, it will be known which part of the deposit it will be most advisable to drive on. The richest bands in the deposit should of course be selected, and drives should be started on either side of the present tunnel, crosscuts being put out at short intervals to ascertain the width and value of the deposit. The present tunnel should also be continued along the axinite vein, with the object of finding other shoots of ore. Even if the ore cuts out on both walls, which will probably be the case, the vein is worth driving on, as it may be presumed that where other favourable beds are intersected these will also contain ore. As to the prospects of the tin ore living down, nothing very definite can be said, and this can really only be proved by actual mining work. I think, however, that it is not too much to hope that the shoot will be continuous in depth. If it is true, as I believe, that the principal factor in the deposition of the tin is the favourable nature of the bed of shale which has undergone replacement, then we may expect that the shoot of ore will live down until the bed alters its character, which is not at all likely to take place within a short distance. Certainly, the deposition of the tin is in no way connected with the present surface, for the deposition of the tin took place during or shortly after the intrusion of the granite, which is believed to be of Devonian Age, and is certainly older than Permo-Carboniferous. But since that time denudation has lowered the surface of the ground many hundreds or, possibly, many thousands of feet, so that the tin which we now find near the surface

was really deposited deep down below what was then the surface.

The treatment of pyritic tin ore, though by no means as simple as that of free milling ore, involves no insuperable difficulty. It will have to be crushed and roasted, and the tin oxide concentrated from the roasted product. It would be advisable, before erecting machinery, to send a trial parcel to some well-equipped works, in order to decide upon the most suitable class of machinery to be employed.

I believe that the Cornwall Mine is a really good prospecting show, and has every prospect of developing into a valuable property.

Section 2959-87M, 80 *acres.*

This section, which is north and adjoining the Cornwall Company's ground, is vacant at the time of writing. There was nobody on the ground at the time of my visit, and I regret that I was unable to examine it as carefully as I would have liked. The axinite vein, which has already been described as occurring in the Cornwall Company's workings, continues for a considerable distance in this section, and has been trenched along for 120 feet. Some pyrites and pyrrhotite have been taken out of this trench, but no considerable body of ore was uncovered. I understand that no tin was found. One hundred feet to the east of this axinite vein there are several old trenches and open cuts, which have exposed a body of pyrites of considerable thickness. This is also evidently connected with an axinite vein, as I found a good many pieces of axinite on the various tips, though I could not locate the vein in the workings. The pyrites is of the same nature as that found in the Cornwall Company's ground, and the deposits are evidently closely connected. I am told that some of the pyrites from these workings is very rich in tin, and nearly all of it is stanniferous.

Some six or eight chains north-west of these workings, there is a another large pyrrhotite formation exposed in the bed of a creek, and likewise connected with veins of axinite and fluorite. A tunnel has been driven underneath it without striking the pyrites. I think it is probable that in this case the ore body has dipped to the south of the tunnel, and might be picked up by a crosscut in a short distance. The pyrrhotite contains some copper pyrites, but I did not see any tin oxide. It is, however, of the same nature as the Cornwall Company's deposit, and I would not be at all surprised to learn that tin had been found in it; but, unless

encouraging assays can be obtained from the pyrites at the surface, I do not think it is worth further testing from the present tunnel. Copper lodes have been known to change to tin in depth, but this is not likely to happen within the 50 or 60 feet which the tunnel is below the outcrop. It would be better to wait until a considerable depth had been gained on the other known tin-bearing deposit, and then to crosscut for this one at as great a depth as possible.

Section 5215-93M, 30 *acres.*

This section, which is charted in the name of R. Fox, is situated on the western slope of the Commonwealth Hill. I noticed in some old workings an axinite vein, passing through a dense pyrites formation. I am not aware that tin has been found here, or if it has been looked for, but certainly, wherever axinite occurs in this district, tin is worth looking for. If, however, it is not found on the surface, I do not think it is worth seeking underground at present. It is possible that some day it may be proved that all of these pyritic formations contain tin in depth, for there are theoretical grounds for believing that this may be possible, but this should first be proved by deep mining on deposits which will pay for their development from the surface. There is a galena lode on the section from which two tributors are winning some metal.

The Renison Bell Prospecting and Mining Co., No Liability.

This company holds Sections 165-93M, 166-93M, 2534-87M, 2606-87M, and 2536-87M; in all, 181 acres. The Emu Bay Railway passes through the northern sections, and by this route the distance from Zeehan is about 10 miles.

The country rock in the vicinity of the mine consists of clay, slates, and sandstones, striking from 30° to 45° west of north, and dipping to the north-east at angles varying from 0° to 35°, and sometimes steeper. In several places flat anticlinal and synclinal folds may be observed, but these do not alter the general north-easterly dip of the strata. To the west of the tin-bearing deposits a dyke of tourmaline porphyry traverses the sections, and there is no doubt that the tin deposits are genetically connected with this intrusion. There are quite a number of large tin-bearing formations known on the property, but they are at present in a very undeveloped state. They have been trenched across in a number of places, and some tunnelling has been done, but,

until lately, the underground work had not succeeded in proving the formations to any extent. Even now there is very little underground work done on the tin-bearing formations themselves.

In my examination of the mine I did not take any samples for assay. My reason for not doing so is that I believe that unless samples are taken with the greatest care they are only misleading. It would take at least a week's work to sample the Renison Bell Mine properly, and a very large number of samples would have to be assayed before any accurate notion of the value of the deposits can be formed. In the present report the assay-values given are those furnished to me by Mr. C. Stevens, the Mining Manager. These samples have been very carefully taken, and I have no reason to doubt their trustworthiness. That in several cases they represent fair bulk samples of the class of ore that can be won, is substantiated by the fact that five parcels of ore of one ton each were taken from five different places, and in each case the result of treatment in Melbourne came out very close to the results obtained from Mr. Stevens' samples.

One error, the result of too great a desire for economy, was, however, made in the sampling of the mine. The samples taken for assay generally represented either bulk samples right across the whole width of the formations, or specially selected samples of very rich ore. Neither of these methods of sampling afford sufficient information on which to base an estimate of the economic value of the deposits, or enable one to form an opinion as to the best method of mining which may be adopted. For example, one of the outcrops at the Renison Bell Mine is 120 feet across, measured horizontally; the bulk sample of this 120 feet gave a result of 1·2% of tin. This result gives only a small portion of the information which is desired. What we principally want to know is what proportion of the deposit is barren, how much of it will go 3%, how much 5%, and so on. This can only be obtained by sampling and assaying separately each few feet across the deposit.

Plate I. gives a sketch plan of the lode system and mine workings. This is not an accurate plan of the mine, but is the result of a quickly-made plane table survey. The aneroid was used in determining the contour lines. In this plan there are five large formations shown; they are known as follows:—No. 1 Lode, The White Lode, The Cross Lode, The Pyritic Lode, and the Big Blow. All these lodes have had more or less work done upon them, and have been

proved to be stanniferous. There are several other outcrops on the property, but, as no work has been done upon them, their value is at present an unknown quantity.

No. 1 Lode.—The outcrop of this lode has a course of about 30° west of north, and the dip is very flat to the north-east. On the surface it is exposed in the open face on the southern bank of the Argent River; also in No. 1 trench, No. 2 trench, No. 4 trench, and in the deep cutting of the Emu Bay Railway. Underground, what is supposed to be No. 1 Lode, has been cut in two easterly crosscuts from No. 1 Tunnel. All these exposures are marked on the plan, Plate I.

In the open face the lode looks very promising indeed; it is about 20 feet wide, and consists of gossan on the top and partially decomposed pyrites below. A number of bulk samples from this face have been taken, and have given results of from 9% to 12% of metallic tin. One parcel of a ton of ore, representing a bulk sample of the pyrites exposed, was treated in Melbourne, and yielded 10% of tin. Mr. Stevens assures me that this sample was taken from the bottom of the open face, and consisted of, practically, solid pyrites. It contained no gossan or rubbly matter which might be regarded as having been enriched by mechanical concentration. It should therefore represent the true value of the ore at this point. Unfortunately, at the other points where this lode has been exposed, it is very poor. In the three trenches and in the railway cutting the lode is completely oxidised. In No. 4 trench the gossan carries a little tin, but in the others it is practically barren. In the two eastern crosscuts from No. 1 tunnel, what is supposed to be No. 1 Lode has been cut. In the first crosscut a pyritic formation about 9 feet in thickness is cut, dipping at about 45° to the east, and for 10 feet more the country contains veins of quartz and a little pyrites. A bulk sample taken by Mr. Stevens from a length of 20 feet gave ½% of tin. In the next crosscut a dolomite formation about 30 feet in width has been intersected. On both the western and eastern wall of this dolomite there are bands of pyrites, but both of these are very poor in tin. The most easterly of these has not been driven through, so that its width is as yet unknown.

The White Lode.—This lode is exposed in four trenches and in the railway cutting. A detail sketch of the exposure in the cutting is given in Plate II. The lode consists of a zone of fissured rock, highly charged with mineral matter. The upper portion of the lode, as exposed in the railway

cutting (E, Plate II.), consists of rather soft white sandstone, with numerous veins and bunches of quartz and many cavities and cracks which are often encrusted with minute crystals of tin oxide; below this softer portion there is a layer of hard lode matter (F) consisting of quartzite, with a good deal of pyrites and vein quartz; and below this again, in the bottom of the cutting, there is a layer of almost solid pyrites (G). This occurrence will be referred to again, when discussing the geological relations of these deposits. The White Lode has not been systematically sampled. It is undoubtedly rich in places, but on the whole it is poor. In the trenches the lode matter consists of sugary quartz and sandstone containing some tin wherever it has been cut.

The Cross Lode.—This lode has been cut in No. 2 trench, No. 3 trench, No. 4 trench, and the railway cutting. Further, what is believed to be the same lode, is cut in No. 6 trench, seven chains south-east of the railway cutting, and also in the entrance of the No. 2 tunnel, near the open face at Argent River. It is at present not quite certain that all these exposures are on the same lode. At the entrance of No. 2 tunnel a small but very rich seam of tin ore was cut. It was about two feet in width, and a winze was started upon it, but, as it was practically at river level, it was only possible to sink about three or four feet, owing to the influx of water. Thirty-five bags of picked ore were sent away for sale from this lode some years ago. I have not been able to get particulars of the assay value of this parcel, but I note, from Mr. Twelvetrees' report on the mine, that it only realised £8 per ton. This is an extraordinary result in the light of subsequent tests on the ore, for one ton of the strippings from this parcel, *i.e.*, the stone which was rejected as being too poor to send away in the first parcel was treated in Melbourne, and yielded 22½% of metallic tin; this parcel was not selected, but was taken straight away from the heap of strippings. It is evident that either the lowest grade material was selected for export in the first place, or that some very serious mistake was made in the sampling or assaying of the parcel.

No. 2 tunnel was started on this rich vein, but a few feet from the entrance a belt of broken country was entered, which faulted the lode, and its continuation has not yet been picked up at this level. In No. 2 trench, the cross-lode is 19 feet wide. It consists of two bands of pyrites 4 feet and 1 foot in thickness respectively, separated by 14 feet of soft sandstone, carrying numerous veins and bunches of

PLATE I.

5 cm

SKETCH PLAN
OF THE
RENISON BELL MINE

100 50 0 100 200
Scale of Feet

G. A. Waller.
Asst. Govt. Geologist

REFERENCE

Underground workings shown in doited lines.

Lode Formations exposed on the surface

Lode Formations exposed underground

THE ARGENT RIVER

Pyrites Outcrop

Creek

RAILWAY

EMBANKMENT

450 425 425 460 475 500 525 550 600 625 650 675 700 725 750 775 800 825 850 875 900 925

No 2 TUNNEL

No 1 TUNNEL

No 1 Trench

No 1 LODE

Proposed position of Tunnel level

No 2 Trench

No 3 Trench

CROSS LODE

No 4 Trench

No 1 THE BAY

DEEP CUTTING

THE PYRITES LODE

EMU

THE WHITE LODE

Trench

Trench

Trench

Large exposure of Lode Matter

THE BIG BLOW

Main Tunnel

East Tunnel

Big Blow Lode at Tunnel level

Fault

Fault

Axis

Axis

Stripped

Synclinal

Anticlinal

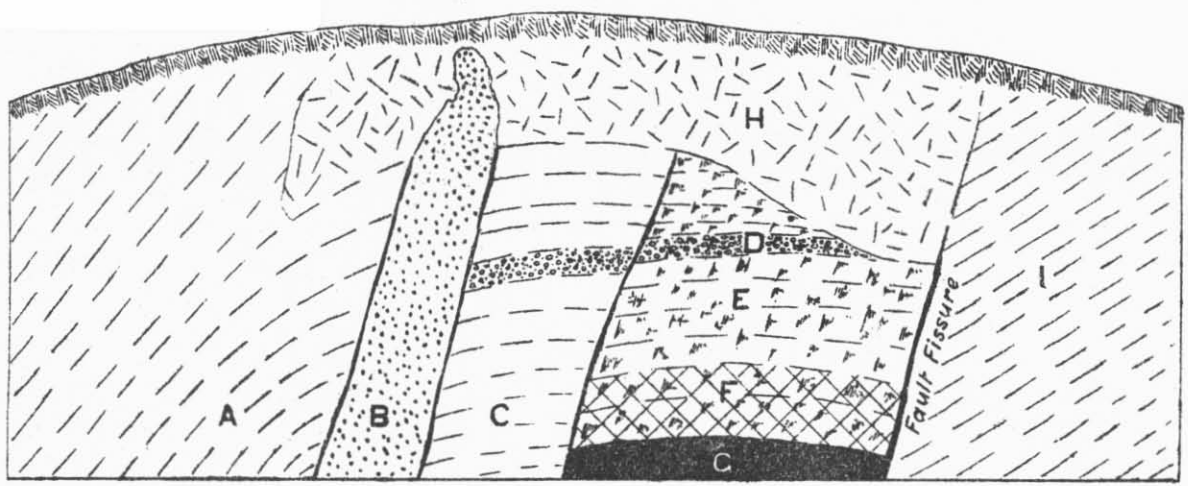
PLATE 2.

SECTION EXPOSED IN RAILWAY CUTTING

RENISON BELL MINE.

G. A. Waller
Asst. Govt. Geologist.

5 cm



A.—Slate and Sandstone. B.—"The cross lode," soft pug and gritty formation, evidently a fissure filling. C.—Slate, &c., dipping very flat. D.—Seam of pebbly grit, carrying tin in cavities. E.—Soft sandstone and sugary-quartz formation, with cavities encrusted with tin oxide. F.—Hard quartzite formation, containing stanniferous pyrites. G.—Almost solid stanniferous pyrites. H.—Broken country. I.—Slate, sandstone, &c., unconformable with E. D, E, F, and G = "The White Lode."

quartz, with joints and cavities encrusted with fine crystals of tin oxide. A bulk sample from 14 feet of lode-matter in this trench gave 1·5% of tin oxide.

In No. 3 trench, the cross-lode is 14 feet in thickness. The lode is of the same character as in No. 2 trench, but the tin contents are much more satisfactory. A bulk sample across the whole lode yielded 7½% of tin.

In No. 4 trench, the lode is 20 feet in width. A bulk sample from this place yielded 1% of tin. In the railway cutting the cross-lode is small and poor.

In No. 6 trench, a formation is exposed 120 feet in width. It consists principally of pyrites, with some quartz and hardened country-rock. Some of this pyrites is rich, but a bulk sample across the 120-feet yielded only 1·2% of tin.

The Pyritic Lode.—This lode was first discovered in the Emu Bay Railway cutting, and was subsequently picked up in a trench about three chains to the north of the first exposure. Further north, at the Argent River, a third exposure of what is probably the same lode has been made, but no work has as yet been done at this point. The pyritic lode as exposed in the railway cutting is 30 feet in width, and is composed of almost solid pyrites, with some qaurtz and altered country-rock. At the surface, the pyrites was barren, but, as depth was gained, it was found to contain tin. One ton of stone from the bottom of the cutting, treated in Melbourne, yielded 2% of metallic tin.

The Big Blow Lode.—This is a very remarkable deposit of tin ore. It is situated about 20 chains south of the railway cutting, in which several of the other lodes have been intersected, and the outcrop is about 300 feet above this level. As will be seen by the plan, the course of the outcrop of this deposit is very irregular, and at once suggests the fact that it is not an ordinary lode. The deposit is conformable with the surrounding strata, and forms a layer from 10 to 25 feet in thickness of nearly solid pyrrhotite and pyrite. Observations of the dip and strike of the slates lead me to the conclusion that the deposit takes part in an anticlinal and synclinal folding of the strata; but, before this can be regarded as established, further observations are required. At the time of my visit, observations were only possible in two or three places. The axes of the supposed anticlinal and synclinal folds are shown on the plan. The main tunnel was driven below and a little to the east of the large gossanous outcrop of the deposit. At about 70 feet from

the entrance, two short crosscuts were put in east and west, and in the eastern crosscut the foot-wall of the deposit was broken into. At this point the ore-body is dipping very flat, not more than 5° or 10° to the eastward. Forty-five feet further in the foot-wall of the deposit was struck in the roof of the tunnel, and another short crosscut was put in to the eastward in the solid pyrites. Thirty feet beyond this crosscut, a fault occurs, which has thrown the ore-body for a few feet to the east, but the tunnel was kept on in a straight line, and again intersects the pyrites about 30 feet further on. It is, of course, a pity that the tunnel was not driven along the ore-body, and crosscuts put out at regular intervals. The tunnel was put in before the nature of the deposit had been realised, and it was driven along a formation carrying a little quartz and pyrites, but no metal of value. Another short tunnel has been put in to the east of the main tunnel, and, after some 20 feet of broken country had been passed through, the pyrites was cut, and a small chamber opened out. In the east of this chamber, the pyrites is cut off abruptly by a dolomite formation, which occurs between the slate and pyrites. In the western portion of the chamber, the lode is oxidised, but the foot-wall has not yet been reached.

Parts of this Big Blow Lode are undoubtedly rich in tin, but the deposit has not yet been systematically sampled. One sample, consisting of hard oxidised lode-matter, has been taken along the foot-wall of the deposit at the surface for a distance of two chains, and gave the satisfactory return of 5¾% of tin. A parcel of one ton of ore, broken out from the face of the first eastern crosscut from the main tunnel, returned 7% of tin. This is still more satisfactory, because the ore consisted of solid pyrrhotite and pyrite, and there can have been no question of mechanical enrichment. In the eastern tunnel, the ore has not yet been sampled. Some of the ore exposed certainly contains very fair tin, but, on the whole, the deposit is not so rich at this point as where it has been cut in the crosscuts from the main tunnel.

From the above descriptions of the Renison Bell deposits, it will be evident that they are very patchy in their occurrence. In places they are very rich, and in other parts they are practically barren. The proposition, therefore, which the miner has to face is that of discovering these rich patches, or shoots, mining them, and leaving the poorer portions of the deposit standing, or using them for filling in the stopes. The question as to whether the proposition will be a payable one or not depends upon whether these shoots

occur in sufficient abundance, and of sufficient size and richness, to pay for the prospecting work which will be necessary for their discovery.

The Renison Bell deposits have undoubtedly been formed, like the other pyritic tin-deposits of North Dundas, by replacement of the slates and sandstones with mineral matter. In most cases, as, for example, No. 1 lode, the white lode, the cross lode, and the pyritic lode, the mineralisation has taken place along certain zones of fracture or fissuring. The mineralising solutions have ascended along the cracks and fissures, and have attacked and replaced the country rock with which they came in contact. In other cases, as, for example, the Big Blow Lode, and, probably, also the wide deposit which is exposed in No. 6 trench, the mineralising solutions travelled along some specially-porous or specially-soluble bed, and attacked and replaced it with mineral matter more or less completely. In the latter case, also, the solutions, in all probability, originally ascended along fissure planes, or zones, of fissuring. In fact, these deposits may form only flat branches, or spurs, from the first type of deposit. Now, the important point which the miner has to take into consideration is the fact that certain beds of sedimentary rocks are more favourable to the deposition of mineral matter than others. This fact is very evident in some other pyritic tin mines in North Dundas. In the Cornwall Tin-Mining Company's mine, which has already been described, the rock which has undergone replacement is a finely-laminated shale, containing separate layers of of different composition. These layers have been attacked and replaced to a varying degree, some of them being completely replaced, others only partially, while some have repelled the attacks of the mineralising solutions altogether. The result of this has been that the ore retains the whole structure of the original shale to a remarkable degree. In the case of the Renison Bell deposits, the rock which has suffered replacement is a normal slate or sandstone, and is not finely-laminated like that of the Cornwall Mine. The replacement is not so evident, and the change in composition of the different layers is not so sharply defined. That the composition of the lode does vary with the character of the rock which has suffered replacement is, however, plainly shown by the section of the white lode which is exposed in the railway cutting. A sketch of this section is shown in Plate II. As already explained, there are here three layers exposed, the upper layer being composed of somewhat decomposed sandstone, containing sugary and vein quartz, and

numerous cavities and joints lined with minute tin crystals. The second layer is composed of hard sandstone, or quartzite, with quartz veins and veins and bunches of pyrites. The third and bottom layer consists of almost solid pyrites. Now it is possible, and even probable, that the upper layer is merely a decomposition product of the layer just below it, produced by the leaching away of the pyrites and deposition of the tin in the cavities and joints. But is it inconceivable that the second layer, which is composed of hardened sandstone, impregnated with pyrites, could be the result of the decomposition of the bottom layer, which is composed of almost solid pyrites. It is quite evident that here we have a case of replacement of two layers of rock of different composition, the bottom one being more favourable to replacement than the layer immediately above it. In the same cutting, the pyrites lode also shows a remarkable alteration in composition, which cannot be explained by any surface-action. Here the lode consists of nearly dense pyrites, but, whereas at the top of the cutting the pyrites was practically barren, at the bottom it contains considerable amounts of tin oxide. From this it would appear that the deposition of tin in the deposit has been influenced by the composition of the rock which has undergone replacement. We see exactly the same thing on a much smaller scale in the Cornwall Mine. Here some of the seams are rich in tin, others are poor, and each seam is evidently a replacement of a particular layer in the finely laminated shale.

I think it is probable that the seeming irregularities not only in the tin contents, but also in the general mineralogical composition of these deposits, may be satisfactorily explained on the assumption that certain beds, owing either to their greater porosity or solubility, or to differences in chemical composition, and the presence of suitable precipitating agents, have been more favourable to the processes of replacement and to the deposition of certain metals than others. Where, therefore, these favourable beds have been intersected by fissures carrying mineralising solutions, there will be the most likely place for shoots of payable ore to be deposited. Should this theory prove to be correct, we may find that the shoots of ore at the Renison Bell Mine are by no means so irregular in their occurrence as might at first be supposed. They will be generally fairly flat, as the dip of the planes of stratification of the country seldom exceeds 35°, but they may prove to be continuous for long distances. Although no one shoot of ore is likely to live to any depth, since its extension will be more in a horizontal than in a

vertical direction, still there is a strong probability of other similar flat shoots being met with in depth along the same lines of fissuring. The solutions originally emanated from the granite at a great depth, and probably deposition of tin has taken place along each favourable bed which the ascending solutions encountered during their journey upwards.

These theoretical considerations lead me to believe that the exploration and exploitation of the Renison Bell deposits need not be of such a costly nature as might at first be supposed. With careful management, and intelligent observation, of the mode of occurrence of the ore-shoots, there appears to me to be every probability of the mine turning out a very payable one.

With regard to recommendations for future work, this should be directed, for the present, to the exploration of the known shoots of ore, in order to definitely determine the amount and value of the ore in sight. In the case of the Big Blow, several crosscuts should be put across the lode from the main tunnel, and the stone which is taken out carefully sampled and assayed. The main tunnel should also be extended, but I should recommend it to follow the foot-wall of the lode, instead of the apparently barren formation along which it has been driven up to the present point.

The big formation exposed in No. 6 trench is certainly worth prospecting. At present I am uncertain whether to regard it as an impregnated bed, branching from one of the other lodes, like the Big Blow, or as a very wide portion of the cross-lode itself. This could be determined by a short tunnel into the hill from the bottom of the trench. The subsequent work would entirely depend on the results obtained in this tunnel. If good ore were met with, it should be driven on, and the extent and direction of the shoot determined.

The exploitation of the other lodes would have to be performed from a tunnel driven 50 feet below the level of the Emu Bay Company's line. This would afterwards be a useful working tunnel, as it would be sufficiently above the Argent River to give fall for the dressing-plant and get-away for the tailings. It should, however, be remembered that, as we may expect the shoots of ore to be flat, sinking or rising on the lodes will be more effective as regards the discovery of new shoots of ore than driving.

The very rich shoot of ore which is exposed in the open face on No. 1 lode at the Argent River should not be neglected. It is certainly surprising that it was not struck in the first crosscut east from No. 1 tunnel, and the only

explanation which I can offer is that the shoot of ore has dipped underfoot. In order to test this, I should put in a short crosscut from No. 2 tunnel, and, if the rich ore is struck, drive on it, and find out what becomes of it. If it is not struck in this crosscut, then sink a winze, and ascertain if it is underfoot. A problem of this sort should be solved definitely, at whatever cost, but in this case the cost would probably be trifling.

The erection of a dressing plant should not be undertaken until a considerable amount of payable ore has been proved to be available, and I am of opinion that further trials are necessary before it will be possible to decide upon the best class of machinery to adopt. The majority of the ore consists of dense iron pyrites and pyrrhotite, with small grains of tin oxide embedded in it. The ore will have to be first crushed, then roasted, and the tin oxide concentrated from the roasted product. In some of the ore, where the pyrites is not dense, it will probably pay to concentrate before as well as after roasting. Some of the tin is in an extremely finely divided state, and this no doubt will be difficult to save, and the loss in concentration will be considerable; but I think that, with the majority of the ore, the tin is sufficiently coarse-grained to enable a fairly close saving to be effected.

In conclusion, I desire to thank Messrs. T. Brannan, Borley, and C. Stevens, Mining Managers, for much valuable assistance and information which they have willingly given, often at considerable inconvenience to themselves.

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

G. A. WALLER,
Asst. Govt. Geologist.

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

REPORT ON COUNTRY ON THE EAST SHORE OF LAKE SORELL, AND ON A DISCOVERY OF COAL NEAR OATLANDS.

Government Geologist's Office,
Launceston, 17th March, 1902.

SIR,

As instructed by you, I proceeded on the 28th January to Lake Sorell to examine the geological structure of the country through which the tunnel will pass, which it is proposed to drive from the north-east corner of the lake through the rim-rock to the eastern fall overlooking the low country round Tunbridge. At the same time I took note of the geological features of the country generally.

Lakes Sorell and Crescent are, geologically, one lake, though at present they are separated by a narrow strip of flat land not exceeding half a mile in width. At no very distant date in the past they were connected, as proved by evidences of either a rise of the land or shrinkage of the lake to the extent of a few feet in recent times. Mr. K. L. Rahbek, the hydraulic engineer in charge of the lake survey, informed me that the water-level of Lake Crescent is 2·16 feet lower than that in Lake Sorell.

Lake Sorell is a fine sheet of water, 5 miles from N. to S., and nearly 6 miles from E. to W., while Lake Crescent is much smaller, being 3½ miles long by a couple of miles broad. As a rule, undulating wooded shores bound these lakes, but at the northern and southern extremities lofty mountains close in the view. Thus, Mt. Franklin, rising from the north end of Lake Sorell, attains a height of 3600 feet. Further north are Molly Hawk's Nightcap and a mountain mis-named Cradle Mountain. Table Mountain forms an imposing object at the south end of Lake Crescent, rising to about 3600 feet above sea-level. It is a flat-topped mountain, hence the name.

The beds of the lakes themselves consist of a shallow depression in the lofty central plateau of the Island. My aneroid reading of their height above sea-level was 2750 feet. Using the temperature of the vapour of boiling water in a Casella's hypsometer, I made the height to be 2729 feet. Walch's Red Book gives it as 2688 feet. The mean of the

three readings is 2722 feet. Lake Sorell, according to Mr. Rahbek, is only 13 feet deep in the middle, and Lake Crescent, 8 feet.

The elevated position of this great plateau with its numerous lakes is a dominant feature in the configuration of the Island. The table-land occupies a tract averaging 60 miles x 60 miles, at an average elevation of 3000 to 4000 feet above sea-level, with points rising to 5000 feet. The surface is often remarkably level, otherwise hills and mountains diversify the plateau. At the Dog's Head, on the east side of Lake Sorell, it is very level, being covered with a sheet of Tertiary basalt, which has had little time for erosion. The edge of the table-land on the southern, eastern, and northern fronts is steep and often precipitous, forming high mural escarpments. On the western edge it connects easily with the high lands of the West Coast.

In the midst of much that is perplexing, the geologist readily sees that the plateau has not formed a central boss or nucleus, around which the sediments of the low country have been deposited. Stratified rocks—sandstones, lithologically similar to the Lower Mesozoic strata at Ross—occur on the shore of Lake Sorell. They have therefore been lifted from sea-level to that height. This elevation was manifestly not due to our granites, which had consolidated prior to the Permo-Carboniferous Period. Some of it may be due to a rising movement in Tertiary times; but there is more reason to connect it, as a whole, with the stupendous eruptive processes which formed and faulted the diabase rock.

From the sea, on the east, the same formations, Mesozoic sediments and the diabase intrusive into them, rise successively in tiers to the central plateau. On the sea-shore Mesozoic sandstones and diabase occur at water-level; inland, a lofty tier, 1000 and 2000 feet high, fronts the east, on this level diabase and Permo-Carboniferous, with Mesozoic strata, also occur; further west, the country round Ross and Oatlands, at an elevation of 1000 to 1400 feet, consists of the same formations. Again rising from Oatlands to 2000 feet, the same sandstones and eruptive rock are met with; and the final ascent, 500-700 feet to Lakes Sorell and Crescent, brings us still again on a plateau with precisely the same geological features as were observed at sea-level. It is impossible to avoid the conclusion that a series of huge step faults has taken place, and that the sandstones which we see on the lofty plateau were originally continuous with others at lower horizons; otherwise, an

unwarrantable thickness would have to be ascribed to the sedimentary formations. Hence it is, too, that we meet at high horizons with beds lower in the geological series than others at lower levels.

At that time a large part of the Island was in the throes of deep-seated diabasic convulsions. It was fissured and shaken on a large scale by intrusions of the molten mass, as dykes, intrusive sheets, perhaps laccolites, disturbing and penetrating the coal measure sandstones, but without, as far as the evidence goes at present, ever reaching the then surface of the ground. Possibly volcanic pipes ascended to the surface as basalt through overlying sediments now removed by denudation. The surmise that the actual diabase masses are sub-aërial lava flows is unsupported by any positive evidence. Inspection of the diabase sills at Blackman's Bay and Frederick Henry Bay, where they are covered by beds of Permo-Carboniferous age, serves to show the ease with which an erroneous impression may be formed. Imagine an inspection of the same places at some time in the geologically near future, when the overlying sedimentary covering has been wasted away, and all evidences of intrusion gone. The same surmise of a thick lava flow might then be hazarded, and an entirely wrong conclusion drawn.

I know that there is a certain amount of difficulty in realising how thick masses of molten rock may insinuate their way into and between superincumbent strata, and without much alteration of the latter. On these points the great basic sills of Scotland and Ireland are highly instructive. Sir A. Geikie, in his work on the Ancient Volcanoes of Great Britain, delineates their features with the hand of a master. He describes (Vol. II., p. 301) the great Tertiary sill of coarsely crystalline ophitic olivine dolerite entering into the composition of Fair Head, Antrim, and presenting a vertical cliff face 250 feet in height, rudely columnar from base to summit. This is intrusive into carboniferous shales and the chalk. He then goes on to give an account of the basic sills of the Shiant Islands, north of Skye; one of these shows a sheer face with columnar structure 500 feet high, and its total thickness may even exceed that, as it passes down below sea-level. Some of the prismatic columns are stated to be 300 or 400 feet in length. These sills have been injected between Jurassic shales. Thick columnar sills of dolerite or gabbro occur on Skye, intrusive into the Jurassic. One of these is quoted 200 feet thick. Some of the illustrations in Sir A. Geikie's volumes faithfully reproduce many of the typical escarpments of

columnar diabase rock in Tasmania. The contact-effects on beds of clay are exactly similar to those often noticed in this Island. He says of Fair Head (Vol. II., p. 300), "The contact metamorphism . . . consists mainly in an intense induration of the argillaceous strata. These pass here from their usual condition of fissile, laminar, dull, dark shales into an exceedingly compact, black, flinty substance, which in its fracture, colour, and hardness reminds one of Lydian stone."

Again, it is pointed out how insignificant is the amount of contact alteration which is produced by these huge sills. "It seldom goes beyond a mere induration of the strata for a few yards, often only for a few inches from the surface of junction."

There are proofs on the western edge of the great plateau in Tasmania that in late Tertiary times it constituted a snow field which fed glaciers descending the West Coast gorges nearly to sea-level, if not to sea-level itself; but evidences of glaciation are wanting in the eastern part. I see nothing in Lakes Sorell and Crescent to indicate Tertiary glaciation in this part of the country.

Country near Tunnel.

On the eastern shore of Lake Sorell there are several little bays with sandy beaches. These are covered with fine quartz sand, which cannot possibly have been derived from the hills of basalt and diabase which skirt the shores. There is such a beach a little east of Interlaken House, another further north (marked as Diamond Beach on the Government chart), and a longer one at the north-east corner of the lake where it is intended to drive the tunnel. The sand on all these beaches has undoubtedly come from the degradation of beds of sandstone, and I feel pretty certain that these must exist somewhere on the floor of the lake. Though there is a good deal of sand in the north-east corner, I could not find any sandstone. The water there is very shallow, the depth being said not to exceed two feet for a quarter of a mile out into the lake. Four or five years ago, the lake in this corner was dried up for that distance out, and the bottom was seen to be sandy. The bed-rock is probably sandstone, but the trial holes which Mr. Rahbek is going to sink here will settle the matter decisively. However, the light yellow quartz sand has already determined my view of the nature of the underlying rock. Mountain Creek, which comes from the north from Molly Hawk's Nightcap, is the main feeder of the lake, and, as

this flows through diabase and not sandstone, it cannot have brought the sand which is seen on the beaches.

Proceeding along the line of the proposed tunnel, the country for nearly half a mile east of the shore of the lake is flat and covered with sand, much of which may be wind-blown. A gentle rise then takes place to the summit of a saddle of diabase rock, higher diabase hills being situate N. and S. This saddle is 90 to 100 feet above the shore of the lake. The surface then plunges down eastwards towards the Tunbridge Plain. No lake sand is seen on the eastern side of the saddle; boulders and protuberances of diabase are visible, and no sandstone is met with until 500 feet below lake level, when steep cliffs of it appear on the hillside. The deduction which I make is, that on the shore of the lake and in the low marsh east of it the tunnel channel will probably be in sandstone, but that it will enter diabase rock at the base of the saddle, and continue in it for the remainder of its length. There is a remote possibility that sandstone may be found passing under the diabase at tunnel-level, but no sign of it is seen on the eastern side of the ridge, where it would crop out upon that supposition, and I think it safer to assume that the saddle referred to has cut it off.

This diabase rock, consisting of plagioclase felspar (labradorite), titaniferous magnetite, and augite, is not so hard a rock as granite, but it is much tougher, in virtue of the interlocking of the crystals which compose it. Where it is fresh and massive, the absence of jointing makes it more difficult shooting ground than granite. In tunnelling through the same rock in connection with the Electric Light Works at the Second Basin, Cataract Gorge, Launceston, one hard unjointed portion was encountered, in which a power drill could only make 6½ feet in a week's work of 18 shifts. I do not think this hard variety of the rock will be met with on the line of tunnel at Lake Sorell, as the works will be shallow and for the most part within the zone of surface decomposition. The rock seen at surface, though tough enough, is distinctly decomposed.

Dog's Head.

All along the shore south from the locality just described, as far as Bennett's cottage in Dog's Head Bay, the lake rim is comparatively flat, rising here and there into low ridges of diabase. South of the bay is the Dog's Head, a flat-topped promontory of basalt. Small knolls of broken basalt protrude here and there through the grassy plain

on top. On the lake side, the waves appear to have undermined the cliff, bringing large masses away and giving rise to huge clefts and chasms in the rock. The basalt is of Tertiary age, compact and dense in grain, with crystals of honey-yellow brilliant olivine scattered through its substance. I could find no vesicular lava nor volcanic ash.

Diamond Beach.

A little over a mile south of the Dog's Head is the Diamond Beach, so-called from the numerous small stones of pellucid (yellow, red, brown) cornelian, jasper, and allied varieties of quartz, of which the sand is largely composed. The stones vary from the size of a pin's head to that of a pea, but though some of them are brilliant and attractive in appearance, none are of any real value.

Various speculations have been entertained as to their origin. The view which, on the spot, appeared to me the most likely, is that the veins or seams of which these stones are the degraded fragments were the result of the diabase-sandstone contact. I accordingly searched for sedimentary rocks, and eventually found sandstone at both ends of the beach. At the south end of the bay they occur at the water's edge, hidden underneath the beach sand, and at the north end they extend out into the water and form the low grass-covered bank a couple of feet above lake-level. At the south end the flat beds are fissured with vertical joints, giving them a quasi-tesselated appearance, probably due to the proximity of the intrusive diabase. The colour of the sandstone is light buff, its nature is somewhat clayey, and it contains pebbles of quartz. It is hardly possible, without further evidence, to determine whether these strata are Mesozoic or Permo-Carboniferous; from the appearance of the stone, I am inclined to refer them to Lower Mesozoic. Such sandstones are certainly the origin of the sand of the beaches.

Lake Echo is also said to have a sandy bed; there are sand banks and sandy bottoms at the Great Lake. Lake St. Clair is bounded by mountains, the lower part of which is sandstone, the upper part diabase. Thus, it would not be correct to conceive of the Tiers as a uniformly solid mass of eruptive rock. The plateau is evidently a replica of what is met with at lower levels; areas of sandstone capped with and intersected by diabase.

The Diamond Beach is not without its intrusive diabase at water-level, and both the horns of the bay are of the

same rock. On the beach are several boulders of coarse, yellow, cemented sand, containing the beach pebbles. These consist really of the consolidated sand of the beach, and are also found a little distance from the shore up the flat eastwards, and a few feet above water-level. This shows the former existence of the beach a little higher than it is now, and consequently the former greater extent of the lake.

About half a mile east of this beach are one or two small cones of Tertiary basalt. One of these is a truncated cone of ideal contour, not more than 15 or 20 feet in height. The flat top is perfectly level, grass-covered, with blocks of basalt protruding through the floor. Its elliptical margin is edged all round with broken columnar basalt rock. The cone is about 100 feet in diameter at its base, and is the most perfect survival of a volcanic cone which I know of in the Island. No ash or scoriæ are to be seen. Close to the east of this is another cone, larger, but worn down by denudation.

The neck of land at Interlaken House between the two lakes is diabase, but east of it is a basaltic floor of lava containing large yellow aggregations of olivine crystals. Further east again before the junction of the roads to Tunbridge and Oatlands the diabase rock peeps out again; and again further north on the Tunbridge Road the basalt recurs.

From a mineral point of view, this part of the plateau is hopeless. There are no outcrops of granite, serpentine, or the older slates and schists. The only formations are the sandstones and diabase of Upper Mesozoic Age—posterior to the date of origin of our great mineral deposits. The only hope is in the possible occurrence of coal, but I believe the sandstones on Lake Sorell to be below the horizon of the Upper Coal Measures.

A phenomenon of scientific interest is the occurrence of the well-known but mysterious noises heard from time to time resembling the distant booming of cannon. They have been erroneously referred to the blasting operations at Mt Lyell, on the West Coast, but were in fact known long before the Mt. Lyell Mine was started. They are also heard occasionally on Clarke Island, Bass Straits, where they go under the name of "Cape Barren Guns." They the sound seeming to come from the direction of that island. In India similar noises are called "Barisal Guns." They occur also in other parts of the world. Whether they are of atmospheric or subterranean origin has not yet been

determined. The latter seems the more probable, though it is difficult to explain the absence of earth vibration.

Coal at Mike Howe's Marsh.

This marsh lies at the foot of the last great rise to the lakes' plateau, about 7 miles N.W. of Oatlands, and 4 miles S.E. of the southern end of Lake Crescent. The main road, an excellent one, from Oatlands to Lake Sorell, intersects it. The coal seam is a few hundred yards S.W. of the road on Mr. Askin Morrison's land at the base of a hill rising a couple of hundred feet above the marsh, which, in its turn, is 2000 feet above sea-level.

The upper part of the hill consists of diabase, coming down to within about 40 feet of the marsh, when it gives place to sandstone. This is a soft yellowish variety, in beds dipping N.W. at angles from 10 to 20 degrees. From its appearance, I should judge that it belongs to the Mesozoic series, but, in the absence of fossils, no decisive determination can be made.

Near the S.E. boundary line, and at the base of the hill, a seam of coal has been struck near its outcrop by a shallow pit 6 feet deep. A dip 20 to 25° has been put in on the seam for about 15 feet, bearing N. 40° W. The roof is sandstone, the floor clay, and the seam 3 ft. 6 ins. to 4 feet thick. The dip had only been cleared out specially for my visit, and all the coal which was accessible must have suffered to some extent from the standing water. It is a consistent seam, free from bands, but the coal was somewhat clayey, and broke in small pieces.

The samples which I broke off from the walls of the drive were the brightest which I could knock out, and even then they looked none too pure; the walls being fairly-well saturated with moisture. When assayed by the Government Analyst they returned—

Fixed Carbon.	*Gases, &c.*	*Ash.*	*Moisture.*
33·4	20·2	21·0	25·4

These results are disappointing in every particular. I am disposed to think the coal has been under water too long for fair samples to be taken without fresh work being done on the seam.

Mr. Loone gave me some drier samples, which yielded a much more satisfactory assay. Mr. Ward returned these as—

Fixed Carbon.	*Gases, &c.*	*Ash.*	*Moisture.*
62·4	18·4	10·8	8·4

If this assay be taken as a guide, the coal would appear to be a strong durable one, capable of giving out a good heat, but of no use for making coke. The Government Analyst mentions in his return that no coke was found in either assay. The fixed carbon is high enough, and the ash low enough in the latter sample to make the coal suitable for steam purposes; but, to be sure of this, the iron and sulphur contents would require determining.

About 20 feet north of the above a small dip has been started on the same seam, but the timber in it has become insecure, and it was full of water at the time of my visit.

It has been thought that prospecting might reveal the outcrop of the same seam on Pillinger's land, which is the adjoining estate on the S.E., but I hardly think that likely. There is a valley of erosion between the two localities, and the seam would come to surface in the space now occupied by the gully; at least, it is only barely possible that it would strike across to the higher ground beyond, and once a certain height is reached, the eruptive diabase comes in.

Driving on the seam about a couple of hundred yards N.W. will bring the face below the contact of the sandstone with the eruptive diabase. Whether the coal measures pass under the latter, or whether the diabase intrudes into them and abruptly cuts them off, is impossible to say at present. It can be determined in three ways:—

I. By driving on the seam till the vertical plane of the supposed contact is reached;

II. By putting down a bore, in advance of the drive, higher up the hill into the diabase, and continuing it to a depth at which it would strike the seam if the measures are present;

III. By cutting down the surface-soil to the bedrock at the contact line of the two formations, when it can be seen whether there are signs of the sandstone being indurated or otherwise metamorphosed by the intrusion of the molten diabase material.

In some of these sandstone and diabase areas there are evidences of intrusion and severance; in others, it is possible that the coal measures underlie the flat intrusive sheets of diabase, so that it is impossible, where the junction is obscured, to predict, in any given case, one way or another, without actual work.

The seam plunges at an angle of 20°, and by pushing the works well down it could be followed under the marsh, where, however, water would have to be contended with.

I am afraid the diabase of the hill cuts the coal off, and thus restricts the area of the seam to the marsh aforesaid and the immediate base of the hill. Before commencing operations, bores ought to be put down all over the marsh, between the hill and the lake road, for the double purpose of ascertaining the extension of the seam and its quality, and seeing whether others do not exist below.

Towards the N.W. end of the hill, about 10 feet from the fence, and just where the hill begins to rise, I saw a couple of small pits, with slack coal thrown out on the bank. The pits were full of water. This seam would be a higher one than that described above, but it is too near the diabase for one to be very confident about its continuance. Its occurrence, however, makes it likely that there is a series of coal seams in these sandstones, and that others may be found below if the ground is prospected by the drill.

The conveyance of the output to Oatlands would be by tramway, but I did not go into the question of what route this would take. It is probable the distance would be over 10 miles, and the construction outlay would be £10,000 or £12,000.

It seems to me probable that the coal raised from this place would not at present be able to compete, in point of cost, with that which exists in more easily accessible parts of the State. There would be little use in dealing with it on a small scale, and a good deal of preliminary work is necessary before it can be definitely said that large quantities are available.

Whether these sandstones belong to the Mesozoic or Permo-Carboniferous, it is impossible to say without fossil evidence. The same alternations of diabase and sandstone continue S.E. all the way to Oatlands, in a succession of diabase-crowned hills and sandstone valleys, the diabase, in some cases, cropping out of the valley floors as well.

Oatlands, a substantial-looking stone-built town, is on a plain 1400 feet above sea-level, encircled by hills of moderate elevation. The building-stone, when properly smoothed, has an attractive appearance for architectural purposes; some of it has been used in Launceston for the handsome building of the Australian Mutual Provident Society, and in the construction of Trinity Church now in course of erection.

The buff sandstone is quartzose, with spangles of white mica rather loosely aggregated, friable, and apt to

decay when exposed to the weather in its rough state, especially where impaired by ferruginous segregations. Some varieties of it, however, are very durable when smooth-dressed. Lake Dulverton, on the east side of the township, is in a shallow depression in the sandstones, which are exposed on the banks in horizontal beds. The lake water has fallen several feet in the dry weather of the last five or six years. When full, I was told, it is 12 feet deep, but not now more than 3 feet in the middle. Any scheme which would keep this lake full would be a great boon to the town.

This quartzose sandstone belongs to the Lower Mesozoic (homotaxially probably equivalent to the European Trias), and hitherto no Mesozoic coal has been found below it. There is, of course, the possibility of the Permo-Carboniferous strata existing beneath it, and these might contain seams of the Lower Coal Measures, but this could only be determined by boring. At what depth these measures, if present, would be struck, it is not possible to say, for we do not know to what extent the upper sandstones have been denuded, nor do we know whether the lower ones, if ever present, have been cut out or not by the intrusive diabase which is visible on the surrounding hills. Of course there is the possibility that any greenstone found underlying these sandstones might be a sill or sheet, below which the sedimentary beds recur, but to prove this by boring would be a great undertaking. It will be well for those interested in the discovery of coal at Oatlands to bear in mind that the indications are, that the geological horizon of the buff quartzose sandstones is below that of the Upper Coal Measures; consequently, in the search for coal, the higher sandstones of felspathic character, so common in the eastern coal fields, must be looked for, otherwise, the sandstones lower in the series will have to be either reached by boring, or found raised by faults in connection with the diabase. It is not absolutely certain that some of these raised beds do not occur somewhere in the district, but if they do, they do not appear to have been recognised. The most likely positions for their occurrence are on the higher ground, and in proximity to the eruptive trap-rock.

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

W. H. TWELVETREES,
Government Geologist.

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

EVIDENCE OF GRAPTOLITES IN TASMANIA.

By T. S. HALL, M.A. (Melbourne University, Corr. Memb.)

(Read 29th April, 1902.)

At the last Sydney meeting of the Australasian Association I discussed the Tasmanian graptolite record,* and arrived at two conclusions—Firstly, that Thureau had found a Diplograptus, and, secondly, that, on the supposed identification of an (Upper) Silurian graptolite, the Lisle slates had been referred to Ordovician.

After the publication of my paper Mr. Thureau wrote to me on the matter. He speaks of the Lisle so-called graptolite, that is, the one he had recorded under the useless name of Diplograptus nodosus, as follows:—"I now recollect seeing there (*i.e.*, at Lisle, T.S.H.) dark elongated imprints—probably carbonaceous—in those dark-blue slates, but they were too indistinct to be classified. . . ." Then follow some remarks which explain the confusion into which I fell in my previous paper through my ignorance of Tasmanian geography. "With regard to the *true* graptolite . . the locality is about 10 miles from Strahan, on the old Mount Lyell Road (Tas.), close to an old road-maker's camp and stable, near a spring of water." This is the specimen which, from Mr. Thureau's conversation, I felt convinced was a Diplograptus. Of the Lisle record I express no other opinion than my belief in its worthlessness.

During the session of the Australasian Association, at Hobart, last January, while looking over some samples of slate in the collection of Mr. Thomas Stephens, M.A., I found traces of a graptolite in a specimen from near the Ring River, on the North-East Dundas Railway. I understand that the rock samples had been given to Mr. Stephens by Mr. G. A. Waller, Assistant Government Geologist. The slate is a very hard, much-jointed rock, with a silky lustre, and the fossil is badly preserved. Some branched talcose and ferruginous markings first caught my eye, and on examination with a lens I found three or four thecae.

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* 1 Rep. Aust. Ass. Adv. Sci., v. 7, 1898, p. 401.

As the thecae can be seen only when the specimen is held in a particular position with regard to the light, they are not easily demonstrated. Their outer edge is straight, and the apertural margin is about normal to the branch. From the appearance of the indistinct markings present on the stone the specimen belongs to the Dendroidea, and I am inclined to think to the genus Callograptus, which is in itself of no great stratigraphical value.

A few weeks ago Mr. Waller sent me two slabs of slate from 12½ miles from Zeehan, on the same railway line. On one of these a fragment showing graptolite thecae can be distinguished, the specimen being monoprionidian. The specimen on the other slab is more obscure, and I can only say it is suggestive of a graptolite. In neither instance can even a guess at the family be hazarded.

We thus have undoubted evidence of the existence of graptolites in Tasmania, but, so far, no evidence is thrown on the exact age of the containing rocks, and it rests with those on the spot to fill up the hiatus in our knowledge.

Mr. Stephens' specimen has been sent to the Hobart Museum, and Mr. Waller's two specimens to Mr. Twelvetrees, for the Survey Collection.

REPORT OF THE ORE DEPOSITS (OTHER THAN THOSE OF TIN) OF NORTH DUNDAS.

[Four Plans.]

Zeehan, 30th April, 1902.

SIR,

I HAVE the honour to forward the following Report on the Ore Deposits of North Dundas. These deposits are extremely varied in their nature and metallic contents, and include a number of types which are found elsewhere on the West Coast.

The following is a list of the principal types which I have noted in the district:—

1. Tourmaline cassiterite veins (Penzance type).
2. Pyritic cassiterite deposits (Commonwealth type).
3. Axinite and pyritic copper deposits (Colebrook type).
4. Tourmaline gold copper veins (Mt. Black type).
5. Pyritic zinc-lead and copper deposits (Mt. Read type).
6. Fahlore and galena veins.
7. Deposits of nickeliferous pyrrhotite.

Of these types, the first two have already been described in my report, recently published, "On the Tin Ore Deposits of North Dundas"; the remaining types will be dealt with in the present Report. I regret to say that, with regard to some of them, the information which I have been able to collect is somewhat meagre. Many of the mines have been abandoned for years, and it is very difficult, now, to obtain reliable information concerning them.

AXINITIC AND PYRITIC COPPER DEPOSITS (COLEBROOK TYPE).

The Colebrook Prospecting Association, No Liability.

This company holds Sections 236-93M, 239-93M, 216-93M, and 5364-93M, with a total area of 286 acres. The mine is reached by a pack-track from Ringville, from which it is distant nearly three miles in a direction a little east of north. The natural outlet for the mine is to the Emu Bay Line, by

a self-acting tramway, a route for which has already been surveyed. The country rock consists of hard fine-grained laminated shales and slates, with beds of impure limestone or calcareous shale. To the west of the mine there is a belt or massive dyke of gabbro, peridotite, and serpentine, which runs in a northerly direction from a little north of the Fahlore Mine. This belt goes up to nearly 20 chains in thickness.

Plate I. gives a topographical sketch plan of the mine workings, together with the supposed positions of the principal ore-bodies. These are four in number, and are situated on either side of a steep spur, which runs in a north-easterly direction. They are roughly parallel to one another, striking for the most part a little east of north, and dipping to the west at high angles. The deposits vary in width from 10 up to over 60 feet, and have been traced for distances varying from 550 to 700 feet along their strike.

The minerals forming the great mass of the ore bodies are as follows:—

Non-metallic.	*Metallic.*
Axinite	Pyrrhotite
Actinolite	Pyrite
Datolite	Marcasite
Danburite	Chalcopyrite
Calcite	Arsenopyrite
Quartz	Galena, Zinc blende, Tetrahedrite, } traces only.

The most striking feature in these deposits is the great abundance of the mineral axinite, a boro silicate of aluminium and calcium. This mineral occurs abundantly in all the ore-bodies. The structure is often banded, but in other parts it is quite massive; sometimes it occurs in irregular patches or masses in the adjoining country. Where it occurs in the ore-bodies it is usually associated with considerable quantities of pyrrhotite and chalcopyrite.

Actinolite (silicate of calcium, magnesium, and iron), is also very abundant, both in the ore-bodies themselves and in the adjoining country. The structure is generally banded, much of the ore consisting largely of alternate bands of axinite and actinolite. It is worthy of note that the impure limestone, which may generally be found associated with the deposits, nearly always contains minute crystals of actinolite distributed through it. The latter gradually increases in quantity, till we have, finally, a rock composed almost entirely of actinolite.

Datolite and danburite (silicates of boron and calcium), occur associated with calcite and axinite as the lining of cavities in the ore-bodies. Neither of these minerals is very abundant.

Quartz is nowhere abundant, and is practically absent from the greater part of the ore.

Of the metallic minerals present, pyrrhotite is the most abundant. This occurs in large bands and masses up to 10 or 15 feet in thickness. It is associated with copper pyrites, and crystals of axinite may often be found embedded in it.

Pyrite and marcasite are present in relatively small quantities.

Chalcopyrite is widely distributed. It occurs in small grains throughout the large masses of axinite, and is also present in the massive pyrrhotite. This is probably the only copper-bearing mineral present in the ore-bodies.

Arsenopyrite occurs distributed in small quantities through the ore-bodies. In places it occurs massive, in the form of veins up to 6 or 8 inches in thickness, and may become a by-product as soon as mining operations are commenced. It is, however, nowhere present in very large quantities.

Galena, zinc-blende, and fahlore are only present in very small quantities. Where they do occur, they are very low in the precious metals.

Bismuth has been detected in traces in one or two special samples, but it is absent from the greater part of the ore.

The content of the ore in gold and silver is, unfortunately, low. Most of the assays return only a trace of gold, and from one-half to an ounce of silver to the ton.

It is a remarkable fact that the ore-bodies have suffered very little oxidation. It is true that several bodies of gossan are known, but these are insignificant in comparison with the amount of ore that is unoxidised. As a rule, the ore is quite undecomposed within a few feet of the surface. The gossan is very low in both gold and silver.

The several deposits are separated by bands of hard shale or slate, which is also often highly mineralised, and, as a rule, the walls of the deposits are not well defined. Often there are branches and tongues of axinite and actinolite running out into the wall-rock, and in places these constitute masses of considerable size.

As regards the origin of the Colebrook deposits, the banded nature of the ore at once suggests metasomatic replacement

of the impure laminated limestones, which occur in the vicinity of the ore-bodies. These limestones often contain small crystals or fibres of actinolite, and when the latter increases in abundance a complete passing over is to be observed from the impure limestone to actinolite rock. The latter contains seams and bunches of axinite and the other constituents of the ore-bodies, in all proportions. As further evidence, it may be remarked that the minerals forming the bulk of the ore-bodies (axinite, actinolite, calcite) all contain considerable quantities of lime. I think, therefore, we are fully justified in assuming that the Colebrook ore-bodies have been formed by the replacement of beds of impure limestone; and the question arises, whence came the solutions which brought about such a profound alteration? There can be no doubt as to the answer to this question. The mineralogical composition of the Colebrook ore-bodies is essentially the same as that of the axinite veins which are associated with the pyritic tin ore deposits in the vicinity of Commonwealth Hill. In my previous report I have shown that the filling of these veins is the result of hot ascending solutions containing boron compounds emanating from the granite magma during the process of consolidation. There can be no doubt that the Colebrook ore-bodies have been deposited by similar solutions.

It is not evident, at present, what channels have been used by the ascending solutions. There are many fissures cutting across the deposits, and it is possible that these may have been utilised, but I think it more probable that the main channels were along the planes of sedimentation. Although I am quite satisfied that the above is a satisfactory explanation of the origin of the deposits, it is quite possible that they do not in every case form continuous bodies as shown on the plan. They have been proved to be to a great extent continuous, but in one or two places, as for example, in No. 2 ore-body, south of "D" open cut, the ore-body appears to have pinched, for it is not met with in "E" cut. Probably it will be found to the east of this cut, as shown on the plan, as the walls in "D" open cut strike in this direction, but if not, this will not be evidence against the replacement theory. Often replacement deposits occur as lenticular masses along certain lines of favourable country, and it is quite possible that some of the exposures at the Colebrook Mine may be of this nature. It may also be that some of the exposures which are supposed to be along the same formation are really separate. Thus, the exposure in "H" tunnel may not be a continuation of No. 1 lode, but a separate

deposit. These points cannot be cleared up until the ore-bodies have been driven on underground, or trenched along on the surface.

With regard to the copper contents of the ore-bodies, I regret that I have been unable to obtain much definite information. Some years ago, when a wealthy syndicate held an option over the property, the mine was exhaustively sampled, but, unfortunately, no record appears to have been kept of the details of these assays. It was thought at that time that the whole spur on which the ore-bodies occur constituted one immense ore-body, striking in a north-easterly direction, and the proposition was then to mine away the whole hill on the open-cut system. This proposal has long since been abandoned. All that is now proposed is to mine the richer portions of the ore-bodies by the ordinary methods of mining, leaving the lower grade ore and the barren country standing. The only records of the sampling of the mine which appear to have been preserved are averages of great numbers of bulk samples taken as the work was proceeding. These averages are supposed to represent the contents of the whole ground opened up, and it is expressly stated that the barren country is included in the averages, as well as the copper-bearing ore. As the details of these assays have not been recorded, the only thing to be done now is to re-sample the mine. The method of doing this will be referred to in another part of this Report.

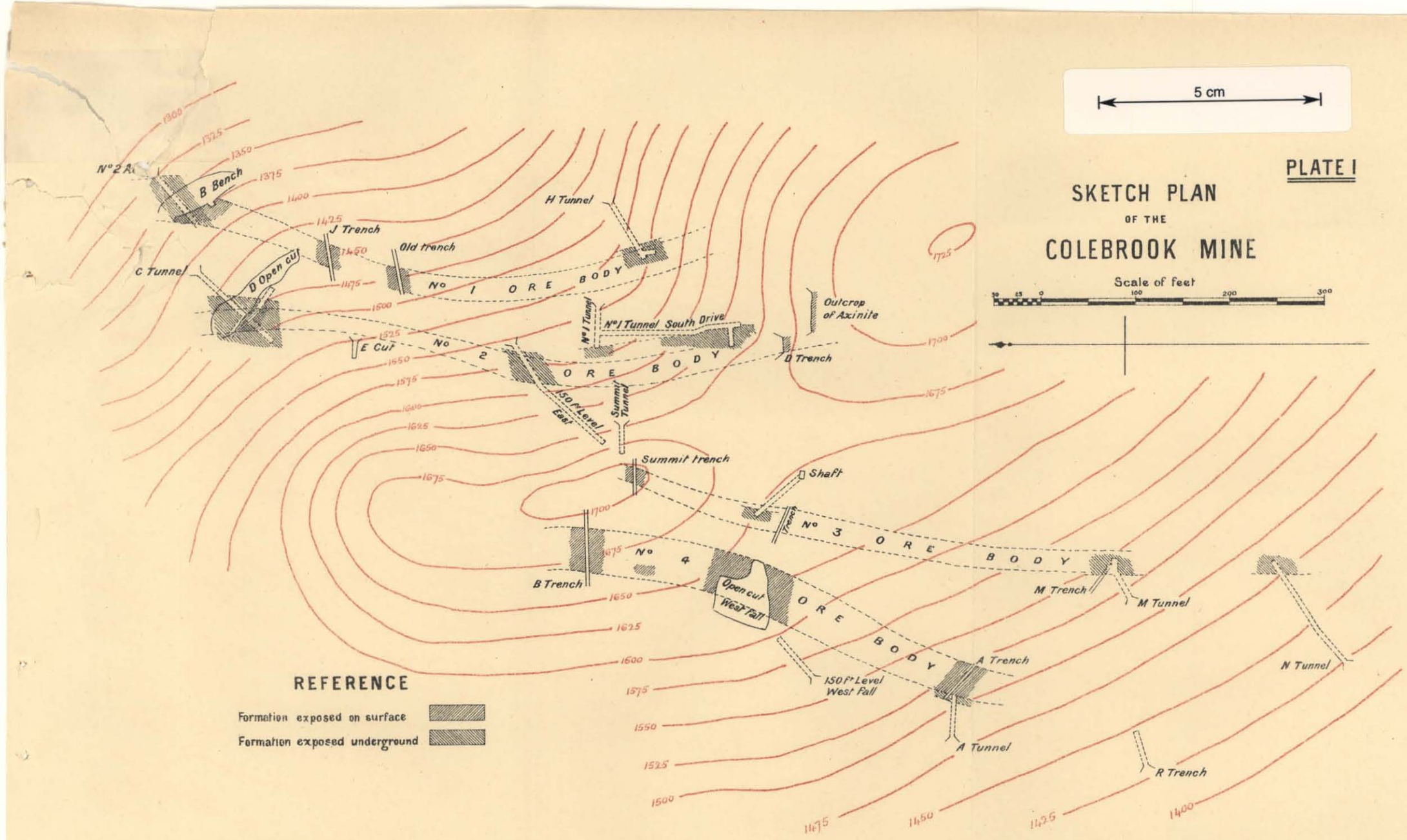
The assay returns given below are those furnished to me by Mr. T. Williams, the mine manager, at the time of my visit. As most of these were taken before his time, he could not give me any information as to the method of sampling adopted; but, in the case of the samples taken by Mr. T. Williams himself, he tells me that they were from chips broken here and there from the ore exposed. This is a rough-and-ready method, and could hardly be depended on to give reliable results.

The Mine Workings.

Almost the whole mining work has been laid out under the impression that the whole ridge constituted one immense ore-body, striking about north-east and south-west. For this reason, most of the tunnels were put in in a north-easterly or south-westerly direction, so that they are really crosscuts cutting diagonally across the ore-bodies. Practically, no driving on the course of the ore-bodies has been done. This is to be regretted, as, although there is no

PLATE I

SKETCH PLAN
OF THE
COLEBROOK MINE



REFERENCE

Formation exposed on surface

Formation exposed underground

reason to doubt that the ore is fairly continuous along the course of the ore-bodies, it would have been more satisfactory if this had been proved by actual mining.

No. 1 *Ore-Body.*—Exposed in No. 2 adit, B bench, two trenches, and in H tunnel. (See Plate I.) In No. 2 adit, the lode has been cut across at an angle of about 45°, the hanging-wall being cut in the end of the tunnel. The walls of the tunnel are much stained with copper sulphate, and copper pyrites may generally be seen by chipping the stone. Some places are evidently richer in copper than others, and it would be well to sample the tunnel in sections, in order to ascertain the value of the richer bands.

B bench is about 35 feet above No. 2 adit. The lode is very wide here, and there is about 20 feet of ore which looks promising. Mr. T. Williams took a sample from the richer portion of the ore-body exposed at this point, by chipping pieces here and there over the face of the bench. This gave a return of 5·9 per cent. copper and 1 oz. 15 dwts. of silver per ton.

In the two trenches there is not much to be seen at present, as they are old and partly filled in. A bulk sample taken by Mr. R. Williams from the most northerly of these trenches gave a return of 1·36 per cent. copper, and 9 dwts. silver, per ton.

H tunnel has penetrated what is believed to be No. 1 ore-body for a distance of about 20 feet, without reaching the other wall. An average of three bulk samples taken by Mr. T. Williams gave 1·67 per cent. of copper and 17 dwts. of silver per ton.

No. 2 *Ore-Body.*—Exposed in C tunnel, D open cut, 150-feet level east, No. 1 tunnel and D trench. In C tunnel and D open cut, the lode looks promising, and probably this is the richest ore-body exposed in the mine at present. The ore-body is considerably wider in the tunnel than it is on the surface. Average of 49 bulk samples from D open cut and C tunnel taken by Mr. R. Williams gave 2·9 per cent. copper and 1 oz. 1 dwt. of silver per ton; this assay is from the whole of the stone exposed in the tunnel and in the open cut, and includes much that is practically barren, so that it is not a fair sample of the ore that would be won if mining operations were being carried on. These workings should be again thoroughly re-sampled in small sections, in order to find out the quantity and value of the ore which is available. There is no other way to get at a reliable estimate.

The 150-feet level east was put across the lode 350 feet south of D open cut. The tunnel passed diagonally through the ore-body for a distance of 45 feet, and was continued in practically barren country for a further 90 feet. An average of 23 bulk samples, taken while the tunnel was being driven, gave a return of 1·6 per cent. copper and 9 dwts. 5 grs. silver per ton. As only one-third of this was really in ore, it is evident that the average for the ore-body should be considerably higher than this. This should also be re-sampled carefully.

In No. 1 tunnel the lode was cut 40 feet from the entrance; a drive was then put in along the eastern wall of the lode in low-grade gossan, and, in the end of the drive, a short crosscut has been put in west, without reaching the other wall.

D trench has lately been put in, and has exposed a copper-bearing formation about 20 feet in thickness. A bulk sample taken by Mr. T. Williams gave a return of 3·06 per cent. of copper and 16 dwts. of silver per ton. To the south-east of D trench, there is another cutting, in which an axinite formation of considerable width is exposed; this contains some pyrrhotite and copper pyrites, and may be regarded as part of the ore-body, but it is pretty certain that the western portion is the only part that carries appreciable amounts of copper.

No. 3 Ore-Body.—Exposed in the summit-trench, in the crosscut from the main shaft, in M tunnel, M trench, and in N tunnel.

In the summit-trench, the ore-body is about 20 feet wide, with 10 feet of highly-mineralised country on either side. Average of six bulk samples taken from this trench, for a width of 40 feet, gave 2·16 per cent. copper and 1 oz. silver per ton.

The lode is again cut in a crosscut from the main shaft 130 feet further south. I was not able to examine it at this point. A trench put across the formation at the surface shows that the lode at this point is highly decomposed.

About 500 feet south of the summit-trench, M tunnel has been put in, and cut across the lode for about 20 feet without reaching the footwall. The lode consists mostly of axinite, actinolite, and copper pyrites. An average of 3 bulk samples taken by Mr. T. Williams from this tunnel and the trench above gave 3·4 per cent. of copper and 18 dwts. silver per ton.

The same lode has been cut 180 feet further south by N tunnel. It is here about 10 feet wide, but it is completely decomposed.

No. 4 Ore-Body.—Exposed in B trench, Open cut western fall, and in A tunnel.

In B trench, the lode is 45 feet wide. A cut was being put into the ore-body at this point at the time of my visit, and some nice-looking ore was exposed.

In the Open cut western fall, a large amount of stone has been broken down. It consists for the most part of axinite, with a little copper pyrites through it. There are also bands of very dense pyrrhotite exposed, and some fair-grade copper ore. An average of 16 bulk samples taken from B trench and this open cut gave a return of 3·12 per cent. copper and 1 oz. 3 dwts. 16 grs. of silver per ton.

There are two other bodies known on the property—one to the east (the east lode), and one to the west (the west lode), of the above workings. Both of these ore-bodies are of the same character as those already described, but they have not yet been thoroughly opened up.

In addition to the above workings, 5 bore-holes have been put in with the diamond-drill. The following notes on the results of these operations are taken from the mine manager's report:—

No. 1 BORE.—From No. 1 tunnel, south drive, bearing due south, total length 192 feet—

0′- 60′—Axinite, actinolite, magnetic pyrites, with little copper pyrites through it.

60′- 65′—Showed copper pyrites freely, best copper in bore.

65′- 94′—Axinite, actinolite, calcite, and little copper pyrites.

94-′142′—Impure limestone, with bands of axinite and actinolite alternating, and little copper pyrites in it.

142′-150′—Marked improvement, axinite, actinolite, and calcite, showing magnetic and copper pyrites freely.

150′-192′—Altered slates, with veins of axinite and magnetic pyrites, with little copper pyrites in these veins.

No. 2 BORE.—No. 1 tunnel west crosscut, bearing S. 30° W., total length 165 feet—

0′- 65′—Through magnetic pyrites, axinite, and actinolite, with a little copper pyrites through it.

65′- 98′—Axinite and actinolite, with a little copper pyrites, bands of altered slate alternating.

98′-165′—Soft gossanous formation.

No. 3 BORE.—From No. 2 adit, bearing S. 44° W., 183 feet 9 inches in length—

0'- 50'—Principally magnetic pyrites and axinite, with copper pyrites through it.

50'-130'—Intrusion of country.

130'-183'—Magnetic pyrites, axinite, and actinolite, with copper pyrites in it through the whole distance.

No. 4 BORE.—From D open cut, bearing about west, total length 90 feet—

0'- 66'—Through magnetic pyrites and axinite, showing copper pyrites all through it freely.

66' 72½'—Intrusion of country.

72½'-77½'—Quartz and arsenical pyrites, with little copper pyrites through it.

77½'-90'—Clean country.

No. 5 BORE.—Vertical bore from D open cut; total depth 298 feet—

0'-186'—Magnetic pyrites and axinite, with copper pyrites all through it.

186'-298'—Axinite and actinolite; no copper.

I understand that one piece of core from each six feet was taken to be assayed, but I have not been furnished with the results. This method of sampling a core might lead to very misleading results, and I think it would be advisable to have the cores (which have been carefully preserved) properly re-sampled and assayed. In sampling the core, it will be necessary to break it up and quarter it down properly. It would be advisable to make a separate assay for each 6 feet, but, of course, where no copper is showing, an assay is unnecessary.

I think it will be evident from the above notes that a thorough sampling of the mine is most desirable. The method to be adopted should be very carefully considered, as the mine is a very difficult one to sample. The copper is not evenly distributed through the stone, but occurs in blebs and patches here and there. There are rich bands and poor bands, and, as the object of the sampling should be to determine the proportion of payable ore in the ore-bodies, these bands must be sampled separately. Sometimes the richer ore appears to occur in irregular masses, and in these cases there does not appear to be any method of ascertaining the proportion of rich ore other than mining on a large scale. However, I feel sure that a careful sampling of the mine will give pretty definite information as to the value of

the ore-bodies. This should be carried out in the following manner:—In all the principal openings the ore-bodies should be carefully inspected, and the distribution of the copper pyrites determined as closely as possible. The copper-bearing belts should then be divided up into sections of not more than 6 feet in width, and the stone gadded off the sides of the tunnels or the faces of the open cuts. It would not be necessary to take off the whole surface exposed; if pieces were taken at equal distances, say 12 inches apart, all over the face, this would be sufficient. The stone broken from each section should then be quartered down, and assayed separately. If this were done, it would be known with a fair amount of certainty what proportion of the ore-body it would pay to mine. The richer portions could then be driven on, and their continuity proved.

The possibility of richer ore being found in depth is a subject upon which miners always speculate. In the case of the Colebrook Mine, I think it may be possible that some of the copper has become concentrated at lower levels, but I do not think that this can have taken place to any great extent. In almost all cases where rich concentrations of copper have taken place at and below water-level a large amount of gossan is present in the upper portions of the lodes, and it is the copper which has been leached out of this gossan-zone, and from portions of the lode which have been removed by denudation, that has been concentrated in the lower levels. Now, in the Colebrook Mine there is not a great deal of gossan in the upper levels, most of the ore-bodies being singularly undecomposed within a few feet of the surface. In other words, there has been very little leaching of the copper from the upper portions of the ore-bodies, and, therefore, there is not likely to be a great concentration of copper in the lower portions. Practically, I think that the mine should stand or fall on the work already done. If payable ore is not exposed now it probably never will be, and a careful sampling of the mine should determine the point once for all.

The ore of the Colebrook Mine is of an exceptionally favourable nature for smelting, since its mineralogical composition renders it practically self-fluxing. For this reason the cost of smelting should be materially less than at Mt. Lyell. On the other hand, the cost of mining would be more, as the open cut system could not be utilised. It would not, however, be excessive, as mine timber, for a long time to come, could be cheaply got from the hill to the south

of the mine. On the banks of the Pieman River, a short distance from the mine, an excellent site might be chosen for a smelting works.

TOURMALINE GOLD-COPPER DEPOSITS (MOUNT BLACK TYPE).

These deposits occur in what is commonly known as the "schist belt." The rocks consist principally of light-coloured argillaceous schists, with bands of dark slate, and, occasionally, quartzites and silicious schists; bands of a felsitic rock, which Messrs. Twelvetrees and Petterd have determined as keratophyre (a soda syenite porphyry), are common. South and east of the Mount Black Mine there is a very extensive belt of this rock, and a great number of small veins of the Mount Black type have been found in this belt. The keratophyre has often assumed a schistose structure, and when this is the case it is often extremely difficult to distinguish it from some of the schists. I have not been able to determine definitely whether the keratophyre actually cuts across the planes of stratification of the schists. The contact is usually very obscure, and it is remarkably difficult to determine where the keratophyre ends and the schist begins. I think that, as a general rule, the bands of keratophyre are parallel with the plains of stratification. In Messrs. Twelvetrees and Petterd's paper they express the opinion that the keratophyres are probably of effusive origin, and, therefore, of the same age as the schists. They have lately told me, however, that they are now of opinion that the rock is intrusive, and I may say that my own observations incline me to the same conclusion.

The tourmaline gold-copper deposits of the Mt. Black type are, for the most part, fissure-veins, either entirely in the keratophyre, or at its contact with the schists. They are usually small veins, with two well-defined walls, and often presenting a perfectly symmetrical banded structure. They are composed principally of quartz, tourmaline, fluorite (sometimes very abundant), iron pyrites, chalcopyrite, with a little arsenopyrite, bismuthinite, and wolframite. A large number of the veins are almost entirely composed of quartz, tourmaline, and a little pyrites. The lode of the Mt. Black Mine is the largest and most important of these veins, and, I fear, the only one which is likely to become of much economic value. Besides these true fissure-veins, there are two other replacement deposits (at the Salisbury and Chamberlain mines) in the schist-country, composed of quartz, pyrites,

and a little tourmaline, which I take to be connected with the same phase in the process of ore-deposition as that to which the veins of the Mt. Black type owe their origin. The presence in these deposits, of minerals containing boron and fluorine (tourmaline and fluorite), and also the presence of wolframite and bismuthinite, which are such common accompaniments of tin-veins, show that these deposits are, like the tin-ore deposits in the vicinity of Commonwealth Hill, and the copper deposits at the Colebrook, connected with the eruption of the granite. It seems probable that the process of ore-deposition has passed through a number of phases, deposits of different types being found at different periods and at varying distances from the seat of eruption. In this way, I think, we may find a satisfactory explanation of the fact that several different types of deposits are all connected with one and the same eruption.

The Mt. Black Proprietary Mining Company, No Liability.

Sections 58-93M, 59-93M, 4693-93M, total area 65 acres. This mine is situated in moderately-flat country, at the foot of Mt. Black, about half a mile to the east of the Rosebery township. The ore-deposit is a true fissure-vein, consisting of quartz, tourmaline, fluorspar, iron and copper pyrites, and, in parts, a good deal of wolframite and bismuth sulphide. The structure is banded, but not symmetrical, the bands of fluorspar, with bunches of bismuth sulphide, being found principally near the hanging-wall, and the quartz on the foot-wall. The tourmaline does not occur in bands, but forms little veinlets and bunches through the other minerals. The quartz contains a large quantity of tourmaline, in the form of fine needles. The lode is exposed at the surface in a stripped paddock, and at the mouth of an inclined shaft which has been put down on the lode. Here the lode strikes 6° W. of N., and dips to the east at an angle of 55°. The lode is 5 feet 2 inches thick at this point, measured perpendicularly to the walls. The hanging-wall is composed of keratophyre, and the foot-wall of a light-coloured fissile argillaceous schist.

About 200 feet to the east of the inclined shaft, a main vertical shaft was sunk to a depth of 100 feet, and at this depth a crosscut was driven to cut the lode. As all the workings were under water, I was unable to examine them, but Mr. C. M. Henrie, the metallurgist to the Tasmanian Copper Company, has kindly furnished me with the following notes:—The crosscut from the main shaft cut through

three separate formations before striking the main lode. No. 1 lode was 4 feet wide, consisting of bands of quartz-tourmaline, with a little fluorspar, iron pyrites, and a little copper. At 37 feet from the shaft, a silicious rock was cut, carrying a considerable amount of iron pyrites, and some copper pyrites scattered through it. At 61 feet from the shaft, No. 2 lode was cut; this was 15 to 18 inches in thickness, and of the same general character as No. 1. At 100 feet from the shaft, No. 3 lode was cut; this was small, and principally composed of iron pyrites. At 140 feet, the main lode was cut; this was 8 feet wide, with 6 feet of fair-looking ore. The main lode appears to have been cut at its richest and widest part, for, in driving north and south on the lode, it pinched very considerably, and the metallic contents also fell away. This corresponds also with what was found at the surface, so that it appears that it is a comparatively short shoot, or chimney, of ore, pitching at a high angle, perhaps vertically. By driving on the lode, other parallel shoots may be met with, but, if these are continuous, they should live up to the surface, and might be found by surface-trenching. I am also indebted to Mr. Henrie for the analyses of ore from the Mt. Black Mine contained in Tables I. and II.

TABLE I.—MOUNT BLACK MINE.

	I.	II.	III.	IV.
Gold, ozs. per ton	0·44	0·95	0·75	0·15
Silver, ozs. per ton	0·34	0·48	0·62	0·31
Copper, %	1·40	0·82	1.26	1·52
Bismuth, %	trace	7·44	—	trace
Lead, %	trace	trace	—	trace
Zinc, %	trace	0·31	—	trace
Iron, %	16·83	9·45	18·90	16·83
Silica, %	21·30	32·85	20·10	46·90
Alumina, %	5·39	12·02	11·90	12·96
Manganous oxide, %	0·14	0·12	—	0·15
Calcium, %	18·20	15·39	14·73	—
Calcium oxide, %	—	—	—	3·32
Magnesia, %	0·94	0·40	—	0·95
Fluorine, %	17·30	14·75	13·94	trace
Sulphur, %	13·24	0·90	18·00	6·64
Oxygen, in CaO	0·66	—	—	—
Oxygen, in FeO	1·67	0·94	0·90	3·49

I. Sample from face of south drive, main lode, about 12 feet from main crosscut.

II. Sample from south drive, main lode, near hanging-wall.

III. Bulk sample from small shipment taken by Mr. T. Dunn, mine manager.

IV. Bulk sample from No. 1 lode, 100-foot level.

TABLE II.—MOUNT BLACK MINE.

	I.	II.	III.	IV.	V.	VI.	VII.
Gold, ozs. per ton.....	0·85	0·26	0·70	0·84	0·30	0·09	0·42
Silver, ozs. per ton	1·15	0·74	0·80	0·66	0·60	0·48	0·58
Copper, %.....	0·61	0·10	1·15	0·48	trace	trace	0·52

I. Iron pyrites, fluorite and quartz.
II. Fluorite, with iron pyrites.
III. Iron pyrites, fluorite, and quartz.
IV. Iron pyrites and fluorite.
V. Quartz.
VI. Quartz.
VII. Iron pyrites, fluorite, and quartz.

The above samples (Table II.) were taken from the main lode at the point intersected by the main crosscut.

From these analyses, it will be seen that the main value of the ore is in the gold contents, which carry between 5 dwts. and 1 oz. to the ton. In order to bring the ore into a marketable condition, an attempt was made to treat it by mechanical concentration, by which process it was hoped that a marketable product, containing the gold, silver, and copper values, would be obtained. A small mill was erected, consisting of a Blake crusher, one pair of rolls, two trommels, one two-compartment topping-jig, two four-compartment and one five-compartment jig, one spitzkasten, two frue vanners, and a Wilfley table. The mill only ran for one month. The loss in gold was excessive, and the ore in bulk did not prove as rich as had been expected. A few tons of concentrates were obtained, which carry a little over an ounce of gold to the ton, and between 2 and 3 per cent. of copper. The tailings carry over 5 dwts. of gold and ¼ per cent. of copper. I am of opinion that these results might be improved upon by more efficient ore-saving appliances. Very little classification of the slimes was attempted, and there was no provision made for the re-crushing of the finer middle products. I am not aware whether there is any free gold present; if there is, it could be won from the tailings by the cyanide process. There is nothing in the ore which should prevent its successful treatment, and the whole question really rests upon the value of the ore in bulk and the amount of stone available.

In the event of local smelters being erected in the district, it will probably pay the company to have its ore smelted direct, without concentration. The fluorspar in the ore

would be very valuable as a flux, and would enable the smelting company to offer a favourable tariff. On the other hand, the bismuth contents are a disadvantage, but this appears to occur mostly in bunches, and, with a little care, almost all of it could be eliminated. With the exception of picked samples of bismuth ore, nearly all the samples which have been analysed have yielded only a trace of bismuth.

The Great South Rosebery.

Section 1065-93M, 79 acres. This section is situated to the east of the Mt. Black Mine. The country rock is, I believe, all keratophyre, though, where the structure is schistose, and the rock somewhat decomposed, this is difficult to determine with certainty. Quite a number of small veins of the Mt. Black type have been found on the section. They consist principally of quartz and tourmaline, with a good deal of iron and a little copper pyrites. Fluorspar is sometimes present in small quantities, but usually it appears to be absent. About the centre of the section one of these veins has been trenched along for about a chain, and its outcrop is exposed on the surface about two chains further north. This vein strikes 15° W. of N., and dips vertically. It is about 5 or 6 inches in thickness. In the north-eastern portion of the section a short tunnel has been driven to intersect a formation which is exposed on the brow of a small ridge. The formation consists of broken country, somewhat iron-stained, with stringers of quartz tourmaline. In the tunnel, a small leader of quartz tourmaline was cut, and further, in a belt of broken country beyond this, there is a little pyrites showing in the joints of the country, with bunches of quartz. A little to the south-west of the centre of the section, another vein has been driven on carrying quartz, tourmaline, fluorspar, and pyrites. This is said to have been a foot in width in one place, but in the face of the drive it is only 3 inches thick. South of this, on the flat, there is what is supposed to be the outcrop of a big lode, but I fear it is only iron-stained keratophyre, with a few stringers of quartz tourmaline through it. Near the western boundary of the section there is another lode, which has been intersected by a tunnel driven east. This has cut a formation about 5 feet wide, composed principally of broken country. On the eastern wall, there is a vein of decomposed matter, containing a good deal of copper pyrites, and is said to yield 14 per cent. of copper.

I regret to say that I do not think there is much hope of finding anything payable on this section, or on others which are wholly in the keratophyre belt. The keratophyre itself appears to be unfavourable to the process of replacement—to the operation of which, I believe, we owe the great majority of our larger deposits of copper ores on the West Coast. The veins met with in this section are simply fillings of open fissures, and their dimensions are, therefore, dependent upon the size of the original cavities. The contents of the veins are, unfortunately, very poor in the valuable metals, and there is no reason to expect them to become materially richer as depth is gained.

The above remarks apply also to a number of sections which lie to the south of the Great South Rosebery, along the valley of the Stitt River. A great number of small veins of a similar nature to those found on the Great South Rosebery have been discovered in this belt of country, and, although occasionally good assays may be obtained from them, I am of opinion that they are too small, and the country is too hard to permit of their being profitably worked.

The Salisbury Mine.

Section 4429-93M, 79 acres. This section is situated to the east of the Rosebery Railway Station, on the western slope of the Bald Hill, a spur running north from Mt. Read. The country consists of light-coloured argillaceous schists. Just below the road which connects Williamsford with Rosebery, a tunnel has been put into the hill in an easterly direction, and has intersected a small vein, containing a good deal of galena and some zinc blende and copper pyrites, associated with fluorspar and a little tourmaline, carbonate of iron, and quartz. The vein is 6 or 8 inches in thickness, strikes 15° east of north, and dips nearly vertically. About 200 feet higher up the hill, another tunnel has been driven, and in this a strong quartz formation has been cut through and driven on for some distance north and south. In the south end, the lode is 4 feet 9 inches wide, and in the north end 2 feet 9 inches. The lode-matter consists principally of dark-coloured quartz, with a good deal of iron pyrites through it. I did not notice any fluorite in the stone, but I found some minute black needles, which I took to be tourmaline. The stone carries a few dwts. of gold, and should become of value as a silicious flux when smelting operations

are started in the district. The following is the result of an analysis of the stone made by Mr. C. M. Henrie:—

Gold, 4 dwts. per ton.
Silver, 1 oz. 2 dwts. per ton.
Copper, 0·93 per cent.
Iron, 9·53 per cent.
Silica, 69·83 per cent.
Sulphur, 5·69 per cent.
Manganous oxide, 0·21 per cent.
Alumina, 12·42 per cent.
Oxygen with FeO, 1·1 per cent.
Zinc, lead, lime, and magnesia, traces.

The lode is not a fissure vein, but is probably a replacement deposit parallel in strike and dip to the surrounding country. The section is now vacant.

The Chamberlain Mine.

Sections 1908-93M and 911-93M. These sections are situated to the south-west of the Salisbury Mine, on Section 911. A lode of exactly the same character as the silicious lode on the Salisbury Mine has been cut through in a trench on the surfaee. It is 10 feet 6 inches wide, striking about north and south, and dipping to the east at an angle of 50°. Another small lode has been cut further west, consisting principally of copper and iron pyrites associated with quartz, from which assays up to 14 dwts. of gold per ton have been obtained. Neither of these lodes are workable under present conditions, but if smelting works are erected in the district, they will no doubt receive further attention.

PYRITIC ZINC-LEAD AND COPPER DEPOSITS (MT. READ TYPE).

These deposits are not confined to Mt. Read, but also occur on the southern slopes of Mt. Black. There are two distinct varieties, which, however, are so closely connected that it is most convenient to consider them together. These are—

(*a*) Zinc-lead sulphide bodies (containing a little copper).
(*b*) Pyritic copper deposits (containing a little zinc and traces of lead).

The zinc-lead sulphide deposits consist of large masses of zinc-lead sulphide ore, carrying a little copper and appreciable quantities of the precious metals. The total gross value of the greater part of the ore ranges between £3 and

£8 per ton, and, as about two-thirds of the value is represented by the zinc, it is evident that, before the whole of the deposits can be worked, a process must be found which will yield the zinc in the form of a marketable product.

It is beyond the scope of the present report to discuss the possibilities of the solution of the zinc problem. It is well known that a number of eminent metallurgists are engaged in carrying out researches in connection with it, and several have expressed themselves as confident of ultimate success. The Tasmanian Copper Company has made an exhaustive examination into a number of proposed processes, and it is now stated that it is about to export a large parcel of its ore for experimental purposes. It is to be hoped that its perseverance and energy will be rewarded with success.

In some of the mines, as, for example, the Hercules and the Mt. Reid, there are limited though still considerable quantities of richer zinc-lead sulphide, which yield a fair profit, even under present conditions. This does not, however, alter the fact that for the successful operation of the great mass of the zinc-lead sulphide ores, a new process is necessary.

At the Hercules Mine, there are also large deposits of low to medium-grade pyritic copper ores, which present a separate mining proposition. There are no metallurgical difficulties to be overcome in the treatment of these ores, and their successful working depends only on the quantity and quality of the ore which is available.

The ore-bodies in the several mines are so similar in character, that it will be most convenient to deal with their geological features as a group before describing the mines in detail.

The rock in which the ore bodies occur consists of schists, of which there are a number of varieties. These may be briefly described as silicious, argillaceous, and calcareous. The general strike of the country is about 12° W. of N., and the dip to the east, at angles varying from 55° to 70°. The silicious varieties of schist, though frequently containing a considerable amount of mineral matter (pyrite, blende, and galena), in the form of an impregnation, have not, so far, been found to contain any mineral deposits of value. The latter are confined to the argillaceous and calcareous schists, and it appears that, of the argillaceous schists, those which have undergone the least metamorphism are the most favourable to deposition. The calcareous schists, which are always associated with the argillaceous, appear to have a very close connection with the zinc-lead sulphide

bodies; indeed, I have found them either within, adjoining, or immediately adjacent to every deposit which I have examined. As I believe these rocks have played a most important part in the deposition of the ore, I will describe them in greater detail. Many of the harder highly metamorphic argillaceous schists contain small round or ellipsoidal blebs of calcite, which are generally about one-eighth of an inch in diameter. Occasionally the calcite concretions have a definite crystalline outline. Thus, on No. 4 tramway, at the Hercules Mine, there is an exposure of a highly metamorphic argillaceous schist, containing rhombohedra (R) of calcite about half an inch in diameter. These appear to have been distorted somewhat by pressure, as the faces are often bent, and facial angles are not always normal. Other concretions of calcite may be seen on the track between No. 4 and No. 5 levels. These consist of large round masses the size of cannon balls, weathering brown, and containing, besides calcite, a good deal of quartz. I think this quartz is probably due to a secondary replacement of the carbonate of lime by silica, for there are other types of calcite concretions which appear to have suffered a similar alteration. Thus, on No. 4 tramway, there is an exposure of argillaceous schist containing small ellipsoidal blebs of quartz, the exact counterpart of the calcite blebs from other parts.

Most of the calcareous schists differ from these argillaceous schists only in the abundance of the calcite blebs. Viewed in a direction at right-angles to the folia, they may readily be mistaken for argillaceous schists; but when the cross-fracture is examined, they are seen to be composed of multitudes of lens-shaped particles of calcite, separated from each other by a thin film of argillaceous material. Calcite schist apears to me to be an appropriate name for this rock. Perhaps the most typical example is to be found in the No. 3 tunnel, at the Hercules Mine. By decrease of the argillaceous matter, the rock passes over into a fine-grained crystalline limestone, and, by a decrease of the calcite, into argillaceous schist. The calcite schists are by no means persistent, either in strike or dip. Thus, at the Hercules Mine, in No. 3 tunnel (see Plate II.), calcite schist is very abundant. In No. 4 tunnel, 50 feet lower, it is distinctly less so; and in No. 5 tunnel, which is 200 feet lower than No. 3, there is no calcite schist in that portion of the tunnel which is below No. 3 and No. 4 tunnels. Further in it re-appears, but these are evidently separate bands. In strike, also, the bands of calcite schist appear to die out and come in again. Thus, no connection appears to exist between the bands of

calcite schist in No. 2 tunnel and those in other workings further south. Each band appears, therefore, to be a separate lens dying out both in strike and dip. I think that the most probable explanation of the facts of the occurrence of these calcite schists is, that they are of concretionary origin, the lime being concentrated along certain planes from the adjoining strata, all of which may have been more or less calcareous. In the vicinity of the ore-bodies the calcite schist is sometimes very nodular, the individual nodules going up to 3 inches in diameter. Very often the calcite is here replaced by rhodochrosite, or, more frequently, by an isomorphous mixture of carbonate of lime and carbonate of manganese.

The period at which the formation of these concretionary bands of calcite schist took place was probably prior to or contemporaneous with the metamorphism of the schists. As direct evidence of this, the distorted crystals of calcite on No. 4 tramway at the Hercules Mine may be referred to. The general ellipsoidal form of the other calcite blebs may also be due to distortion during the process of metamorphism.

Throughout the belt of schist country in which the zinc-lead sulphide ores occur there are numerous bands of keratophyre. At Mt. Read one of these occurs to the east of the ore deposits, and has been penetrated by the No. 2 tunnel of the Hercules Mine for a distance of about 25 feet. The contact between this rock and the schists is very obscure, owing to the fact that the keratophyre is distinctly schistose at this point, while the schists are slightly crystalline. The latter may possibly be due to contact metamorphism. At Rosebery there is a very massive belt of keratophyre, or an allied rock to the east of the mine. The water-race of the Tasmanian Copper Company traverses this rock for about two and a half miles. There are also numerous dykes of keratophyre in the schist to the west of this mass.

At the Hercules and Mt. Reid mines the whole country appears to be cut up by a network of slides and minor faults. A number of these are shown on the plan of the Hercules Mine (Plate II.), but it is unlikely that I have succeeded in noting, in the ground opened up, more than a small proportion of the slides actually in existence. Many of the slides are very flat, and nearly all of them dip towards the east or north-east. In many places there has been considerable movement of the country, as shown by the non-continuance of certain bands of schist on both sides of the slides. The ore-bodies have also been affected by the movements to some extent, as shown by the workings in the

stopes in places. Many of the ore-bodies are very much broken up by joints and slides passing through them. In some places curious open cavities, evidently water channels, have been found running through the solid ore.

The ore-bodies are invariably accompanied by a curious type of mineral vein, which I have also noticed in connection with the North Lyell ore-deposit. The veins are usually quite small, not more than two or three inches wide, but, occasionally, they go up to about 18 inches. They are composed principally of quartz, with rhodocrosite and calcite, or with isomorphous mixtures of these minerals; further, crystalline chlorite, and occasionally a little purple fluorite. Metallic minerals occur sparingly; they are represented by copper pyrites, zinc-blende, and galena. The quartz and rhodocrosite, or calcite, generally occur in interlocking fibres, about an eighth of an inch in thickness, crossing the vein at right-angles to the walls. At the surface, the carbonates of lime and manganese and the metallic minerals have generally been leached away, leaving the quartz fibres alone, as the vein-filling. The veins have then a very characteristic honey-combed appearance. These veins will, I think, prove of geological importance in connecting the sulphide deposits of Mt. Read and Rosebery with the Mt. Lyell deposits.

In mineralogical composition the ore-bodies consist of a mixture of iron pyrites, zinc-blende, galena, and a little copper pyrites. In the richer ore fahlore is present in small quantities, and occasionally traces of bismuth have been found. The several minerals forming the bulk of the ore-bodies often form an intimate mixture, in which the naked eye fails to recognise the separate minerals. In other parts the component minerals are less finely divided, and sometimes they are quite separate. With the exception of the very dense ore, the ore-bodies exhibit a finely laminated structure parallel to the strike and dip of the surrounding schists. They often contain a considerable proportion of argillaceous material. I believe that every gradation may be found between the practically barren schist slightly impregnated with mineral matter and the dense pyrites or the zinc-lead sulphides.

The ore differs very greatly in the proportion of the metals present. Sometimes it consists of practically barren iron pyrites; this again often contains bands of ore composed of an intimate mixture of iron pyrites and zinc-blende. These bands are generally parallel to the laminæ of the ore, but if the pyrites is quite dense, the blende-pyrite mixture forms irregular veins or bunches in the pyrites. Sometimes

the whole mass of the ore is composed of this blende-pyrite mixture. By addition of galena and diminishing amounts of pyrite this passes over into the normal zinc-lead sulphide. With the galena and blende comes usually, also, the silver and gold values, which only exist in traces in the dense pyrite. The gold appears to be present in the zinc-lead sulphide in the metallic state. Mr. S. Thow, Manager of the Hercules Mine, tells me that his sale samples contain on an average 0·03 to 0·04 oz. per ton of metallics on a screen of 80 holes to the running inch, and some parcels have gone as high as 0·145 oz. per ton. Occasionally a little silver is found as metallics, but this is not usually the case. The silver appears to be present in the fahlore. Mr. Luke Williams, the late Mine Manager of the Mt. Reid Mine, tells me that in selecting the richer ore to send to the Tasmanian Smelting Company, he always followed the ore in which this mineral was showing. This theory has been verified by special assays of fahlore at the Mt. Reid, the Hercules, and the Tasmanian Copper Company's mines, selected samples having gone as high as 2000 ounces to the ton; whereas, selected samples of the other metallic minerals generally go very low in the precious metals. Very rich assays for gold have also been obtained from the fahlore. Non-metallic minerals are nowhere abundant in the ore-deposits. Occasionally a little baryta is present in the ore, and sometimes this occurs in fair-sized masses. Flourite is occasionally found in very small quantities. The presence of calcite and rhodocrosite has already been referred to; these do not, however, usually occur in the solid ore.

As regards the relative abundance of the metals at varying distances from the surface, very little can as yet be said. At the Tasmanian Copper Company's mine the ore-body strikes approximately at right-angles to the slope of Mt. Black. Backs are gained rapidly by driving north on the ore-body. In the drive north from the lower tunnel the ore appears to be getting poorer in zinc and lead as depth is gained. At the Hercules Mine the evidence is not very decisive, and is somewhat contradictory. In No. 5 tunnel none of the zinc-lead sulphide bodies have been cut, but it is not known whether this is because they do not live to that depth, or whether it is because they have pitched to the north. As regards the precious metals, there is a certain amount of evidence that these decrease in quantity as depth is gained. In No. 1 lode rich sulphide ore was mined several years ago, above No. 1 level. 62 tons of ore, assaying over 2 ozs. of gold and 68 ozs. of silver per ton were won.

Ore is now being stoped between the intermediate level and No. 1 level of an average value of—gold, 0·35 ozs.; silver, 450 ozs.; and lead, 17·6 per cent. A part of this difference is probably due to the fact that in the old days it only paid to mine the richest ore, while now the whole ore-body is being stoped out. However, where this lode is cut in No. 2 level all the ore is very poor in the precious metals. I think it may also be said with regard to the other ore-bodies that, as far as they have been proved, there is a tendency for the gold and silver values to decrease in depth. B lode has been cut across, both in No. 3 level and No. 4 level, and in both places it has been carefully sampled every five feet. Plate IV. gives two diagrams showing the the assay-values of this lode at the two levels. It will be at once seen that it is both larger and richer in No. 4 level than in No. 3, while the relative proportions of the metals are about constant. In the case of the Mt. Reid Mine, I understand, from Mr. Luke Williams, the late Mine Manager, that the assay-value of the ore is about the same in the tunnel level as it is in the open cuts at the surface.

Table No. III., containing analyses of ore from the several mines, gives a good idea of the average composition of the ore.

TABLE III.

	I.	II.	III.	IV.	V.	VI.
Gold, ozs. per ton..	0·13	0·23	0·50	0·10	0·12	0·07
Silver ,, ...	12·77	10·84	33·10	7·70	7·38	9·43
Copper, per cent...	0·15	0·76	0·59	0·48	0·68	0·76
Zinc ,, ...	43·27	24·30	19·80	38·30	16·17	19·57
Lead ,, ...	13·88	10·52	11·50	6·80	3·75	2·50
Iron ,, ...	10·17	8·64	—	13·70	19·70	15·56
Manganese ,, ...	0·42	1·29	4·9	0·4	—	—
Sulphur ,, ...	29·53	33·64	—	32·60	34·06	28·76
Alumina ,, ...	—	—	—	—	2·30	2·34
Silica ,, ...	—	—	21·20	—	16·40	24·46
Insoluble ,, ...	3·06	30·30	25·0	6·5	—	—

I. High-grade zinc ore, Mt. Reid Mine.

II. Average of ore in Mt. Reid Mine. Sample taken by Mr. Luke Williams, mine manager.

III. Ore from south lode workings, Hercules Mine; assay from bulk shipments.

IV. Bulk from 9 samples, B lode, north drive, Hercules Mine.

V. Average of two bulk samples from ore on tip No. 2 level Tasmanian Copper Company.

VI. Average of two bulk samples from ore on tip No. 4 level Tasmanian Copper Company.

In shape, the ore-bodies at Mt. Read appear to be that of irregularly-lenticular masses, cutting out both in strike and dip, and with the two longest axes approximately parallel to the strike and dip of the schists. They vary very greatly in width, going up to 70 or 80 feet. In the majority of cases, the ore-bodies appear to have been found along planes of movement, but the whole country is so full of slides and faults that it is difficult to determine whether these have been formed before or after the deposition of the ore. At Mt. Black, the ore is more in the form of a continuous ore-body, varying considerably in width, but continuous for a long distance, and, I believe, accurately conformable with the surrounding schists. It appears also that at Mt. Black there has been only one horizon along which ore has been deposited. At Mt. Read, on the other hand, there are quite a number. Several of the ore-bodies at the Hercules Mine have been proved to pitch towards the north.

I have already referred to the argillaceous schists which contain small ellipsoidal blebs of calcite. These same argillaceous schists also occur with similar blebs of brown zinc-blende. Also, in the dense ore, the same blebs of blende are very common. In the Mt. Reid Mine I have found dense low-grade pyrites, with blebs of calcite exactly similar in shape. I have no doubt, therefore, that the zinc-blende is pseudomorphous after calcite.

In the upper portions of all the zinc-lead sulphide bodies, there exist considerable masses of gossan. These appear sometimes merely as a capping of the sulphide ore; at other times, as in the Hercules Mine, as irregular masses in the sulphide ore, while sometimes the sulphide ore occurs as irregular masses in the gossan. In nearly all cases, the dividing-line between the gossan and the sulphide ore is sharp and distinct. The gossan consists of a soft porous mass of iron oxide and clayey matter, with, frequently, crystals of carbonate of lead distributed through it. It also contains a percentage of zinc, probably in the form of carbonate.

At the Hercules Mine, there are, in addition to the deposits of zinc-lead sulphide, considerable bodies of copper ores. It is not yet established what connection exists between these bodies and the zinc-lead sulphide. In No. 3 ore-body, the south end of the shoot appears to be composed of copper ore, but it is not certain that this is not a separate mass, divided from the zinc-lead sulphide by a band of

schist. In No. 5 tunnel (see Plates II. and III.), a fine body of copper ore, 40 feet in thickness, has been cut through. It is possible that this may be a continuation of B lode, but it is rather too far east, and I am more inclined to think that it is a separate lenticular mass. It consists of bands of highly-impregnated schists and dense ore, all showing copper pyrites very freely. Bulk samples taken every 5 feet have proved the ore-body to contain up to 7 per cent. of copper. For a distance of over 100 feet to the west of this good copper ore, the country consists of bands of more or less highly-impregnated schist, containing in parts a considerable amount of copper pyrites and a little zinc-blende. To the east of the copper, the schist is also impregnated, but not so highly. There are also a few small seams of zinc-lead sulphide at No. 5 level.

As regards the origin of the zinc-lead sulphide bodies, I think that the finely-laminated character of most of the ore, and the facts connected with the passing over of the impregnated schist into the massive ore-bodies, is indisputable evidence that the ore-bodies have been originally formed by the replacement of the substance of the schists with mineral matter. The formation of these deposits may be the result of still another phase in the process of ore-deposition which we already know to have been active in the district. In other words, the metal-bearing solutions may have emanated from the granite magma. In support of this, the presence of small quantities of fluorspar and bismuth sulphide may be referred to. The chlorite in the quartz veins with which these deposits are associated is also evidence of the plutonic origin of the solutions which deposited the ores. Chlorite is rarely met with in the ordinary types of silver-lead veins, but is a common constituent of cassiterite veins. On the other hand, it is quite possible that metalliferous emanations may have taken place from other eruptive rocks in the district, such, for example, as the keratophyre with which the deposits are associated. It is, however, possible that this rock is merely a differentiation product from the granite magma, and, in that case, we would still be right in saying that these deposits belong to the same general process of ore-deposition to which we have attributed other large bodies of sulphide ores in the district. It is to be hoped that these points will become clearer as our knowledge of the West Coast is extended.

But, although I regard it as certain that the original deposition of the ores took place by ascending solutions, I think

that there is very distinct evidence that a concentration of the valuable metals has taken place within the ore-bodies, comparatively recently, by descending solutions. This subject is one which has received much attention during the last few years at the hands of American geologists, and several important articles on the subject have recently appeared among the transactions of the American Institute of Mining Engineers.* As evidence of this, I may mention the presence of bands and patches of the blende-pyrite mixture in pyrite, and the gradual passing over of this, by addition of galena, into the zinc-lead sulphide ore. The presence of pseudomorphs of zinc-blende after calcite, both in the schists and in the dense ore, is also strong evidence of the secondary deposition of this mineral. It is, of course, an open question as to the amount by which the deposits have been enriched in this way, and this point can only be finally settled when the unaltered deposits are opened up.

The conditions for the existence of descending solutions appear to be most favourable, especially in the case of the Mt. Read deposits. Take the Hercules Mine as an example. The mine is situated on the steep western slope of Mt. Hamilton. Below the outcrops of the ore-bodies, the angle of slope of the surface of the ground is about 60° from the horizontal for several hundreds of feet; below this, for nearly a thousand feet, the angle of slope is between 30° and 50°. The strike of the schists and of the ore-bodies make an angle of about 30° with the average direction of the contour lines of the hill at this point. The dip of the schists is to the east, while the hill slopes to the west. The country is intersected by very numerous faults and slides, almost all of which dip to the east or north-east. It is, therefore, evident that much of the water which enters the rocks near the top of the hill must travel downwards through the openings in the rocks for long distances before again emerging at the surface. At the Mt. Reid Mine, the conditions are probably quite as favourable, although the deposit is situated a little further from the steep slope of the mountain. The ore-body at the Tasmanian Copper Company's Mine is probably not so favourably situated as those of Mt. Read, because the strike of the schists and of the ore-body itself is approximately parallel to the slope of the mountain. There would, therefore, be a tendency for the water to flow

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* See the papers of Van Hise, S. F. Emons, and W. H. Weed. Transactions Am. Inst. Mining Engineers, Vol. XXX.

downwards along the ore-body, or along the planes of stratification of the schists, without descending to any great depth.

The first work of the descending surface-waters when they come in contact with the ore-bodies, or with the smaller particles of ore distributed through the schist, is that of decomposition. The chemistry of the process is very complex, and need not be discussed here; suffice it to say that the sulphides of most of the metals are altered to sulphates or carbonates, and in that form are taken off in solution. Sulphuric acid, and, under certain conditions, hydrogen sulphide, are among the decomposition products of iron pyrites. The former is, no doubt, always present at first, but may become neutralised by contact with carbonate of lime. Hydrogen sulphide can only exist when lead, copper, and silver are absent from the solutions, because it would immediately combine with them to form sulphides. Whenever the conditions are such, therefore, that hydrogen sulphide is formed, it is only possible for zinc and iron to go into solution, since these are the only metals present which are not precipitated by hydrogen sulphide in an acid solution. I think the pseudomorphs of zinc-blende after calcite may be satisfactorily explained by the action of such solutions. The calcite would neutralise the sulphuric acid, enabling the sulphide of zinc to be precipitated, and the sulphate of lime would be carried off in solution. Iron sulphide might, of course, also be precipitated in the same way, but not till all the zinc had been precipitated, since zinc has a greater affinity for sulphur than has iron. It is probable that the amount of hydrogen sulphide present would seldom be sufficient to precipitate all the zinc from solution, so that the precipitation of iron sulphide would be rare. In one specimen, taken by me from No. 5 tunnel at the Hercules Mine, I found small blebs of calcite containing crystals of iron pyrites. It is possible that these may have been deposited in this way.

The bulk of the zinc-lead sulphide deposits have, however, been formed by the replacement of iron pyrites, and in this process carbonate of lime probably played an important part, since the deposits are only found in the immediate vicinity of rocks containing this mineral. On theoretical grounds also the presence of carbonate of lime appears to be necessary for the concentration, both of the zinc and lead. Zinc sulphide cannot be precipitated from an acid solution, but the presence of carbonate of lime would ensure the solutions remaining neutral. The originally acid solutions

coming in contact with the carbonate of lime would become neutralised, forming sulphate of lime and carbonic acid. The presence of the latter would then enable a considerable quantity of carbonate of lime to go into solution, and this would ensure the neutralisation of any other acid which would be subsequently formed. The presence of carbonates is also probably necessary to enable the lead to go into solution. Lead sulphate is very insoluble in water, while lead carbonate, which would be formed if carbonate of lime were present, is appreciably soluble in water containing carbonic acid.

The several reactions for the precipitation of the sulphides of the metals by iron pyrites are as follow:—

$$Ag_2SO_4 + FeS_2 + 3O = Ag_2S + FeSO_4 + SO_3$$
$$Ag_2CO_3 + FeS_2 + 3O = Ag_2S + FeCO_3 + SO_3$$

$$PbSO_4 + FeS_2 + 3O = PbS + FeSO_4 + SO_3$$
$$PbCO_3 + FeS_2 + 3O = PbS + FeCO_3 + SO_3$$

$$ZnSO_4 + FeS_2 + 3O = ZnS + FeSO_4 + SO_3$$
$$ZnCO_3 + FeS_2 + 3O = ZnS + FeCO_3 + SO_3$$

As regards the order of precipitation, this depends upon the relative affinities of the several metals for sulphur, and also on several other factors. As between the above three metals, the order of precipitation is as follows:—1 silver, 2 lead, 3 zinc. This order will probably be found to be repeated in the metallic contents of the ore-bodies as depth is gained. Silver sulphate is very readily decomposed, and will, therefore, be quickly re-deposited as sulphide, or in combination with sulphur, antimony, and copper, as fahl ore, &c. Lead and zinc salts are more stable, but lead has a strong affinity for sulphur, and will, therefore, be soon precipitated. Zinc has rather a weak attraction for sulphur, and will therefore be precipitated more slowly.

It is of course not to be supposed that the metallic contents of the ore-bodies have been wholly derived from the portions of the deposits which we now see oxidised at the surface. The process is a continuous one, and keeps pace with denudation, so that the metals which are now found in the sulphide bodies may have been derived from hundreds, or even thousands, of feet of low-grade material which has been removed by denudation. Rapid denudation, such as must have taken place both at Mt. Read and Mt. Black, is favourable to enrichment, because it quickly removes the upper, already leached, portion of the deposits, and enables a larger amount of lode-matter to be lixiviated

in a given time than would result were denudation less active.

Although these theoretical considerations go to show that the zinc-lead sulphides must gradually become poorer as depth is gained, the amount of ore actually in sight is so large that this fact need cause no uneasiness. If only the zinc problem can be solved, there is sufficient ore available to keep a very large works employed for many years.

The deposits of copper ores at the Hercules Mine present, I believe, a separate problem. It is perhaps too early to speak definitely yet, but I am at present inclined to the belief that these deposits are in their original state, and have not been enriched by descending waters. Certainly, at present there is no evidence of enrichment. The ore consists of copper and iron pyrites, disseminated through schist, with large bands of practically solid ore. There are none of the rich copper minerals, such as bornite and chalcocite, which are commonly recognised as of secondary origin. Unlike the zinc-lead sulphide bodies, the copper appears to be independent of the presence of lime in the adjoining rock.

The difference in the metallic contents of the two classes of deposits may be due to two causes. It may be due to differences in the levels (or, what is the same thing, differences in the distances from the cooling granite magma), at which the original deposits were formed. It may also be due to differences in the composition of the rocks, some being more favourable for the precipitation of copper, others being more favourable to the precipitation of zinc and lead. Of these two theories, I think the former is more probable. Such changes in the composition of ore-deposits as depth is gained are not uncommon. At the Hercules Mine, copper is very much more abundant in No. 5 level than in any of the others. Further, at Mt. Read all the zinc-lead sulphide bodies are at a great elevation. Lower down, on the western slope of Mt. Read, two ore deposits are known, namely, the Ring P.A. and the Jupiter, in both of which the ore is composed of cupriferous pyrite, with very little zinc, and only traces of lead. The respective heights above sea-level of the outcrops of the several deposits are, approximately, as follows:—Ring P.A., 1540 feet; Jupiter, 1800 feet; Hercules and Mt. Reid Mine, 2900 feet. There is, therefore, much reason to believe that a zone of copper ore may be found below the zinc-lead sulphide zone; and, if this proves to be the case, it will make a very great difference to the future of the district. The presence of payable copper ores would render the mines independent of the solution

of the zinc problem, and enable them to carry on operations pending the discovery of a suitable process for the treatment of their large reserves of zinc-lead sulphide.

The Hercules Gold and Silver Mining Company, No Liability.

This company holds the following sections:—Nos. 89-95, 49-95, 103-94, 100-94, 88-95, 50-95, 101-94, 102-94, held under gold lease, with a total area of 71 acres; also section 1918-91M, 31 acres, held under mineral lease.

The mine is situated on the western slope of Mt. Hamilton, a spur on the west side of Mt. Read. It is connected by a self-acting endless wire-rope tramway with the terminus of the North-East Dundas tramway at Williamsford.

Plate II. gives a sketch plan of the mine workings, together with the positions of the several ore-bodies. Most of this is taken from the excellent plan recently published with the company's half-yearly report. The contour lines have been sketched in partly from data supplied to me by Mr. S. Thow, the mining manager, and partly from barometric readings taken by myself. There are five principal zinc-lead sulphide ore-bodies known on the mine, but some of these may eventually prove to be connected. Further, there are a great many more "makes" of ore in the vicinity of what are now regarded as the main ore-bodies, some of which may, when driven on, develop into large bodies of ore. At present the principal ore-bodies are known as follows:—No. 1 lode, A lode, the south lode, No. 3 lode, or the main lode, and B lode. Besides these there is the surface outcrop of a sulphide lode on No. 4 tramway behind the blacksmith's shop. There are several makes of ore between No. 1 and No. 3 lodes, and between No. 3 and B lodes. There is, further, the copper formation connected with No. 3 lode, and the large copper formation cut in No. 5 tunnel.

The mine workings will, I think, be intelligible from the plan, and need not be further described.

No. 1 Lode.—The rich sulphide ore mined several years ago, and packed in to Dundas, came principally from this lode above No. 1 level. According to the late Mr. J. Harcourt Smith's report, 9 tons 13 cwts. of gossan, averaging over 10½ ozs. of gold and 212 ozs. of silver, per ton, and 62 tons of sulphide ore, assaying over 2 ozs. gold and 68 ozs. of silver per ton, were won. At present stoping is being

carried on between the intermediate and No. 1 level, the ore consisting of both gossan and sulphide, but principally the latter. The average assay value, as published in the last half-yearly report, is as follows:—Sulphide ore—gold 0·35 ozs., silver 45·0 ozs., lead 17·6 per cent.; gossan—gold 1·50 ozs., silver 60·0 ozs., lead 2·4 per cent. The lode is about 10 feet in thickness in the present stopes. At No. 2 tunnel level the lode appears to have split up. The drive north from No. 2 tunnel follows a small make of ore for 100 feet. A crosscut was then driven west, and a much larger body of zinc-lead sulphide was cut through, about 35 feet in thickness. This body has not been systematically sampled, but it is known to be low-grade, and unworkable under present conditions. A rise has been put up in the ore-body between this level and the intermediate, so that there is no doubt that it is a continuation of the ore-body which is now being stoped in the upper levels. In a southerly direction the ore-body appears to lose most of its zinc and lead contents, for in No. 2 tunnel only pyrites and highly-impregnated country was cut.

A Lode.—This is a promising-looking lode in the upper levels, consisting of 10 or 12 feet of gossan, with sulphide ore underfoot. Unfortunately, the latter does not appear to live down, as in No. 2 tunnel only highly-mineralised country is met with. However, the occurrence of the shoots of sulphide ore is so erratic that it is impossible to say definitely whether the ore has given out or whether the tunnel has happened to strike the formation in a poor place. From the surface it has been driven along for a distance of 170 feet, of which 120 feet was in good gossan ore. Stoping operations are now in progress above this drive, the average assay value of the ore won being as follows:—Gold 0·80 ozs., silver 16·0 ozs., lead 2·5 per cent.

The South Lode.—This body of ore has been proved down to No. 4 level. The length of the shoot is about 75 feet. In No. 3 level the average width of the ore is about 5 feet, going up in places to 10 or 11 feet. In No. 4 level the maximum width is 15 feet, but the shoot is somewhat shorter. The ore consists of saleable zinc-lead sulphide, which is now being stoped out and sent to the Tasmanian Smelting Company. The following assay gives the average value of a number of bulk shipments of sulphide ore from the south lode:—Gold 0·5 ozs., silver 33·1 ozs., zinc 19·8 per cent., copper 0·59 per cent. Quite lately an important

make of gossan has been discovered at the surface to the south of the present underground workings on this lode.

Between the south and No. 3 lodes several bands of ore have been cut, both in the south lode crosscut, and in the crosscut connecting the south drive on No. 3 lode from No. 3 tunnel, with the intermediate drive on the south lode. One of these, consisting of 18 inches of sulphide ore, assays—gold 0·2 ozs., silver 12·2 ozs., and lead 16·8 per cent. Another body of pyritic ore met with in the lower crosscut is 5 feet in width, and assays—gold 0·2 ozs., silver 7·0 ozs., lead 17·3 per cent., copper 1·4 per cent.

No. 3 Lode.—This is a curiously complex system of irregular lenticular masses of gossan and sulphide ore. It has been driven on for about 300 feet in No. 3 level and 400 feet in No. 4 level. Above No. 3 level it is largely oxidised, and the greater part of the output of gossan ore during the last twelve months has come from this portion of the mine. The sulphide ore is not high-grade, and most of it is just too low to pay under present conditions, but the gossan leaves a fair margin of profit after all expenses are paid. While stoping is proceeding, it is the practice to drive into the hanging-wall of the lode, with the combined object of obtaining filling for the stopes and of prospecting for other bodies of ore. These crosscuts have in places proved payable gossan to exist for a width of 50 feet, though this is exceptional; nearly all of them have been the means of discovering bodies of gossan or sulphide ore more or less extensive. At the end of the north drive, at No. 3 level, the ore-body which had been driven on appears to pinch out, but a crosscut from the north drive on B lode has quite lately proved that there is a large body of gossan and sulphide ore 25 feet north of this. This is now called C lode, but it will probably be found to have some connection with No. 3 lode. This ore-body was first cut 50 feet to the east of the drive on No. 3 lode, and was followed in a north-westerly direction for 80 feet. This crosscut has opened up a large amount of both gossan and sulphide ore, the existence of which was not known, and promises to add very considerably to the amount of ore in sight. There is a curious make of copper ore in No. 3 lode. It appears to be separated from the zinc-lead sulphide by a band of schist. In No. 3 level it appears on the western wall of the drive for a distance of about 50 feet, and a cuddy has been put into it for about 10 feet without reaching the foot-wall. In No. 4 level the drive follows the western wall of

the body for a distance of 60 or 70 feet, and an easterly crosscut proves the width to be about 35 feet.

B. Lode.—This is a large zinc-lead sulphide body which must await the solution of the zinc problem before the whole of it can be profitably worked, but probably richer portions will be discovered in the upper-levels, which will pay to mine under the present tariff conditions. The ore-body has been intersected by No. 3 tunnel, and by the east winze crosscut at No. 4 level. Between these two levels the width of the ore-body has increased from 25 feet to 54 feet in horizontal measurement. At No. 3 level the ore-body was driven on south for a distance of 25 feet, and north for a distance of 45 feet; beyond this the north drive passes out of the ore, and it is not known whether the ore-body continues to the west of the drive or whether it has pinched out. In No. 4 level no driving has been done along the course of the lode. In No. 5 level, B. lode has not been cut, or, at least, has not been identified. As the shoots of ore in the other lodes have a northerly pitch, it is quite possible that this shoot has pitched north of No. 5 level, and may yet be found by driving in that direction. I think, however, that it is quite possible that the shoot of zinc-lead sulphide does not live to this depth. This will most readily be proved by the contemplated crosscuts from the winze, between No. 4 and No. 5 levels. Plate IV. gives two diagrams, taken from the last half-yearly report of the company, giving the assay values of the ore-body at the two levels.

The Copper Formation, No. 5 Tunnel.—No. 5 tunnel has been driven 250 feet below No. 4 level. For the first 550 feet little else but country impregnated with mineral matter was met with, the zinc-lead sulphide bodies having, apparently, either cut out or pitched north. At about this point the country became decidedly more highly mineralised, with bands of nearly solid pyrites carrying copper pyrites. Some of these bands carry up to 3 per cent. of copper, and, with copper at a good price, should pay for mining. At about 660 feet from the entrance of the tunnel a belt of good copper ore, about 40 feet in thickness, was entered. This deposit consists of bands of highly impregnated schist and dense pyrites, all carrying copper freely. The ore-body has been systematically sampled every five feet, and a diagram showing the resulting assay values is given in the report of the company for the half-year ending 31st July. From this it appears that there is nearly 40

feet of ore, which will average 4·4 per cent. of copper, or, omitting one poor band of 20 feet, which probably would not be taken out when mining operations were being carried on, the remaining 30 feet should bulk 5·3 per cent. To this is to be added the contents in gold and silver to the value of about 5*s.* per ton at present prices. Little has been done so far with regard to proving the extent of the formation, as, since it has been cut, expenditure in connection with getting the mine into an ore-producing condition has been very heavy; but a start is now being made by sinking a winze on the formation. This has reached a depth of 20 feet with, so far, quite satisfactory results, and I am informed by the mine manager that it is the intention of the company to vigorously prospect the formation. This is certainly the right policy to adopt, as the formation is a very promising one. The existence of a large body of payable copper ore, even if the gross metallic contents are much below that of the zinc-lead sulphide bodies, will add very greatly to the value of the mine, for this ore involves no difficulties in metallurgical treatment, and is not dependent on the solution of the zinc problem.

The East Hercules Sections.—These sections have been lately acquired by the Hercules Company, and it is proposed at some future date to extend the Hercules No. 2 tunnel, with the object of cutting the East Hercules lode. This formation is situated on the east side of Mt. Hamilton, and between it and the Hercules workings is the band of keratophyre already alluded to, which forms the ridge of Mt. Hamilton. The workings were full of water, so that I was not able to examine the formation. The country rock is rather obscure chloritic schist, which will require careful microscopic examination before it can be determined. From an extract from Mr. F. T. Sullivan's report on the prospects of the old company, which is published in the last half-yearly report of the Hercules Company, I note that the mine workings "comprise a shaft 47 feet deep, and a drive from this shaft driven in a westerly direction a distance of 95 feet. At about 70 feet from the shaft the first bands of ore were cut, and from this point to face of drive, a distance of 25 feet, in pyritic schist showing bands and pockets of copper sulphides. These bands are from 3 to 6 inches wide in crown of drive, and from 8 to 15 inches wide on floor." With the object of cutting the formation in depth, an adit was laid out, and has been driven a distance of 202 feet, leaving 203 feet of driving before the shaft is reached.

This will give 116 feet of backs from the brace of the shaft. Assays from the bands of copper ore cut in the drive from the shaft have yielded from 6 to 30 per cent. of copper. The No. 2 tunnel of the Hercules Mine will come under the East Hercules shaft with 530 feet of driving, and thereby will gain 312 feet of backs.

It is, of course, impossible to form a definite opinion without being able to examine the formation *in situ*. Chloritic schists are very commonly associated with copper on the West Coast, and I am strongly inclined to think that the processes of chloritisation and of ore-deposition are very closely connected. At the same time I believe it is a fact that although many promising shows on the West Coast are associated with chloritic schists, none of these have actually proved payable. I think, therefore, that the proposal should be left in abeyance for the present. It is probable that, as our knowledge of the geology of the West Coast ore-deposits extends, we shall be able to come to some more definite conclusion as to the behaviour of copper ores in depth than is possible at present.

The Hercules Company has entered into contracts with the Smelting Company of Australia, Limited, and the Tasmanian Smelting Company, Limited, for the supply of large quantities of both gossan and sulphide ore. Shipments were commenced on the 6th April, 1901, and since that date 7020 tons of gossan ore and 2612 tons of sulphide ore have been delivered. The fulfilment of these contracts will keep the mine employed for between one and two years at the present output, and, as stoping operations have led to the discovery of quite a number of large "makes" of ore, the presence of which were previously unsuspected, it is reasonable to hope that the company can carry on for several years before it comes to an end of its saleable ore. In the meantime it will have proved the extent and value of its copper formation, and, it is to be hoped, will be in a position to work this on a payable basis. The solution of the zinc problem would, of course, add enormously to the value of the mine, as it would enable large quantities of ore, which are now just below the payable limit, to be worked.

The company has selected a site for a smelting works on the banks of the Pieman River, near Rosebery, and propose, eventually, to connect this with its mine by means of a railway and self-acting tram.

The Mt. Reid Mining Company, Limited.

This company holds sections 3302-87M, 80 acres; 4894-93M, 23 acres; 266-93M, 80 acres; and 267-93M, 41 acres. The mine is situated on section 3302, which is directly south of the Hercules Mine, two sections belonging to the South Hercules Company intervening. The other three sections are held for the purpose of securing a site for metallurgical works.

There are two bodies of sulphide ore on the property, which may be described as the eastern and western ore-bodies respectively. The principal workings are confined to the eastern ore-body, which is certainly the largest yet known at Mt. Read. It is a large lenticular mass between 800 and 900 feet in length, with a maximum width of about 80 feet. This ore-body has been exposed on the surface for a distance of nearly 500 feet by means of a series of large open cuts, and a tunnel has been driven from the north end along the formation. Where first cut the ore-body was quite small, but 150 feet further south crosscuts east and west from the tunnel proved the width to be 74 feet. The ore-body was driven on for 770 feet altogether, and the end of the shoot has not yet been reached. On the surface, however, about 145 feet above the level of the tunnel, and 70 feet further south, the ore-body appears to pinch out.

Analyses Nos. 1 and 2, Table III., were furnished to me by the late mining manager as fairly representing the grade of ore that can be won in bulk. These do not include patches of very low-grade material, which would naturally be discarded when mining operations were being carried on.

The eastern lode has not received much attention up to the present. To the west of the eastern ore-body there is a long ridge, which is believed to form the capping of the ore-body. This consists of partly-decomposed schist, much pitted, as though mineral matter had been leached out. I believe it is the continuation of the belt of country passed through at the entrance of No. 5 tunnel on the Hercules Mine, which at that point was fairly highly charged with mineral matter. The eastern tunnel of the South Hercules is driven in the same belt, and here it is even more highly mineralised, and with a larger proportion of galena than on the Hercules ground. I doubt if this band, which actually forms the ridge, will ever prove to be much more than impregnated schist, but to the west of it there are some calcite schists, in which zinc sulphide ores occur, and which I think are of a much more favourable nature.

The formation has been tested by two prospect shafts, known respectively as Williams' shaft and the west shaft. Williams' shaft, which is situated about 450 feet south and 150 feet west of the open cut workings on the eastern lode, was sunk 50 feet on what was at the surface a narrow band of sulphide ore. The shaft continued in the ore to 50 feet, where it had widened out to 5 feet. On the surface some 30 feet north of the shaft the deposit shows 10 feet in width. A bulk sample of the better class of ore from this shaft assayed—gold 1 dwt. 23 grs., silver 15 ozs. 16 dwts. 4 grs., lead 16½ per cent.; while the bulk of the whole ore taken out, namely, 109 tons, gave the following result:—Gold 1 dwt. 7 grs., silver 6 ozs. 4 dwts. 3 grs., zinc 26·8 per cent., lead 8·5 per cent., and copper 2·0 per cent.

The west shaft was sunk on the same line of country, about 14 chains further north. Quartzite and schist, with bunches of sulphide ore, were struck, from which the following assay was obtained:—Gold 2 dwts. 14 grs., silver 12 ozs. 16 dwts. 2 grs., zinc 14·6 per cent., lead 36·5 per cent., copper 0·6 per cent.

The western formation could be most readily tested by cross-cutting from the tunnel in the eastern ore-body. For testing the ore-bodies in depth there are splendid facilities. From the south-eastern portion of section 266-93M a tunnel could be driven, gaining 1500 feet of backs below the present tunnel-level, with 3300 feet of driving, while from Conliffe's Creek over 2000 feet of backs are obtainable with 1 mile of tunnelling. For reasons which I have given elsewhere, I do not think that the zinc-lead sulphides will be met with at these great depths. On the other hand, I think that the possibilities of finding payable copper ores are sufficient to warrant the ground being tested in depth.

Mr. Luke Williams, the late mining manager, has laid before the directors of the company a scheme for treating the zinc-lead sulphide ore of the Mt. Reid Mine. He proposes to mine the ore in bulk, and divide this into three classes by hand-sorting—

1st. Smelting ore containing sufficient values in gold, silver, and lead, to render it saleable under present conditions.

2nd. Ore containing over 38 per cent. of zinc to be exported as zinc ore.

3rd. Concentrating ore, to be treated by mechanical concentration, winning as final products (*a*) silver-lead ore, (*b*) zinc ore.

PLATE II

SKETCH PLAN OF THE HERCULES MINE

Scale of Feet

5 cm

REFERENCE

- Zinc-Lead Sulphide
- Cupriferous pyrites
- Gossan
- Impregnated country
- No 1 Level
- No 2 Level
- No 3 Level
- No 4 Level
- No 5 Level

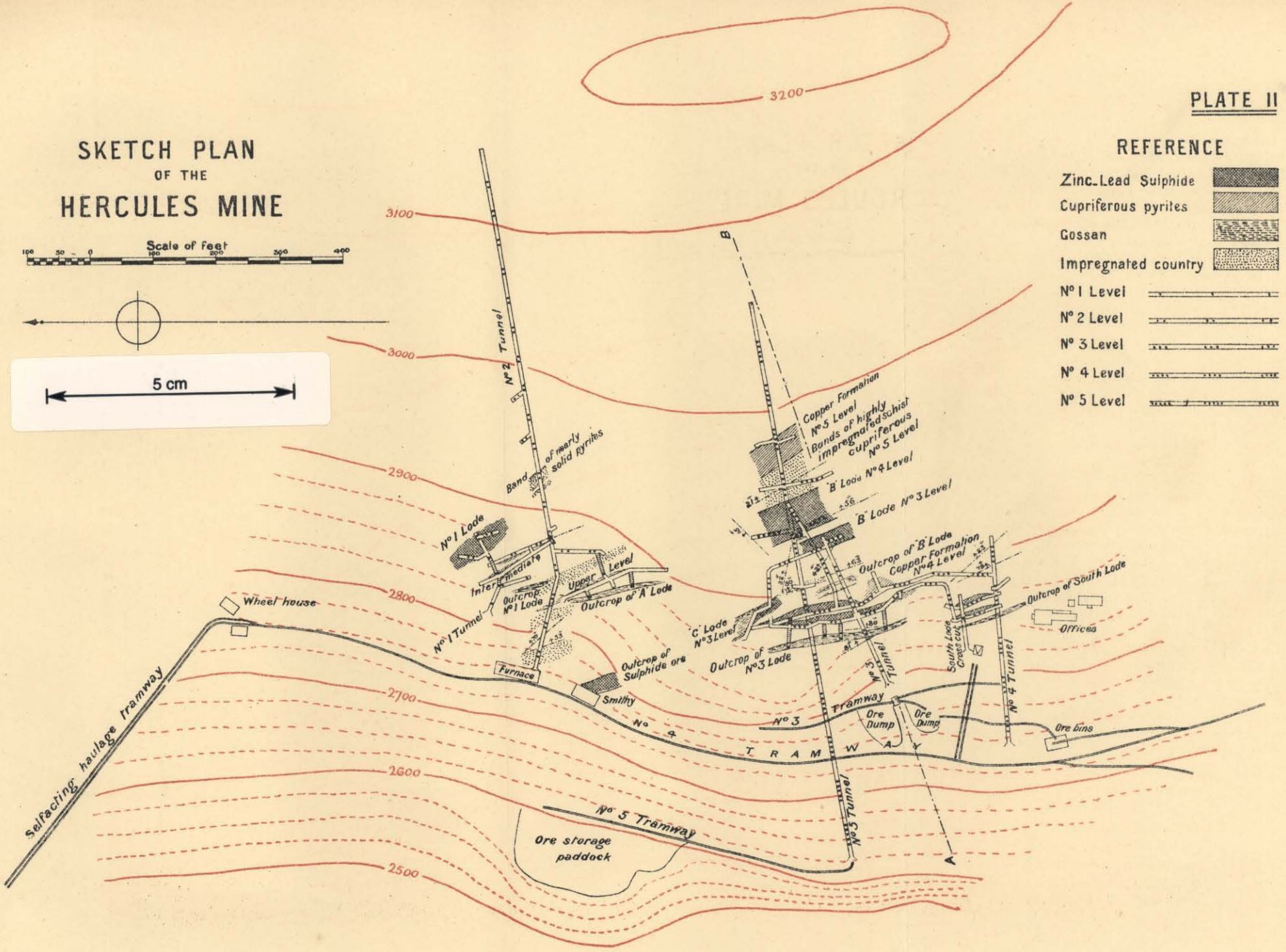
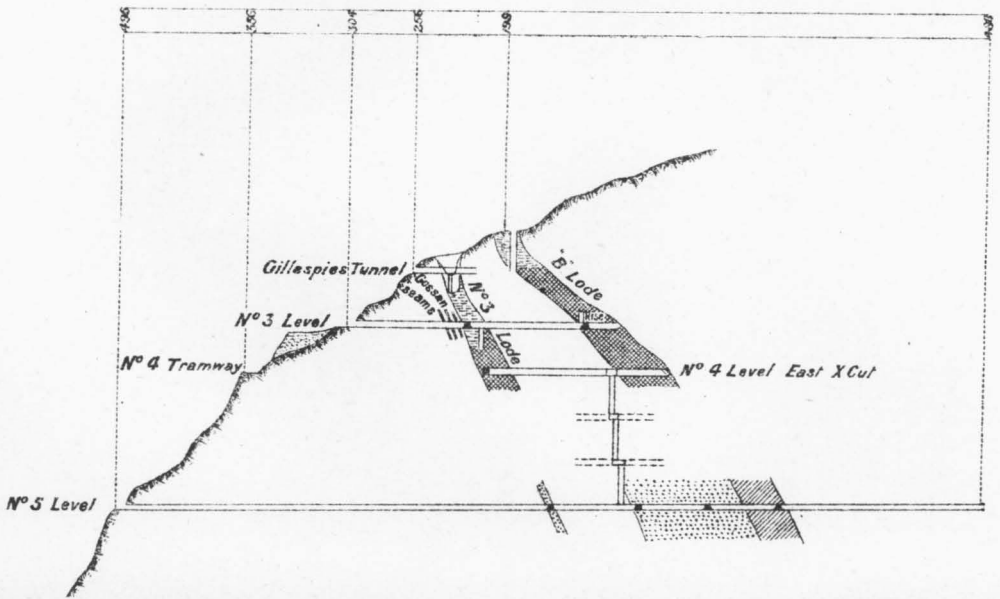


PLATE III

HERCULES MINE

5 cm

Cross Section A_B



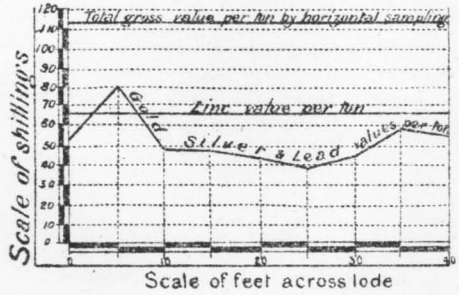
5 cm

PLATE IV

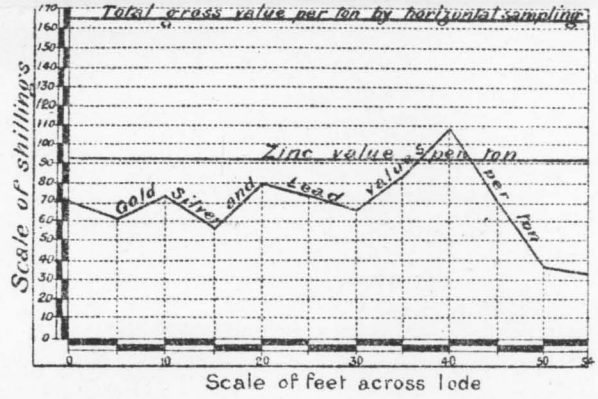
HERCULES MINE

Diagram showing assay values of 'B' Lode in Nos 3 & 4 Levels

Cross_cut N° 3 Level



Cross cut N° 4 Level



Basis of calculation

Gold 4/ Per dwt:	Lead 2/6 Per unit
Silver 2/6 . oz:	Zinc 3/6 . unit

In order to get some idea as to the possibility of concentrating the ore mechanically, small parcels of ore were tested in the concentrating mills of the Silver Queen and Oonah mines in Zeehan. The mills are, of course, not suitable for the treatment of such ore, and nothing approaching clean products were obtained; but Mr. Williams tells me that the tests proved that there was a decided tendency for the precious metals to be concentrated with the lead, and he regards the results as, on the whole, satisfactory. The ore would have to be crushed very fine, and this would make the loss, not only in the precious metals, but also in lead and zinc, very heavy. At the same time, if the ore could be treated at even a small profit it would be much more preferable than leaving the ore standing. Mr. Williams deserves every credit for bringing forward the proposal, and I think it is decidedly worth giving a trial. A small experimental plant should be erected first, and from the results obtained from this it should be possible to judge of the practicability of the scheme. Much of the ore at the Mt. Reid Mine is not such an intimate mixture that the particles could not be separated by moderately-fine crushing. This does not apply to all the ore, and I do not think it applies to the Hercules ore to as great an extent as to the Mt. Reid ore. There is a large amount of ore in both mines which is so intimately mixed that it appears impracticable to obtain any mechanical separation at all. This class of ore, if it is not rich enough in gold, silver, and lead, to be sold as smelting ore, or in zinc to be exported as zinc-ore, will have to await the solution of the zinc problem before it can be treated. But I think that—at the Mt. Reid Mine, at least, and probably also, to some extent, at the Hercules Mine—there is a proportion of the ore in which the particles of galena, pyrites, and blende are sufficiently coarse-grained to enable a separation to be effected by moderately-fine crushing. The practicability of applying mechanical concentration will depend upon three things:—1. Cost of treatment. 2. The degree of efficiency which is obtainable in the separation of the several minerals. 3. The distribution of the precious metals among the several products. These three points can only be determined by experiments carried out on a working scale on the ore itself.

A machinery-site has already been selected on section 266-93M, and a tramway route connecting this site with the mine has been surveyed and cleared. This will be a self-acting tram, with a fall of 1500 feet in a distance of three-quarters of a mile. There is then 200 feet of fall for the

concentrators between the terminus of the self-acting tramway and that of the branch 2-feet gauge tramway connecting the machinery-site with the North-east Dundas Tramway. This connecting tramway has already been constructed. An ample water supply, both for dressing purposes and for power, has been secured by the company.

The South Hercules Mining Company, No Liability.

Sections 19-95G.L., 9 acres; 23-95G.L., 10 acres; and 5347-93M, 64 acres.

These sections are immediately south and adjoining the Hercules Mine, and north and adjoining the Mt. Reid Mine. Almost at the south-east corner of section 19 a shaft has been sunk on what I presume to be the continuation of the Mt. Reid Company's ore-body. This shaft was under water, and could not be examined. At the surface there is a large heap of sulphide ore, which has come out of this shaft. I am not aware of the assay value, but I fear it is poor, as it is principally composed of zinc-blende and pyrites, with only a small proportion of galena.

At about the centre of this section a tunnel has been driven into the spur, which, further south, separates the eastern from the western formations on the Mt. Reid Company's ground. The tunnel passes through hard silicious schist heavily impregnated with galena, blende, and pyrite, for a distance of 200 feet. This is probably the same belt of country which occurs on No. 5 tramway at the Hercules Mine, but here it carries considerably more galena than it does further north. I think it would be worth while extending this tunnel, because, further south, we know that calcite schists occur to the west of this belt of country, and where this is the case the zinc-lead sulphide bodies are to be looked for. The highly-metalliferous character of the country already passed through may be regarded as a very favourable sign. Near the entrance of this tunnel a seam of sulphide ore was struck, which was followed south for about 80 feet. The maximum width of the sulphide ore in this formation appears to have been about 12 inches. The ore is of good grade, and carries a fair proportion of galena Near the northern boundary of the section a long tunnel has been put in, with the object of picking up the continuation of any of the Hercules ore-bodies. This tunnel was locked up, and therefore could not be examined. I understand that some sulphide ore was cut near the end of the tunnel, but apparently the formation was not extensive.

The Barlen Hercules Gold, Silver, and Copper Mining Company, No Liability.

Section 30-92G.L., 10 acres. This section is north, and adjoining the Hercules Mine. A good deal of underground work has been done on this section, with, unfortunately, disappointing results. Several small bodies of sulphide ore were cut by two tunnels, which were driven in an easterly direction into the hill, but they all proved to be short lenticular bodies, cutting out when driven on in both directions. A description of the workings will be found in the late Mr. J. Harcourt Smith's report of 10th June, 1898, on the district.

Dunne's Mt. Read Mining Company, No Liability.

This company holds sections 218-93M, 44 acres, and 164-93M, 19 acres—both of them south, and adjoining the Mt. Reid Mine. The spur which runs through the Mt. Reid Mine between the two lode formations continues as a low ridge into these sections, and just to the west of it a shaft has been sunk upon what is almost certainly the continuation of the western formation of the Mt. Reid Company. This shaft was full of water, and therefore the ore-body could not be examined *in sitû*, but, from an examination of the tip, it appears that the calcite schists observed on the Mt. Reid Mine continue in this direction. These have been attacked by the ore-bearing solutions, for they have been to a great extent converted into carbonate of manganese, and at the surface weather black, owing to the formation of manganese dioxide. Some sulphide ore has been struck, but so far, apparently, not in large quantities. Such as there is, however, is very nice-looking ore, carrying a good percentage of galena. From this shaft the outcrop of the schist has been exposed by a trench in a westerly direction from the shaft, for a distance of 970 feet. Two formations were cut, the first of which consists of a band of mineralised country three or four feet in thickness, carrying zinc-blende, galena, and pyrites. Further west a small shaft has been sunk, from which a little sulphide ore is said to have been obtained. From the end of the trench a long tunnel is being put in to cut the formation which was exposed in the main shaft. This is a big piece of work, and when completed should test the ground effectually. The tunnel is now driven 254 feet, and will require to be driven 715 feet more before it comes below the main shaft. As the formation is dipping to the east, it will then have to go

some distance more before cutting the lode. This tunnel will give about 300 feet of backs. The country passed through up to the present consists of argillaceous and silicious schists, with occasional quartz veins carrying galena and zinc-blende.

The formation on which the main shaft has been sunk is again exposed in a trench by the side of the Mt. Read track. Crystalline limestone occurs here, and some pretty solid pyrites, but I could see no zinc-lead sulphide.

In another part of the report I have referred to the connection which the zinc-lead sulphide bodies have with rocks bearing lime carbonate. These rocks are present on the mine, and zinc-lead sulphide has been found in connection with them, therefore there is no doubt that the essential features necessary for the formation of ore-bodies are present. The formation of large ore-bodies is, however, always more or less accidental, and until they are discovered it is only possible to form an opinion as to the favourableness or otherwise of the conditions. Here, I think, the conditions are distinctly favourable.

The Tasmanian Copper Company, Limited.

This mine has been accurately described by the late Mr. J. Harcourt Smith in his report on the district in 1898, and as no mining work has been done since it will be unnecessary for me to describe it again. The deposit is situated about 5 miles north of the Mt. Read deposits, on the southern slope of Mt. Black. In mineralogical composition it is of essentially the same nature as the Mt. Read deposits, though it is usually somewhat poorer in lead. It differs, however, in that it is more of the nature of a continuous body of ore, since it has been traced for nearly a mile in almost a straight line. It is, of course, not of equal width or richness the whole distance, and very possibly it may form a series of lenticular bodies along one line of strata. The strike of the lode is about 20° W. of N., and the dip to the east at an angle varying from 40° to 60°. The width as exposed in the mine workings is from 30 to 60 feet in horizontal measurement. I did not find any typical calcite schists in the vicinity of the deposit, but some calcite occurs with the ore. I also found a little crystalline limestone on the tip of No. 2 tunnel. It is very likely that the schists originally contained lime, but at present they are almost everywhere very much decomposed.

Tables IV. and V. show the value of the ore in bulk. The analyses in Table IV. are of samples of a shipment of 100 tons, which was exported for experimental purposes. Table V. is taken from the report of Mr. Harold Wilson, the company's engineer, and are the results of analyses of large samples taken by him with the object of ascertaining the value of the ore in bulk.

TABLE IV.—TASMANIAN COPPER COMPANY.

	I.	II.	III.	IV.
Gold, ozs. per ton	0·15	0·11	0·36	0·45
Silver, ozs. per ton	10·35	10·50	9·24	9·30
Copper, %	0·90	0·63	0·75	1·26
Lead, %	7·10	5·85	4·00	4·25
Zinc, %	27·30	24·75	22·95	18·90
Silica, %	7·18	6·10	7·00	6·80
Iron, %	18·00	20·25	22·95	24·75
Alumina, %	2·20	3·25	3·14	3·20
Lime, %	trace	trace	trace	trace
Magnesia, %	0·20	0·26	0·22	0·24
Sulphur, %	36·24	37·00	38·65	38·95
Undetermined	0·88	1·91	0·34	1·65

I. No. 1 crosscut No. 4 level.
II. Between No. 1 crosscut and No. 2 crosscut No. 4 level.
III. No. 2 crosscut No. 4 level.
IV. Between No. 2 and No. 3 crosscut No. 4 level.

TABLE V.—TASMANIAN COPPER COMPANY.

	I.	II.	III.	IV.
Gold, oz. per ton	0·106	0·152	0·116	0·155
Silver, ozs. per ton	7·73	10·35	13·58	8·625
Copper, per cent.	0·23	0·65	0·61	0·77
Zinc "	21·97	23·10	38·86	21·07
Lead "	4·90	3·15	12·65	4·73
Silica "	13·50	8·65	6·10	—
Iron "	20·21	22·14	6·58	—
Alumina "	—	2·10	0·90	—
Sulphur "	35·21	38·06	29·58	—

I. Average of several bulk samples taken throughout No. 2 level.
II. Average of several bulk samples taken throughout No. 4 level.
III. Average of three bulk samples of selected zinc ore.
IV. Average of 25 large bulk samples, representing the whole of the ore in sight.

The deposit of ore, as has already been remarked elsewhere, strikes approximately parallel with the slope of Mt. Black. It is evident therefore that the conditions which regulate the flow of surface-waters are essentially different from those obtaining at Mt. Read. The waters will have a tendency to flow along the deposit without going to any great depth, and will therefore produce a relatively shallow zone of enrichment. Of course it is possible for channels to form underground along the lode, and in this way for enrichments to take place down to great depths, but these, if they occur, must be regarded as accidental, and certainly cannot be depended on. As far as mining operations have gone yet, the ore-body is clearly within reach of the surface-waters, for the schists are nearly all somewhat decomposed, showing that they have been affected by the same waters which have caused the concentration of the zinc and lead. In the north end of the drive from No. 4 tunnel, *i.e.*, the deepest point at which the ore-body has been exposed, the ore carries a larger proportion of pyrite and a smaller proportion of blende than elsewhere, and I take this to indicate that at this point the workings are already getting out of the enriched zone. This point is about 260 feet below the surface.

As has already been pointed out, observations at the Hercules Mine and elsewhere point to the presence of a zone carrying copper ores, below that of zinc and lead, and the question naturally arises as to whether it would not be worth while testing the ore-body for copper at a depth. This can be done by sinking or by boring with the diamond-drill, and considering that the lode has been proved to be fairly continuous on the surface, I am of opinion that the latter course would be the correct one to pursue. The drill should be capable of boring to at least 1500 feet, and probably several bore-holes would be required to test the deposit thoroughly. Taking into consideration the magnitude of the deposit, and the reasons there are for believing that copper will be found in greater abundance in depth, I think that the comparatively small expenditure which this course would involve is fully justified. At the same time it is only right to point out that the existence of a copper-bearing zone, below the zinc-lead zone, has not yet been proved, and that, even if it does exist, it does not necessarily follow that payable ores will be found below every zinc-lead sulphide body.

The North Tasmanian Copper Company, No Liability.

Section 191-93M, 40 acres. This section is north, and adjoining the Tasmanian Copper Company. The workings were closed at the time of my visit, and I therefore did not see them. A good deal of exploratory work has been done, and the Tasmanian Copper Company's lode has been located. It does not, however, appear to be continuous right through from the Tasmanian Copper Company's workings. The lode is smaller on this section than where it has been exposed further south, but the metallic contents are about the same.

The Primrose Mine.

Section 63-93M, 10 acres, and section 240-93M, 16 acres. The sections are situated south, and adjoining the Tasmanian Copper Company's Mine, and the ore-body of the latter company continues into these sections. The lode has been intersected by a tunnel some 5 chains south of the northern boundary, and from this a drive has been put along the ore-body for a distance of about 260 feet in a northerly direction. The drive follows approximately the hanging-wall of the lode, and from this two crosscuts have been driven to the footwall. The width of the ore-body as shown by these crosscuts and the tunnel varies from 12 to 24 feet in horizontal measurement. The three analyses given in Table VI. have been kindly given to me by Mr. C. M. Henrie. They are from bulk samples of the Primrose ore.

TABLE VI.—PRIMROSE MINE.

	I.	II.	III.
Gold, oz. per ton	1·35	0·12	0·16
Silver, ozs. per ton	9·15	7·38	15·60
Lead %	13·50	9·50	9.00
Copper %	0·68	0·65	0·60
Zinc %	30·20	33·50	31·80
Iron %	6·38	11·66	11·15
Silica %	20·25	11·40	12·80

From this it will be seen that the general average of the ore is somewhat higher in gold, silver, lead, and zinc than that of the Tasmanian Copper Company.

The Jupiter Mining Company, No Liability.

Sections 409-93M and 401-93M, total area 40 acres. This mine is situated a little over a mile to the north-east of Williamsford, the terminus of the North-East Dundas Tramway. A first-rate macadamised road, connecting Williamsford with Rosebery, passes within 10 chains of the mine workings. At about the centre of this property there is an outcrop of schist impregnated with iron and copper pyrites, which has been tested by means of a tunnel at a depth of about 120 feet. The tunnel is driven on a bearing of S. 70° W. At 120 feet from the entrance a vein of solid cupriferous pyrites was cut, which strikes 15° west of north, and dips at a high angle to the east. On the south side of the drive a chamber was made and a winze sunk on the vein. In the south end of the chamber the vein is 9 inches in width near the roof, and 15 to 18 inches wide near the floor, while on the north side of the drive it is only about 6 inches wide. I am informed by Mr. H. Brickhill, who was the mining manager for the company, that it increased to about 2 feet in thickness in the winze. It appears therefore to be increasing in size going south, and also in depth. The ore is of good grade, and should carry from 7 to 9 per cent. of copper. This vein looks as if it would make into a larger body of ore if driven on in a southerly direction. The tunnel is continued for about 200 feet beyond this vein. Several bands of pyrites and heavily impregnated country are passed through, but these are all of a much lower grade. The largest of them was cut at about 300 feet from the entrance, and short cuddies were made on either side of the tunnel. The north cuddy entered decomposed country with seams of gossan, but the face of the south cuddy is in dense pyrites. I think it would be well worth continuing this drive south to prove the formation.

Section 252-93M, 40 *acres.*

This section, formerly known as the Ring P.A., is now owned by the Tasmanian Copper Company. It is situated about half a mile to the north-west of Williamsford. No work has been done on this section for some years, and as there was no one on the ground to show me over the mine, I was not able to make a detailed examination. However, as I visited the mine some years ago, when work was in progress, I can give a short general account of the ore occurrence.

The ore-body consists of a band of iron and copper pyrites deposited as a replacement of the country rock along the line of a fault-fissure. On the footwall of the lode the schist is often heavily impregnated with pyrites. There is also a little barite associated with the ore. The strike of the lode is approximately parallel to that of the schists, *i.e.*, a little to the west of north. I am not aware of the actual length of the shoot of payable ore proved, but I believe it is something over 100 feet. The width varies from 18 inches up to 4 or 5 feet. The following short account of the mine workings is principally taken from Mr. Harcourt Smith's report:—A shaft 50 feet in depth has been sunk on the outcrop of the formation. This passed into the foot-wall country, and from the bottom a crosscut was driven to the hanging-wall, when a band of copper ore was struck 18 inches to 2 feet in thickness. 137 feet below this shaft, No. 1 tunnel was driven on a course of S. 55° W. The hanging-wall of the lode was cut at 220 feet from the entrance, and a good shoot of ore was found. This pinched out when driven on in a northerly direction, in 25 feet. The south drive follows the shoot for some distance; 22 feet from the tunnel a winze was sunk 15 feet, and some good ore obtained, but water prevented further progress. At 38 feet a rise has been put up, connecting with the crosscut from the vertical shaft, and at 50 feet a crosscut has been driven 22 feet towards the foot-wall, passing through 3 or 4 feet of solid ore. The drive continues along the hanging-wall, showing a little ore in places and a good deal of baryta.

No. 2 tunnel has been put in 100 feet below No. 1. This winds about a good deal, following walls and planes of movement in the country, till, finally, it does cut the lode, which has been driven on for a short distance. It is small—not more than a foot or so in width—but contains very nice-looking copper pyrites.

Mr. C. M. Henrie has kindly furnished me with the results of analyses of the ore from this mine, contained in Table VII.

TABLE VII.—RING P.A.

	I.	II.	III.	IV.	V.
Gold, ozs. per ton	trace	trace	trace	trace	0·03
Silver, ozs. per ton	1·75	4·20	3·00	2·70	1·74
Copper, °/₀	8·76	8·49	5·60	4·38	14·99
Iron, °/₀	31·98	31·5	29·40	39·90	29·06
Silica, °/₀	18·48	16·5	27·00	7·55	15·10
Zinc, °/₀	0·50	1·5	1·25	trace	1·30
Lead, °/₀	trace	nil	nil	nil	trace
Sulphur, °/₀	37·95	—	—	—	33·10
Bismuth, °/₀	trace	—	—	—	—
Antimony, °/₀	trace	—	—	—	—

I. Average of 15 or 20 samples from the mine.
II. Sample from ore-shoot in No. 1 level.
III. Sample from ore-shoot in No. 1 level.
IV. Bulk of all the ore exposed in No. 1 level.
V. Sample of picked-ore from "A" rise, No. 2 level.

The Tasmanian Copper Company purchased this mine with the object of mixing the ore with their zinc ores at Mt. Black. There is undoubtedly a payable shoot of copper ore here, provided there were local smelters to treat it, and even without local smelters a large quantity of the ore should pay to take out. But, as in the latter case, only the high-grade ore could be mined, it is evidently better policy to wait until it is finally decided whether local smelters are to be erected or not.

FAHLORE AND GALENA VEINS.

There are a number of different types of fissure-veins in the North Dundas district, containing either fahlore or galena as the principal constituents of value. Although it is impossible to draw any sharp lines of distinction, I think it is possible to recognise the following main types:—

(*a*) Sideritic Fahlore Veins (Curtain-Davis type).
(*b*) Sideritic Galena Veins (Zeehan type).
(*c*) Dolomitic Galena Veins (Kapi type).
(*d*) Silicic Galena Veins (Owen Meredith type).

The sideritic fahlore veins are found in what is known as the Curtin-Davis district, that very hilly and often almost precipitous region south of the Township of Ringville. The prevailing rocks are slates, greywackes, breccias, conglomerates, and a curious quartz feldspar porphyry, occurring in irregular intrusions in the sedimentary rocks. The

deposits are true fissure-veins, containing small but often very rich shoots of argentiferous fahlore, and probably other compounds of silver, copper, and antimony, such as polybasite, included here under the local term fahlore. In addition to fahlore there is usually present, in greater or lesser abundance, pyrite, chalcopyrite, arsenopyrite, jamesonite, galena, zinc-blende, bismuthinite, and other rare compounds of bismuth. Native silver rarely occurs. The veinstone is principally carbonate of iron, with occasionally some rhodocrosite, barite, or quartz. Iron pyrites is very abundant in some of the veins, and indeed some of the fahlore mines are simply large iron pyrites veins containing small shoots of fahlore. In these cases the pyrites has often replaced the wall-rock to a large extent. Where much pyrites is present there is usually very little carbonate of iron, but still it is always present to some extent. Most of the veins strike a little west of north, and dip at very high angles to the east. Several of them have been traced for long distances almost in a direct line.

By the addition of galena these veins pass over into an intermediate type between the sideritic fahlore veins and the sideritic galena veins, and as the two main types and the intermediate type occur in close proximity to one another there can be no doubt that the one passes over into the other. The sideritic galena veins are composed essentially of galena and carbonate of iron, with often a good deal of jamesonite and zinc-blende, a little chalcopyrite and pyrite, and occasionally a little bismuth. The symmetrically-banded structure so characteristic of fissure-veins is often present. In other cases the wall-rock has evidently been replaced metasomatically, and the galena occurs in the form of bunches and tongues in the slate.

The dolomitic galena veins in this district have not so far proved of commercial importance, but, as in other parts of the West Coast, galena veins, with a dolomitic vein-stone, have proved of great value, it is important to record the main facts of their occurrence. So far as I have observed them these veins are closely associated with the basic eruptives gabbro and serpentine. They occur either in these rocks or in their vicinity. Very often they are found at the contact of the gabbro or serpentine with the sedimentary rocks. The veins contain galena, zinc-blende, iron and copper pyrites, and sometimes antimonial ores, associated with a vein-stone of dolomite, usually more or less carbonate of iron, and sometimes quartz. In one instance, on the Commonwealth section, I found some fluorspar in a small

vein of dolomite and galena. The galena is not usually very abundant, and is rather poor in silver. In some cases the dolomite forms masses of great thickness in the serpentine or at its margin. These masses often contain a few bunches of galena and copper pyrites, but they appear to be of no value. They are often capped by an immense gossan blow, derived, no doubt, from the decomposition of the carbonate of iron. These gossan blows have often been taken for the capping of a big lode, and have been driven under with disappointing results.

The silicic galena veins are not abundant, the only occurrence which came under my notice being the lode of the Owen Meredith and adjoining mines. This is a fissure-vein composed of galena, native silver, a little fahlore, pyrites, &c., in a vein-stone of quartz, with a little carbonate of iron. A description of the mine will be given later.

It is quite possible that the several types of fahlore and galena veins may not be all connected. The dolomitic veins which are associated with the basic rocks may have no connection with the other types of veins, which appear to be quite independent of the rocks in which they occur. There is also very little evidence at present to show that the silicic galena veins are connected with the other types, but in the case of the sideritic fahlore veins and the sideritic galena veins I consider that the intermediate types between these two furnish abundant evidence that they have had a common origin. If, now, we compare these fahlore and galena veins with the zinc-lead sulphide bodies of Mt. Read and Mt. Black, we find that there is a very remarkable analogy between them as regards their mineralogical composition. There is not a single element (with the possible exception of fluorine), and hardly a single mineral, which is not common to both types of deposit. It may therefore be said that they differ only in two respects, namely, (1) in the proportion of the different elements present, and (2) in the mode of occurrence of the deposits. Both of these points of difference are readily explainable on the theory that the two types have been deposited by the same solutions. It seems therefore highly probable that the majority of the types of ore deposits of North Dundas are not independent geological formations, but represent local modifications of one great process of ore-deposition which is intimately connected with the granitic eruption.

The Curtin-Davis District.

There are a great number of sections to the east and south of Ringville on which veins of fahlore and galena have been found and worked on a small scale, with more or less success. Many of these are abandoned now, and on many others no work was going on at the time of my visit. With the exception of one mine, all the mining which is being carried on is either the work of small parties of tributors or of parties of working miners, who have taken up the sections after these had been abandoned by the larger companies. I only visited a few of the sections, as there are very few new developments since the district was reported on by Mr. J. Harcourt Smith.

The Curtin-Davis Mine.

At the time of my visit the party of tributors which is working at this mine happened to be absent, so I did not go over the workings. A detailed description of them, however, will be found in Mr. Harcourt Smith's report. Since the company ceased work there have been one or more parties of tributors continuously at work on the mine, who have generally been able to make wages, and several parties have made a good deal more. The ore occurs in small rich patches, and those who have had the luck to strike ore have done very well.

The Ring Valley Mining Company, Limited.

Sections 1400-91M, 4736-93M, 4661-93M, and 3049-87M, total area 287 acres. This mine is situated on the banks of the Ring River, about a mile south-east from Ringville.

There are three lodes known in the north-eastern portion of section 1400, from one of which (No. 1 lode) £4000 worth of ore is said to have been won by a party of tributors. With the object of testing these lodes below water-level, the present company sank a main shaft to a depth of 110 feet, and at 100 feet opened out. The shaft is sunk on No. 2 lode, which continued in the shaft from the surface. It consists principally of iron pyrites, with patches of fahlore and copper pyrites through it. The ore appears to be pitching to the south, as, when driven on in this direction, it dipped underfoot about 25 feet from the shaft. The lode was driven on for a further distance of 50 feet, but, with the exception of a few splashes of fahlore and copper pyrites in one place, the lode is barren. The strike of this lode is 18° W. of N., and the dip vertical.

From the shaft crosscuts were driven east and west, with the object of picking up lodes Nos. 1 and 3. In the east crosscut No. 1 lode was cut 32 feet from the shaft. This passed through several bands of pyrites from 6 to 8 inches thick, and on the west wall of the lode a band fully 4 feet in thickness was passed through. These appear to be lenticular replacement bodies. The lode was driven on north for a distance of 100 feet and south for 45 feet, and the north drive is being continued. The lode strikes 16° west of north, and the dip is vertical. So far, at this level it has proved practically barren. There are two good walls, with crushed and broken country in between; in one place only, a seam, a few inches wide, of carbonate of iron, and a little iron and copper pyrites, were found. This is particularly disappointing, because this is the lode which (above water-level) was worked by tributors with such excellent results. Mr. J. Moyle, the mining manager, is of opinion that the shoot has dipped to the north, basing his opinion on the presence of certain joints which are to be seen in the west wall, and which dip in that direction. He is now pushing on the drive in order to put this theory to the test.

Twelve feet north of the east crosscut a rise has been put up on the lode to connect with the adit level. From this rise an intermediate level has been driven for a distance of 30 feet north. Within the last 4 or 5 feet some ore has come in, and is showing about 14 inches in width in the end of the drive. It is not very rich, being composed principally of copper pyrites, with some fahlore through it. Further up in the rise, and just below the adit level, a little underhand stoping has been done recently, and some rich ore is showing in the north end of the stope. There is also a big body of iron pyrites exposed at this point. The developments in these workings are decidedly in favour of the theory that the shoot of ore pitches north.

Above the adit level the ore has been taken out by tributors for a distance of about 100 feet. There is a little ore still left near the surface, which is now being stoped out.

No. 3 lode has been cut in the west crosscut from the shaft. This has been driven on for a few feet north of the crosscut. It is a small vein going up to 3 inches in thickness, and composed of carbonate of iron, pyrites, fahlore, &c. In the end of the drive there is about 2 inches of good fahlore showing.

The company has been very unfortunate so far in not finding the ore in its lower level, and it is to be hoped that its perseverance will be rewarded by meeting with

the rich shoot in its north drive. If this is found it will have a block of ground which should pay for a very large amount of development work.*

The Fahlore Silver Mining Company, No Liability.

Sections 3212-87M and 3692-93M, each 80 acres. These sections are situated north and adjoining No. 1400-91M, belonging to the Ring Valley Company. No one was at the mine at the time of my visit, but Mr. John Moyle kindly accompanied me through the mine workings. I am also indebted to Mr. W. Watson, the late mine manager, for much of the information contained in the following notes.

The main lode of the Ring Valley Company runs through the southern section of the Fahlore Mine, and most of the mine workings are confined to this lode. It has a very persistent strike of 10° west of north, and dips very steeply to the east. The old mine workings are situated near the south-eastern corner of section 3212. A shaft was sunk to a depth of about 100 feet below the level of the Ring River, in the bed of which the lode outcrops. The lode was cut in a crosscut from the shaft, and driven on for about 150 feet. The shoot of ore, which at the surface outcrops in the bed of the creek, proved to be pitching north. It was very patchy, but a good deal of rich ore is said to have been obtained from it.

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* Since the above went to press the Ring Valley Company has had an important development in its lowest level. The north drive on No. 1 lode has been continued for a distance of 120 feet from the east crosscut, and from this point a crosscut was put in in a north-westerly direction, with the object of testing No. 2 lode and the country between No. 1 and No. 2 lodes, all of which had been proved to be highly mineral-bearing by the east crosscut from the shaft; 24 feet west from the main drive north a shoot of fahlore and copper pyrites has been cut, which Mr. Moyle tells me looks very promising. The crosscut has just cut the south end of the shoot, and, although it has only been opened up for a total distance of 6 feet, 76 bags of ore have been won, which are estimated to yield 150 ozs. of silver per ton. This shoot is dipping to the east, and should intersect the main lode about 40 feet below the present level. The junction is a likely place to find a rich shoot of ore, and it is to be hoped that the company will continue its shoot, so that this ground may be tested.

It may also be mentioned that the Ring Valley Company has recently purchased the Fahlore Mine. There is no doubt that this is a move in the right direction, as the known shoot of ore in the southern workings of the Fahlore Mine can be most conveniently worked from the Ring Valley shaft.

The main tunnel was driven in a northerly direction from a point 350 feet north of this shaft. In this tunnel the lode consists mainly of iron pyrites from 1 to 2 feet in thickness. At 120 feet a small shoot of ore was met with, which was stoped out. The lode was followed for a further distance of 150 feet in a straight line from the entrance. At this point it appeared to turn a little to the east, and was followed in this direction for 80 feet. It then became apparent that the tunnel had got off the true course of the lode, and a short crosscut was put in to the west. After being driven 10 feet this crosscut intersected a shoot of ore, which was driven on north and south, and proved to be 60 feet in length. This shoot is stoped out above the tunnel, but it only lived to a height of 25 feet. The shoot lives underfoot, and has been proved by a winze sunk in the ore for 21 feet. The lode is 4 feet wide in the bottom of the winze, and consists of 18 inches of pyrites, with fahlore through it, the remainder being slaty lode-matter and pyrites. In sinking the winze 209 bags of good ore were obtained. Six of these gave a bulk assay of 762 ozs. of silver per ton, 22·3 per cent. of copper, and the remaining 203 bags contained 198 ozs. of silver per ton and 5 per cent. of copper. The winze was discontinued, owing to a strong inflow of water. From this shoot of ore the drive has been continued for a distance of 270 feet without further developments of importance.

The intermediate tunnel was commenced at a point 490 feet north of the entrance of the main tunnel, and follows the course of the lode for 543 feet. For the first 270 feet little was found but iron pyrites, but at this point ore came in in the floor of the tunnel. This continued in patches underfoot for 60 feet. It then improved considerably, and rose above the level of the tunnel. At about 310 feet from the entrance stoping operations were commenced. The leading stope has been taken out for a distance of 126 feet, No. 2 stope 112 feet, No. 3 stope 69 feet, and No. 4 stope 24 feet. The lode is often very wide in these stopes, and is composed mostly of iron pyrites, with bunches and veins of fahlore in it going up to 12 inches in thickness. In the vicinity of the fahlore the pyrites contains a good deal of copper pyrites through it, and a great deal of second-class ore of this nature has been won which is too poor to sell under present conditions, as there is no market for low-grade copper ores. If copper smelters are started in the district it will make a great difference to this mine, as the low-grade ore could thus be sold at a remunerative price.

There is still fahlore showing in the stopes, but operations have been discontinued pending a reformation of the company. The drive is continued for a distance of 100 feet beyond the stoped ground, but here the lode is poor.

I am told there is a very large outcrop of gossan in the southern portion of section 3692, and a tunnel has been driven through it at a shallow level, but only low-grade gossan was met with. It is intended to crosscut for this formation from the intermediate tunnel.

The South-West Curtin-Davis Mine.

This mine is now leased by Messrs. Ogden and Coady, the section having been thrown up by the old company. The lode, which has been traced for a long distance on the surface, strikes 14° E. of N., and dips to the east at an angle of about 70°. It has been opened up from two adits, driven one above the other, about 100 feet apart, vertically, the upper one being 50 feet below the outcrop of the lode. The lode was driven on north and south from both adits. In the upper level there were two principal shoots of ore, one south of the adit, about 50 feet in length, and the other north of the adit, about 40 feet in length. These have been stoped out above No. 1 adit, and a little underhand stoping has also been done. Altogether about 575 tons of ore were won, realising the sum of £5027 16*s.* 4*d.* At the lower level ore was found immediately below both of these shoots, but, unfortunately for the old company, the first two stoped did not pay, and the work was stopped. The present owners started stoping above the south drive stopes, and were fortunate in finding that the lode improved very greatly. They have now a shoot, some 30 feet in length, of solid ore, going up to 15 inches in thickness. The ore carries from 150 to 200 ozs. of silver per ton, and from 10 to 12 per cent. of copper. The party have sold one parcel of 10 tons, and at the time of my visit had another parcel of 14 or 15 tons ready to bag.

The South Curtin-Davis.

This is another mine which has been thrown up by the company which originally worked it. It is charted in the name of H. Coady and F. Clark. A small syndicate has been formed to further test the mine, and it has had the good fortune to strike, almost at the start, a nice little patch of ore. Three tunnels had been driven by the old

company, which directed its attention principally to a fahlore and galena lode, from which it obtained a large quantity of gossan and a good deal of fahlore and galena. The latter, however, proved very patchy, and apparently did not pay for the exploratory work which was necessary. At any rate, the mine was abandoned. The new owners started driving on a small seam of galena which had been passed through in No. 2 tunnel, and after a few feet had been driven this opened out to a very nice shoot of metal. The ore consists of a very pure cubical galena, assaying 80 per cent. of lead and 17 ozs. of silver per ton. The shoot had been driven on for a distance of about 15 feet at the time of my visit, and showed a maximum width of 10 inches of solid ore. From this 6 tons of practically pure galena had been obtained, and as much more, which will require some dressing before it can be sold. Since my visit Mr. H. E. Hittson tells me that important discoveries have been made by carefully overhauling the old workings. Several formations have been discovered, from which very high assays have been obtained, and it is intended to open up the mine energetically. The ore won to date has more than paid all expenses.

The Great Northern Creek **Mine.**

Sections 4729-93M, 5312-93M, and 3738-93M, total area 125 acres. These sections are held by Messrs. P. P. Quinn and W. J. Hodge, who have been prospecting them for some time, and have succeeded in locating quite a number of veins of ore. They are situated on the north-western slope of the Carbine Hill.

On section 4729, a few chains from about the centre of the western boundary, a lode has been exposed on the surface for about a chain in length. It is a fissure-vein composed of bands of galena and carbonate of iron from 8 to 10 inches in thickness. The strike is about 60° W. of N., and the dip nearly vertical. About two-thirds of the contents of the vein is galena. From this a parcel of 10 tons has already been sold, the assay value being 64 per cent. of lead and 75 ozs. of silver per ton. About 50 feet south-west of this exposure another smaller vein has been cut. This is about 4 inches wide, and is of the same character as the first.

About 7 chains north-east of this lode there is another vein striking 30° west of north, and dipping to the north-east at an angle of 80°. A short tunnel has been put in

on the course of the lode, but at this point it is only a few inches wide. It has been traced for two or three chains down the hill. At the lowest point it is about 10 inches wide, and is composed of carbonate of iron, with a fair percentage of galena through it. This is not so rich as the other, but it is certainly well worth further attention.

In the southern portion of section 3738, about 20 chains N.W. of the above workings, another very promising galena lode has been discovered. This lode strikes 30° west of north, and dips to the north-east at an angle of 80°. The lode formation is about 4 feet wide, and is composed of bands and patches of galena and slate, with a little zinc-blende, pyrites, quartz, and carbonate of iron. The true width of the formation is difficult to determine, because, even behind what appears to be the foot-wall, there are patches of galena. The seams of solid galena in the lode go up to 6 or 8 inches in thickness. The lode has been opened up for several chains along the surface. At the time of my visit Messrs. Quinn and Hodge were engaged in taking out a parcel of 10 tons. The ore is mostly galena, but some of it is decidedly antimonial, and there is some pure jamesonite. The lode is a very promising one, and is more like the lodes of the Zeehan district than anything I have seen at North Dundas. A small quantity of backs can be got by tunnelling from the creek, but the lode will soon have to be worked from a shaft. I do not think there will be much difficulty with water if ordinary precautions are taken to prevent an influx of surface-water. It may be necessary to flume the creek, which crosses the lode a little to the north of the workings.

To the west of this lode there is a small vein, containing pyrites, fahlore, and galena, striking about 20° W. of N. This lode has been cut by trenches at short intervals for 5 or 6 chains south of this point. Further west still there is a large pyrites lode carrying a little fahlore. This strikes about north and south. The galena lode junctions with this lode a few chains north of the present workings. Near the junction the pyrites contain a good deal of jamesonite and a little fahlore, copper pyrites, and zinc-blende. Sometimes the jamesonite and pyrite are in the form of an intimate mixture, and I think there has probably been secondary deposition of the antimonial lead ore, the latter replacing the pyrites. The ore containing jamesonite is, unfortunately, low in silver, but samples containing fahlore have gone as high as 77 ozs. of silver, with 6½ per cent. of copper. Further north the pyrites lode has been trenched

across in several places, but here it only contains iron pyrites. The pyrite has evidently been deposited as a replacement of the slate, for the structure of the slate is retained in some of the ore, and, although much of the pyrites is very dense, there is a passing-over to be observed from this dense ore to highly-impregnated slate. I think this lode should be sunk on near its contact with the galena lode, as this is a likely place for a rich shoot of ore to be found.

About 6 chains west of the pyrites lode there is a small lode containing arsenical pyrites and a little bismuth sulphide, with a good deal of iron pyrites in the country, the whole formation being about 18 inches in width. There is nothing payable here, but it would be worth trenching along the strike of the lode, in order to locate any shoots of fahlore that may be present.

Besides the above, there are a number of small veins of galena or fahlore on these sections which need not be described here. They are not payable where exposed, but are worth further testing, as it is impossible to say where a rich shoot may occur.

Section 336-93-M, 80 *acres.*

This section is charted in the name of A. Lucas. In the north-eastern portion of the section two veins have been found. One of these consists of a small vein of galena from 1 to 4 inches in thickness. This is exposed in a trench about a couple of chains in length below the carbine track. This ought to just about pay to take out. I do not look upon it as a lode, but it may possibly be a spur from a larger formation. There is no vein-stone present. About 6 chains north of this a fahlore and galena vein has been trenched on for about a chain in length. The strike is 40° W. of N. This vein varies in width from 3 up to 10 or 12 inches in thickness, and carries carbonate of iron, galena, and fahlore. Some of the latter is said to have gone as high as 180 ozs. of silver to the ton. This vein is worth testing. There are excellent facilities for bringing in a drive along the lode.

Section 4540-93M, 79 *acres.*

This section is charted in the names of W. P. Margetts, O. Davis, and J. Armstrong, but it is now held by Messrs. Bentley and Everest.

There are two lodes on the section. No. 1 has been driven on for about 200 feet, and two stopes have been taken

out above the tunnel for a considerable distance. Overhead, soft decomposed country came in, and the ore died out. There is however good ore underfoot, and a lower tunnel is being brought in to work this. The lode is said to have averaged 6 inches of metal, going up to over a foot in places. The strike of the lode is 40° W. of N.

No. 2 lode strikes east and west, and dips to the north at an angle of 67°; this has also been driven on for some distance, and has much the same character as No. 1. The party have sold several parcels of ore from the mine, and are working it at a profit.

The above comprise all the sections which I visited in this part of the district. They represent only a small proportion of the mines which a few years ago were considered to be very valuable properties. The results which have been obtained by Messrs. Quinn and Hodge, Messrs. Ogden and Coady, and Messrs. Bentley and Everest, should encourage other prospectors to go out into this district. There is a large amount of ground now vacant which is well worth prospecting, and on which there is every reason to believe good payable shoots of ore are to be found. From the working miner's point of view this field presents exceptional advantages. The ore is high-grade, and readily saleable, without requiring any expensive method of treatment, while the hilly nature of the country enables most of the lodes to be worked without pumping machinery. When the shoots of ore are found, therefore, little or no capital is required to start operations. It is impossible to go through the district without being struck by the large number of lodes which have been found, and from which payable shoots of ore have been mined. But, besides these, there are scores of sections—such as those on which Messrs. Quinn and Hodge are now working—which were held for speculative purposes during boom times, and on which little or no work has been done. These sections are now vacant, and might be occupied under prospector's licence and thoroughly prospected.

The Five-Mile District.

No mining work was going on in the district at the time of my visit, and indeed most of the ground is vacant. There are a number of promising lodes known, but, unfortunately, the ground is low-lying, and they cannot be worked to any depth without pumping-machinery. During my visit I was accompanied around the sections by Mr. S. Smith, to

whom I am indebted for much of the information contained in the following notes.

About 8 chains west from the *Madam Melba Hotel* a shaft 28 feet deep has been sunk on what is described as a pyromorphite lode 2 feet 6 inches in width, with 9 inches of pretty solid pyromorphite, the rest being gossan with pyromorphite through it. Thirty feet south of this shaft the lode is exposed in a trench; here it is about 2 feet wide, and composed of gossan and pyromorphite. Some of the ore is said to contain fine needles of chromate of lead, but these I did not find. The strike of the lode is a little west of north, and the dip to the east. From the ore taken out in sinking the shaft a small parcel was sold, realising £2 15*s.* per ton. The assay value was 2½ ozs. silver per ton, and 52 per cent. of lead. The country consists of a reddish decomposed sedimentary rock, the nature of which is uncertain. From its general appearance I am inclined to think it is a submarine tuff. This lode is situated in the eastern portion of section 3505-93M, close to the northern boundary. The section is now vacant.

A couple of chains to the north-east there is another lode on which a good deal of stoping has been done. This is situated on section 3975-93M, also vacant. This is a similar pyromorphite lode to the last, but it contains patches of chloride of silver. The lode is about 9 inches wide, and strikes 15° west of north. A shaft has been sunk on it for a distance of 37 feet, and the gossan, containing chloride of silver, is said to go down underfoot. Work had to be stopped, however, owing to influx of water. Several parcels of ore were sold from this lode, the price obtained varying from £1 to £33 per ton.

I think it would be well worth while making an effort to test these lodes below the zone of oxidation. The upper portions have evidently been leached of their silver contents, and it is quite probable that they may be found in a concentrated form at or below the base of the gossan zone. To test these lodes a shaft would have to be sunk, probably about 100 feet. A small pumping-plant would have to be erected, and this would have to be driven by steam-power, as I think that water-power is impracticable.

Section 5295-93M, 20 *acres, charted in the name of S. Smith.*

This section is north, and adjoining No. 3975. A few chains from the western boundary of this section a trench has been made, which cuts across a curious decomposed greenish rock, probably gabbro. At the western

contact of the rock with the sedimentary rocks there is a black puggy lode formation, going up to 5 feet in width. On this a shaft has been sunk to a depth of 18 feet. A seam of galena is said to have been followed varying from 1 inch to 6 inches in width. This is a favourable-looking formation, and is worth further attention. Between this point and the west boundary there are several other lode formations which have not yet been opened up.

Section 306-93M, 39 *acres.*—This section is west, and adjoining Smith's section, and was formerly held by the McKimmie Silver and Nickel Mining Company. At present it is vacant. About 2½ chains from the centre of the eastern boundary of the section there was discovered a very curious patch of niccolite (arsenide of nickel). It was found in a small but well-defined lode formation, which was traced for several chains along the surface, and contains galena and zinc-blende in small quantities. When found at the surface the patch of niccolite was about 6 feet long and 12 inches wide, and when sunk on it tapered out to almost nothing 6 feet below the surface. The shaft was continued for 26 feet, and proved the lode to contain a little nickel all the way. Two tons of high-grade ore were got out and sent to France for treatment, realising £28 8*s.* per ton. The country to the east of the lode is black slate, but to the west there is a dyke of decomposed gabbro, and it is possible that the lode may be at the contact.

Section 4976-93M, 80 *acres.*

This section, which was also formerly held by the McKimmie Silver and Nickel Mining Company, is now leased by the Silver King Prospecting Association, No Liability. It is south and adjoining No. 306, which has just been described. The main lode of the old McKimmie Mine is situated about the centre of the section. The strike of the lode is 5° W. of N., and the underlay 1 in 6 to the east. When the old company started work there was a shoot of ore exposed in the bottom of a deep trench 26 feet in length. This ore was composed of high-grade galena, and the vein averaged about 6 inches in thickness of solid metal. A main shaft was sunk and two crosscuts were driven at distances of 50 and 100 feet from the surface. Where the lode was struck at the 50-feet level it contained about 2 feet of solid ore. The shoot dipped south, and was about the same length in this level as on the surface. Unfortunately, however, it only lived about

10 feet below this level. In the lower level the lode was driven on north and south for 304 feet, and nothing was met with but a strong carbonate of iron lode with a few splashes of galena. As soon as the shoot of ore became exhausted shareholders lost faith in the mine, and it was closed down. The water was very heavy. A 20-inch lift was used, and over 50,000 gallons per hour had to be raised. The ore was worth from £10 to £19 per ton.

The Success and Owen Meredith Mines.

Sections 5093-93M and 5091-93M, each 80 acres.—These sections are charted in the name of J. E. Robertson. They are situated 4¾ miles north of the Five-Mile Station on the North-East Dundas Tramway. A large amount of work was done some 8 or 9 years ago by a party of tributors, who constructed over 4 miles of wooden tramway through rough country in order to obtain a means of getting their ore to market. This tramway terminates near the present Argent tunnel on the Emu Bay Railway. From here, in the old days, the ore had to be carted into Zeehan, a distance of 7 miles. A very strong and continuous lode runs through the centre of the property. It crosses what is known as the Crimson Creek, just at the centre of the boundary-line between the two sections. From this point it has been traced, by numerous trenches, in a north-easterly direction, through the northern section, and has been picked up on the eastern boundary of the Bon Accord, which is north-west, and adjoining the former. In the northern portion of the Bon Accord section, and again on the Success Extended, north and adjoining the latter, there are a number of old workings on the course of the same lode. South of Crimson Creek the lode has also been traced for a long distance. It has been driven on for 470 feet, and south of this it has been picked up in the bed of a small creek. Still further south what is probably the continuation of the lode is exposed on section 2539-93M, south-east and adjoining the southern section of the Success and Owen Meredith Mines. The outcrop of the lode has therefore been traced almost in a straight line for a distance of about a mile and a half.

The lode strikes about 32° west of north, and dips towards the east at an angle of 50° to 60°. It varies in width from 1 up to 4 feet. The ore consists of quartz and galena, with a little carbonate of iron, occasionally some iron and copper pyrites, and a little antimonial ore. The galena is not

TABLE SHOWING NATURE, OCCURRENCE, AND MINERALOGICAL COMPOSITION OF THE ORE DEPOSITS OF NORTH DUNDAS.

	Tourmalinic Cassiterite Veins.	Pyritic Cassiterite Deposits.	Axinitic and Pyritic Copper Deposits.	Tourmalinic Gold-Copper Deposits.	Pyritic Copper Deposits.	Zinc-Lead Sulphide Deposits.	Sideritic Fahlore Veins.	Sideritic Galena Veins.	Silicic Galena Veins.	Dolomitic Galena Veins.
Typical Mines.	Penzance.	Cornwall. Commonwealth. Renison Bell.	Colebrook. Clifton.	Mt. Black. Great South Rosebery. Berry Consols.	Jupiter. Ring P.A. Copper formation, Hercules Mine.	Hercules. Mt. Reid. Tas. Copper Co.	Curtin-Davis. S.W. Curtin-Davis. Fahlore.	Great Northern Creek Mine. Bentley and Everest's Mine.	Success & Owen Meredith. Bon Accord.	Madam Melba. Kapi.
Nature of Deposits.	Fissure veins with strong metamorphism of wall-rock.	Massive bodies replacing slates and laminated shales.	Massive bodies replacing Calcareous shales and limestones.	Mostly fissure veins, with little or no replacement of wall-rock.	Massive bodies replacing Argillaceous schists.	Massive bodies replacing Argillaceous and calcareous schists.	Fissure veins. When Pyrites is present this often occurs, replacing the wall-rock.	Fissure veins, often without good walls, showing evidence of replacement of wall-rock.	Fissure veins; little or no replacement of wall-rock.	Fissure veins and masses, replacement doubtful.
Association with Igneous Rocks.	Always in Tourmaline Quartz Porphyry or in vicinity of this rock.	In vicinity of (*i.e.*, within 30 ch. of) Tourmaline Quartz Porphyry.	No acid eruptive in immediate vicinity. Close to belt of Gabbro, Serpentine, &c.	Veins generally found in or at contact of Keratophyre.	Deposits occur in vicinity of Keratophyre.	Deposits occur in vicinity of Keratophyre.	Sometimes associated with Quartz Felspar Porphyry.	Appear to be independent of pressure of igneous rocks.	No connection with igneous rocks observed.	Occur in or in the vicinity of basic rocks, Gabbro, Serpentine, &c.
Gold Contents.	†Up to 1 dwt. p.t.	Traces.	From traces up to ½ dwt. p.t.	From 4 to 20 dwts. p.t.	Usually from 1 to 4 dwts. p.t.	Bulk shipments yield from 3 to 10 dwts. p.t. and over.	Traces.	Traces.	Traces.	Traces and up to 2 dwts. p.t.
Silver Contents.	†Up to 2 ozs. p.t.	Up to 2 ozs. p.t.	½ to 1 oz. p.t.	6 to 12 dwts. p.t.	2 to 4 ozs. p.t.	Bulk shipments yield 7 to 40 ozs. p.t. and over.	Bulk shipments yield 150 to 300 ozs. p.t. and over.	1 to 1½ ozs. per unit of Lead.	40 to 400 ozs. p.t. No fixed relation to Lead contents.	About ½ oz. per unit of Lead.
Copper Contents.	†Often a small percentage.	½ to 1½%.	2 to 5%.	½ to 2%.	3 to 8%.	½ to 2 %.	12 to 16 %.	Traces to 2 %.	Small percentage.	Small percentage.
Pyrite.	Moderate quantities.	In large quantities, probably not so abundant as Pyrrhotite.	In considerable quantities. Not so abundant as Pyrrhotite.	In considerable quantities.	In large masses.	Occurs through Zn.-Pb. ore. Ore-bodies associated with masses of Pyrite and Pyritic schist.	Sometimes only in small quantities, but often very abundant.	Sometimes present in small quantities.	Present in considerable quantities.	Present in small quantities.
Pyrrhotite.	Not observed.	Large masses, probably more abundant than Pyrite.	Large masses, more abundant than Pyrite.	Few small crystals observed.	Doubtful.	Doubtful.	Small quantities observed.			
Chalcopyrite.	†Often small quantities.	Widely distributed in small quantities.	Widely distributed, sometimes in considerable quantities.	In small quantities.	Often in large quantities.	Widely distributed in small quantities.	Often in large quantities.	Often in considerable quantities.	Often in considerable quantities.	Relatively to Galena in considerable quantities.
Arsenopyrite.	†Often small quantities.	Abundant in Axinite veins traversing deposits	Fairly abundant.	Small quantities.	None observed.	None observed.	Often abundant.	Small quantities occasionally observed.	Not observed.	Not observed.
Galena.	†Traces observed.	Small quantities.	Traces.	Traces.	Small quantities. Often absent.	Abundant. Average Lead contents 6 to 12 %.	Often absent, but sometimes present in considerable quantities.	Principal mineral of value. Sale samples yield 60 to 80 %.	Fairly abundant. Average about 20 %.	Generally not very abundant.
Zinc-blende.	†Traces observed.	Traces.	Traces.	Traces.	Small quantities. Average 3 % Zn.	Very abundant. Average 20 to 35 % Zn.	Generally absent. Sometimes in considerable bunches.	Small to considerable quantities.	Small quantities.	Often in large quantities relatively.
Fahlore*	Not observed.		A little Tetrahedrite low in silver observed.	Not observed.	Traces, very rare.	Occurs in small quantities through the higher-grade ore.	Principal mineral of value highly argentiferous.	Often absent, but sometimes present in considerable quantities.	Generally present in ore.	Not observed.
Other Antimonial Ores.	†Small quantities recorded by Thureau.					Jamesonite occurs rarely.	Jamesonite, Stibnite, Boulangerite (?), and others occur.	Jamesonite common.	Not observed.	Jamesonite plentiful in some deposits.
Bismuthinite.	†Small quantities.		Very small quantities.	Sometimes fairly plentiful.	Traces reported.	Very small quantities.	Widely distributed and sometimes fairly plentiful.	Sometimes present.	Not observed.	Not observed.
Wolframite.	†Small quantities.			Small quantities.						
Cassiterite.	Abundant; often almost massive.	Abundant in small grains thro. Pyrite and Pyrrhotite.	Not observed.	Not observed.						
Tourmaline.	Abundant.	Sometimes in very small quantities.		Abundant.						
Axinite.	Not observed.	Occurs in veins traversing deposits.	Very abundant. Also small quantities of Datolite, &c.							
Actinolite.		Slates altered to Actinolite rock in vicinity of Axinite veins.	Very abundant.							
Chlorite.	†Doubtful.	Country sometimes altered to Chlorite rock in vicinity of deposits.	In small quantities.	Not observed.	Occurs in quartz veins accompanying deposits. The latter sometimes are in Chlorite schist.	Occurs in quartz veins, accompanying deposits.				
Fluorite.	†In small quantities.	Small quantities observed.	Not observed.	Sometimes abundant.	Not observed.	Sometimes small quantities.				
Calcite.			Fairly abundant.			Deposits generally associated with Calcite schist.	Occasionally occurs.	Occasionally occurs.	Not observed.	Not observed.
Dolomite.		Deposits at Renison Bell associated with large masses; nature of association unknown.	Occurs in small quantities.	Small quantities (?).		Probably present in small quantities.			Probably present.	Very abundant.
Rhodochrosite.					Occurs in quartz veins accompanying deposits.	Abundant.	Present in small quantities.	Present in small quantities.	Not observed.	Not observed.
Siderite.	†Small quantities.			In small quantities.		Small quantities.	Abundant.	Abundant.	Considerable quantities.	Often present in considerable quantities.
Barite.				In small quantities (?).	In small quantities.	In small quantities and sometimes considerable bunches.	Sometimes in small quantities.	Sometimes in small quantities.		
Quartz.	Abundant.	Crystalline quartz uncommon.	Not common.	Abundant.	Quartz veins, often associated with deposits.	Quartz veins often associated with deposits.	Sometimes druses are lined with clear crystals.	Sometimes druses are lined with clear crystals.	Abundant.	Sometimes abundant.

* The term Fahlore as used here may include Sulphides of Copper, Silver, and Antimony other than Tetrahedrite and Freibergite.
† These observations were made on the Tourmalinic Cassiterite veins of the Heemskirk District, where there were much better opportunities for observation.

solid, but consists of grains distributed through a granular quartz matrix. Some of the ore is very rich in silver, and I think that much of the latter is in the form of the native metal. Native silver is visible in some of the stone, and the several assays of the ore which were made for me showed that the amount of silver bears no constant ratio to the lead contents. The lode is a fissure-vein, with strongly slickensided walls. The best ore is found as a seam from a few inches up to a couple of feet in thickness on the hanging-wall, the rest of the lode being composed of slaty matter and low-grade ore.

North of where the lode crosses the creek it is exposed continuously for about two chains. The lode is here from 3 to 4 feet in thickness, and contains some rich ore, but most of it has already been removed. One sample of the richest-looking ore showing at the surface, taken by me from a seam 3 or 4 inches thick on the footwall of the lode, returned 19·9 per cent. of lead and 265 ozs. of silver per ton. At the end of the trench, about a chain north of where this sample was taken, I took a bulk sample across 2 feet of lode-matter. This returned 4·1 per cent. of lead, 11 ozs. 11 dwts. of silver, and 7 grs. of gold, per ton. About 3 chains north of this trench the lode has been cut by a short tunnel, driven in a westerly direction from the creek. Here it is 3 feet wide, with 15 inches of fair-looking ore on the foot-wall. A bulk sample from this gave a return of 2·3 per cent. of lead and 21 ozs. of silver per ton. Another tunnel has been put in north of this one, but here the lode is practically barren. In driving south from this tunnel a little ore was met with, and a winze sunk upon it. There is a little ore at the mouth of the tunnel, but, of course, any payable ore which was got has been sold. Further north the lode is exposed in several trenches. From the most northerly of these I took a sample from 9 inches of lode-matter, which returned 1·6 per cent. of lead and 34 ozs. of silver per ton. All of the above were fair bulk samples of the ore exposed, and I believe they could have been enriched very considerably by a little hand-picking.

South of the creek a tunnel has been driven on the course of the lode for about 600 feet, and three shoots of ore are said to have been met, but apparently these were too poor to work, for no stoping has been done. I went into the tunnel until a fall of earth prevented me from going further. Up to this point the drive is timbered, and for the greater part of the distance the lode cannot be seen, but in one or two places where it was exposed I saw some

galena in the stone. Further south still the lode has been picked up in the bed of a small creek. A sample taken from the lode-matter exposed here gave the return of—lead 10·2 per cent., silver 29 ozs., per ton.

A main-shaft has been sunk on the lode, just south of where it crosses Crimson Creek. This shaft cut the lode 50 feet from the surface, and from this point it was continued on the underlay for a further distance of 40 feet. This 40 feet is said to have been all good ore. From the bottom of the shaft the lode was driven on 150 feet north, and from 50 to 60 feet south. Above these levels some stoping was done, and altogether 405 tons 13 cwts. of ore was won, which, delivered in Zeehan, realised the sum of £2485 13*s*. The assay value of the parcels varied from 4 to 41 per cent. lead and from 32 to 550 ozs. of silver per ton. The majority of the parcels, however, contained between 15 and 30 per cent. of lead and 60 to 110 ozs. of silver per ton.

In the old days the tributors worked under very great disadvantages. The cost of getting the ore to market was very excessive, as after it had been taken over 4 miles of wooden tramway, it had then to be carted 7 miles into Zeehan. Under these circumstances only the best of the ore would pay to take out. The party was also severely handicapped for want of capital. The tramway cost more than had been expected, and the mine had to practically pay for its own development. The result was that, when the first shoot of payable ore was worked out, the mine had to be shut down.

The old tramway is still in very fair order, and could be put into a fit condition for carrying ore with a very small expenditure. By a branch line of about 20 chains in length it could be connected with the Emu Bay Railway within a distance of about 2 miles from the mine.

The silicious nature of the ore from this mine is in its favour, as it may be mixed with the more basic ores of the Zeehan field, and thus replace the silica flux in the furnaces. For this reason the Tasmanian Smelting Company would probably be able to offer a very favourable tariff, and enable the lower grade ore to be worked at a profit.

The conditions therefore for working the mine on an economical basis are far superior now to what they were 9 years ago, and I believe a very large proportion of the ore which had to be left standing then would pay to take out now. The mine will, of course, require capital to start. Pumping machinery will have to be erected, and development work must be pushed on from the start. If this is

done I think there is every reason to believe that the mine will become a valuable property.

The Bon Accord Mine.

Section 4537-93M, 80 acres. Charted in the name of T. Graham. This section is situated north-west, and adjoining the northern section of the Success and Owen Meredith Mines. The lode which was worked on the latter mine has been traced through the north-eastern portion of this section. Near the northern boundary the lode has been worked by trenches and shallow shafts for several chains, and a shallow tunnel has been brought in from the Success Extended section, which is north and adjoining. There is not much opportunity for observing the lode formation, as the tunnel is timbered, and the old trenches are partly fallen in. Above the tunnel there has been some stoping done, and in the south end of the stopes the lode is exposed. It is composed of a black slate and pug formation, containing several seams of ore, near the foot-wall. A bulk sample from these seams gave 14·8 per cent. lead and 10 ozs. 15 dwts. of silver per ton. There is a little galena at the surface, but all the payable ore which was won from the lode has been removed. The present workings are all shallow, and where I saw it the lode is quite decomposed.

The Success Extended Mine.

Section 5080-93M, 80 acres. This section is north and adjoining the Bon Accord, and the lode passes into it at about the centre of the southern boundary. It has been worked at intervals for 7 or 8 chains from the southern boundary by trenches and shallow shafts, and is said to have been ore-bearing the whole way. There is a good deal of second-class ore at the surface which would require ore-dressing machinery to bring it into a marketable condition. The workings are all quite shallow, as water prevented the lode from being worked to any depth. Before anything more can be done pumping-machinery will have to be erected. This section and the Bon Accord might be worked as one mine with advantage, and a main shaft sunk to test the lode on both sections.

DEPOSITS OF NICKELIFEROUS PYRRHOTITE.

There are two deposits of this class known in the North Dundas district, and, though there is reason to believe that neither of them is of commercial value, it is important that the facts of their occurrence should be recorded, as deposits

of the same class which are of sufficient dimensions to become of economic value may be found in other parts of the coast.

The most important of the two deposits in the North Dundas district is situated on section 3510-93M, near where the Emu Bay Railway crosses the North-East Dundas Tramway. The deposit was found in the bed of a small creek which flows through the section. The creek had completely filled up the old workings, and I could not examine them, but Mr. G. Beardsley, metallurgist to the Mt. Lyell M. and R. Company, who was interested in the mine at the time the work was done, has kindly furnished me with the following information:—The deposit occurred at the junction of the slate and the decomposed gabbro. On first appearance it gave promise of being a big lode, but afterwards proved to be merely a rock-cavity filled with nickeliferous pyrrhotite. This was connected with a small leader a few inches thick and 12 or 15 feet in length. The water was very heavy, and the leader was not followed down for more than 20 feet. Several parcels of ore were sold, carrying from 8 to 12 per cent. of nickel, 3 to 5 per cent. of copper, an ounce or two of silver, and a trace of gold. The ore was composed principally of nickeliferous pyrrhotite, containing in places small crystals of milerite. This occurrence is evidently of the same type as the nickeliferous pyrrhotite deposits of Sudbury, in Canada, though on an extremely small scale. These deposits are invariably found at or close to the contact of gabbro with the surrounding rocks, and occasionally form short veins in the latter. They are believed to have been produced by a process of differentiation in the gabbro magma during the process of consolidation. J. H. L. Vogt, who has made a special study of these deposits in Canada and Norway, believes that "there is a certain connection or dependence between the size of the gabbro intrusion and that of the ore-mass within it. At all events, very small eruptive districts are characterised only by small segregations."* The dimensions of the gabbro intrusions at North Dundas are very small in comparison with the enormous masses which occur in Canada and Norway, and this may account to some extent for the small dimensions of the ore-deposits. North of the Pieman River, however, very much larger masses of gabbro are known, and it would be well worth while for prospectors in that district to be on the look-out for large deposits of pyrrhotite at the contact of

* J. W. L. Vogt. The formation of eruptive ore deposits. The Mineral Industry, Vol. IV., 1895.

the gabbro and the sedimentary rocks. The nickel contents of the ore which was won at North Dundas is much greater than that of the smelting ore at the best Canadian mines, which only averages from 2·5 to 3 per cent.

The other deposit which I have referred to is situated on the old King Curtin Mine, about three-quarters of a mile north of Ringville. The formation was cut in an old tunnel which was put in from the side of the track between Ringville and the Colebrook Mine. I have only examined the ore at the mouth of the tunnel. It consists of veins and bunches of iron pyrites in quartzite, with small needles of millerite through it. The quartzite also contains small needles of millerite in the joints. Just beyond the tunnel the track passes through a small patch of serpentinised gabbro, so that it is evident that this deposit is also at or close to the contact of this rock. I am not at all sure that this deposit belongs to the same type as the last, but I think it is probable. The milerite in the joints of the quartzite is evidently of secondary origin, and indeed the whole deposit may have been altered considerably by the action of underground waters since it was formed as a segregation from the gabbro.

Appended to this report will be found a table showing the nature, occurrence, and mineralogical composition of the ore deposits of North Dundas. The deposits of nickeliferous pyrrhotite have been omitted, as an exhaustive examination of these deposits was impossible.

In conclusion I desire to thank the numerous mining managers and others in the district for the great assistance they have rendered me during my visit. I am also indebted to Mr. W. H. Baker, B.A., B.Sc., University Lecturer on Chemistry at the Technical School, Launceston, and Mr. H. T. Waller, F.C.S., Director of the Zeehan School of Mines, for much assistance in connection with the theoretical portion of this paper, and especially with regard to the chemistry of the process of the secondary enrichment of the zinc-lead sulphide bodies.

I have the honour to be,

Sir,

Your obedient Servant,

GEORGE A. WALLER,
Assistant Government Geologist.

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

REPORT ON THE COAL FIELD IN THE NEIGHBOURHOOD OF RECHERCHE BAY.

(One Map.)

Government Geologist's Office,
Launceston, 1st May, 1902.

SIR,

I HAVE the honour to report that, agreeably to your instructions, I proceeded to Recherche Bay on the 18th March to select sites where the diamond drill can be advantageously used to bore for coal.

This time, I journeyed *viâ* Southport. On the coast south of *Ransom's Hotel* in Southport harbour, cliffs 70 or 80 feet high expose in their upper part 50 or 60 feet of soft buff sandstone, passing downwards into 10 feet of a laminated light-coloured variety of the same rock, and then into 10 feet of grey shale, the whole resting on black shale at water-level. The face of the cliff runs N. and S., and the apparent dip of the strata is between 5 and 10 degrees to the S.W. Whether any of the upper beds belong to the Mesozoic system or not is uncertain, but the shales contain impressions of thin, jointed, or branching stems, which Mr. R. M. Johnston refers to *Vertebraria*. The other plant recorded from these beds is *Pecopteris lunensis* (R.M.J.); and the shales would therefore seem to belong to our Lower Coal Measures (Permo-Carboniferous).

In July, 1893, a diamond drill bore was put down for the Southport Coal Prospecting Association to a depth of 612 feet 2 inches, at 70 chains north of the Narrows and 1 chain west of the beach, about 30 feet above sea-level. The strata passed through were as follows:—

	Thickness. ft.	in.	Total depth. ft.	in.
Surface shaft	18	0	18	0
Blue shale, with small sandstone bands	6	6	24	6
Grey argillaceous sandstone.....	9	0	33	6
Grey quartzose sandstone, with mica ...	24	0	57	6
Ditto, with a little coal	0	3	57	9
Blue shale	7	9	65	6
Grey sandstone and blue shale	28	8	94	2

	Thickness. ft.	in.	Total depth. ft.	in.
Black shale	0	10	95	0
Grey sandstone and black shale	5	1	100	1
Black shale, with plant impressions	10	6	110	7
Black shale and dark sandstone	5	0	115	7
Grey sandstone and fossiliferous black shale	19	1	134	8
Coal	0	3	134	11
Hard black shale, with plant impressions	5	11	140	10
Hard blue shale and grey sandstone	41	0	181	10
Hard grey sandstone and grit	38	11	220	9
Hard grey fine-grained sandstone	212	0	432	9
Coarse rubbly sandstone	0	6	433	3
Hard grey fine-grained sandstone	64	0	497	3
Hard conglomerate	10	1	507	4
Hard grey fine-grained sandstone, with pebbles, marine shells, and blue shale bands	104	10	612	2

At this depth the drill aproached the limit of its working efficiency, and began to run heavily. Boring was accordingly suspended, without passing through the whole of the beds of the system.

Coal also occurs near Hastings. The locality was pointed out to me by Mr. Hay, but, as the works were under water, there was not much use in going up to visit them. From what I learned, the coal is fair, but mixed with band stuff, which requires separating. Mr. R. M. Johnston publishes an analysis of this coal in his Geology of Tasmania, page 191:—

Fixed carbon.	Volatile matter.	Ash.	Moisture lost at 212° F.
58 %	30·8	8·7	2·5

A strait, called The Narrows, leads from Southport Bay to the inner sheet of water, on the northern shore of which is Hastings, on the southern, Ida Bay.

Coal Measures also exist at Ida Bay. About a mile S.W. of the bay and 150 feet above sea-level, at the base of the hill called the Sugar Loaf, some work was done 10 years ago on a coal seam which runs north and south, and dips W. into the hill. A small tunnel has been driven on the dip. The inclination of the seam is steep, 40°, as measured at the entrance of the tunnel, but there may have been some recent movement of the earth at surface. At the entrance there is no roof visible, but pieces of loose sandstone were of a soft felspathic variety. I dug out some soft coal from below the soil, but nothing more is to be seen of the seam from

the outside. I gathered that a little coal had been used for household consumption, but no sales had taken place. Lower down the hill is another small seam of soft earthy coal.

A shaft a little higher up was intended to cut the tunnel seam, but after sinking about 60 feet, a mishap in blasting is said to have blown the timber out, and work was then abandoned. Mr. Tyler, who kindly accompanied me to the spot, says another 10 feet of sinking would have reached the coal. He gave me the descending section in the shaft as follows:—

1.	Yellow clay.....	10 or 15 feet
2.	Mud shale, with fossil plants ...	30 „
3.	Sandstone	8 „
4.	Black shale.....	7 „

N.W. of the tunnel, and higher up, is another band of coal in these measures, called "Schäffner's," said to be 18 inches thick.

If the Sugar Loaf is crowned with diabase, as appears probable from the talus on the slope, the coal seams may probably be cut off when they approach the centre of the mountain, but there would appear to be plenty of undisturbed ground available, for the steep ridge is half a mile away from the works on these seams. The coal is in a kind of depression between two gentle spurs coming down from the mountain. The possibility of a backbone of eruptive rock existing in these spurs must not be overlooked when prospecting operations are undertaken.

The Ida Bay coal seams appear to be on a somewhat higher geological horizon than the Southport measures, as the shales contain leaves of the Cycadaceous plant *Zeugophyllites*. The beds are favourable for coal seams, but only thin ones have been found, so far. A heavy drill can be taken by tram to within half a mile of the outcrops, and then a track would have to be made over comparatively easy country. The *Ronnie*, s.s., goes up to the Ida Bay Jetty every week, where there is 6 feet 9 inches of water at high tide. The Jetty is 200 or 300 yards in length, and would need repairing and strengthening for heavy machinery.

The country between Ida Bay and D'Entrecasteaux River, four miles further south, is mostly diabase, with Mesozoic sandstones, and grits of probably Permo-Carboniferous age in the hollows of the undulating land. The ranges to the west are composed of the sedimentary rock for undetermined distances up their flank, when stones and boulders of diabase embedded in the soil point to the existence of that rock on the summit.

At the head of Recherche Bay is the small settlement of Leprena, which has clustered round the saw-mills, and half a mile south of this is Mr. Smith's land, upon which the Moss Glen Colliery Co. is working for coal. Operations are going on upon the 640-acre block, which borders the bay, in addition to which there is the Reward Claim of 201½ acres, 4561-93M. The seams Nos. 1, 2, and 3, described in the Company's prospectus of the 4th October, 1901, are occurrences on the Reward Claim, not being explored at present.

Moss Glen Coal Field.

On the Reward Claim there is a disused timber tramway, which leads up to a short distance of the outcrops, which I inspected by taking a turn-off through the scrub over fallen logs and vegetation, which greatly hampers and, for the most part, prevents examination of the ground. Mr. Smith discovered coal on this section 2½ years ago, and a little prospecting work has been done since, but of a purely preliminary nature.

The first indication of coal which was shown to me was at the base of a fallen tree, which had uprooted some coal and clay, evidently part of a seam. This had not been opened upon. The coal stuff is of a good black; the fireclay soft and extremely greasy.

A little further W. is the Lower Seam, which has been opened upon by a couple of pits, now two-thirds full of water. The small heap of coal lying at the mouth has been there for a couple of years, and is useless for assaying. It is dull in appearance, but has shining layers running through it. The sandstone is a soft white micaceous variety, different from that on the East Coast. I could not verify any section of the seam, as, owing to the water, none of the coal could be seen *in situ*. Mr. Herbert Smith told me that in 11 feet sinking there is 7 feet of coal, interspersed with numerous bands. Fossil leaves had been found at this place, but, unfortunately, were not preserved.

The next seam on this claim is the Upper one. A small shaft has been sunk upon it 17 feet, now two-thirds full of water, the shaft cutting through the seam at the head of a small open cut. On the heap are blocks of dull dense coal, bright here and there. It is referred to as anthracite in the prospectus, but this is an error. The prospectus states that 7 feet of coal are exposed. Mr. H. Smith gave me still higher figures, but nothing can be seen in the present state of the shaft. Much of what has been brought to surface looks clayey, and hardly to be called coal, though

glistening seams traverse it. What is necessary is to get well under cover and see what the seam really is.

These outcrops are about 200 feet above sea-level, and distant from the sea-shore 1½ mile, or 2 miles if the Leprena tramway is used.

At present, having been untouched for a couple of years, and the coal outside being weathered, nothing much can be said beyond that coal seams undoubtedly exist and invite attention. They should be tested by further work. The land badly needs scrubbing, and its surface exposing to daylight.

Here and there a few boulders of diabase rock protrude from the mantle of vegetation which covers the ground. These must have come from a higher level, and have presumably rolled down from the crest of the mountain, 600 feet above the sea, though no bed-rock has been seen there, the top being covered with soil and timber, with boulders showing in places. A few hundred yards further up the tram, at a height of 250 feet above sea-level, I saw large boulders of Tertiary basalt lying in the scrub. The microscopic structure of this differs from that of our ordinary basalt. The rock largely consists of skeletal and embryonic crystals of felspar, and its structure generally points to it being a dyke rather than a lava sheet. It is nowhere known *in situ*.

The eruptive rock formations of this district accordingly comprise the Mesozoic diabase (dolerite, bluestone, greenstone, trap, &c.), called basalt locally, and the Tertiary basalt as just described. The sedimentary rocks of the eastern side of the range are the Mesozoic sandstones and shales which enclose the Upper Coal Seams. I regret that I could not find any well-defined plant remains on the Reward Claim, but the rather ill-preserved ribbed strap-like leaves which I saw in the shales seemed to me to be those of *Zeugophyllites*, a characteristic genus of our Mesozoic strata.

The Reward Claim, which comprises upwards of 200 acres, is a fair-sized block for exploration, and after the ground in the neighbourhood of the outcrops has been cleared, the lines of outcrop must be proved by trenching, and their seams prospected on their dip with the drill. If the soil is too deep for trenching, a hand-drill must be used for the purpose. Connecting lines should be made between these outcrops and those on the 640-acre block to the south, so as to prove their identity or otherwise with the latter, from which they are distant about half a mile.

The 640-acre property just mentioned is the block upon which active explorations were being carried on at the time of my visit. Mr. Hardwick, the Company's Mining Manager, was in charge of the operations, and gave me every possible assistance in my inspection.

The seam outcrops are situate just above or below a timber tramway about 200 feet above sea-level, along which logs are hauled to the sawmill at Leprena. The coastal range at the back of this block has a wide embayment here. The sandstone strata ascend the slope certainly for one mile inland (horizontal distance), and probably for one-and-a-half mile, but for the last half-mile unproved country is hidden below the scrub and surface soil. That they also extend eastwards below Recherche Bay for another three-quarters of a mile is shown by the coal seam on that side of the bay. The sandstones dip about 20° in a north-westerly direction, consequently, we may assume the minimum thickness of the beds as 3000 feet. I believe this thickness of Mesozoic strata is not known elsewhere in Tasmania, and it may be that the calculation is vitiated by upthrows in the strata as they approach the mountain. The first indication of coal in that direction was met with at a height of 91 feet and 36 chains W. of the bay in a horizontal line, where two small pits 5 and 8 feet deep show slack coal. Along this line for a distance of 41½ chains N. 52° W. from sea up to 107 feet, Mr. Hardwick has put down a series of shallow bores, the deepest, 30 feet, in which he has struck solid sandstone only.

Below the tramway a short tunnel has been driven 21 feet N.W. on a seam of coal at 190 feet above sea-level. This drive was cleared of water while I was there, and I brought away a bag of the coal freshly broken from the end. This has been assayed by the Government Analyst, Mr. W. F. Ward, with the following result:—

Fixed carbon.	Gases and moisture.	Ash.
54 %	26·2 %	19·8

The coal did not form a coke. It corresponds in constitution with a good deal of the East Coast coal. The ash is somewhat high, but ash is an inert, not a deleterious ingredient; it means a certain amount of dead-weight to be handled for each ton of coal, and an equal loss in fuel. In this assay it means 3½ cwts. per ton of coal. This coal burns freely on the open fire, and throws out a good heat. There is no doubt that it will answer as a domestic coal, and if the ash is free from iron, which would make it fusible and apt to accumulate as clinker on the bars, it might be used for steam

purposes, though not a first-rate coal for that. The best steaming coals have a high proportion of carbon, little ash and sulphur, and enough gas for quick combustion.

No bulk trials of the Moss Glen coal have been published yet, and I am unaware whether any have been made. It would be desirable to have some trials at an early date, to see what the coal will be most suited for. The descending section of the seam is:—

Coaly and shaly matter at surface—

	ft.	ins.		ft.	ins.
Clay	1	6	to	2	0
Coal		...		1	0
Clay band		...		0	5
Coal		...		2	6
Band		...		0	2
Coal		...		2	0
TOTAL		...		6	1

of which 5 feet 6 inches are coal.

The seam is dipping strongly to the N.W. at 20° from the horizontal, and is evidently subject to faults, for a bore from surface only 6 or 7 feet ahead of the end has failed to strike coal.

Above the tramway and to the N. of the tunnel I was shown the outcrop of an upper seam, about 4½ feet of coal, with a couple of feet of shale. Further south along the tramway, a shaft has been sunk 13 or 14 feet. This is now full of water, but stony and earthy coal and bands of clay are said to have been cut all the way down. This shaft, continued deeper, would intersect the tunnel seam in perhaps 50 or 60 feet. A deep bore near here, 36 feet down, is stated to have struck coal 10 feet from surface, and to have passed through coal and bands for 25 feet.

Further along the tramway, 4 chains 60 links from this bore, another bore-hole was being put down over 31 feet without touching any coal, which would seem to point to some faulting. Until the coal has been picked up again, matters are unsatisfactory. The seam ought to have been struck at about 20 feet in the bore.

A line of shallow bores has been put down also on the level outcrop of the tunnel seam, with a view to defining its course, and this has been done in a very satisfactory way. The right course is being pursued by the Manager in testing, as far as he can, the seam on its dip before launching out into work at the tunnel. Faulting may be expected in the

measures as they near the mountain ridge, which begins to rise very steeply on the other side of the tramway. The non-discovery of the seam in the 31-foot bore is certainly disconcerting, but it will have to be sought by further bores, for there is no use extending the tunnel if the seam has been thrown up or down to any extent. From the probable axis of diabase or greenstone rock at no great distance to the west, I am inclined to think that the dislocations met with will be upthrows on the west side, in which case the faulted seams will be found higher up the hill. Considering the depth of overburden on the mountain side, additional rods for the boring plant would be advantageous.

It would be difficult to get a heavy diamond drill plant high up above the tramway, which is a very convenient means of bringing it from the coast. But a little above the line west of the old shaft, or above the 36-feet bore, would be a comparatively easy site, and suitable for testing the strata down as far as the drill will go. It cannot reach the strata which crop out at the beach, for these plunge 2000 feet below the tramway.

To gain a knowledge of the beds, I would recommend one bore to be put down above the tramway as far up as the drill can be got, and another hole on the flat ground marked on the accompanying map close to the shore N. of Mr. Smith's garden, near available water. There are indications of coal in the greenish soft sandstones on the beach to the north of this. It is impossible, without boring, to know what may be concealed below. Pieces of coal are sometimes found on the beach, and probably outcrops exist in the bed of the bay. The bore need not go down to a depth beyond which a seam would be workable from shafts, for there would be no other way of exploiting any seam which might be discovered.

If the Company would undertake an intermediate bore about half way along the line connecting the two sites just mentioned, the intervening strata could also be tested. True, the same beds, as regards the upper strata, crop out nearer the beach, supposing no faulting to have taken place, which is just the thing which cannot be taken for granted.

The surface soil is heavy, and this, combined with the quantity of fallen timber everywhere, makes trenching a difficult matter. Apart from a few deep bores with the diamond drill, a good deal of inexpensive and useful prospecting can be done with the hand drill, and the work now being carried out with that can be extended with advantage.

Assuming payable seams to be opened out, the position with regard to shipment is that the coal will be brought down by tram for about a mile to a part of Recherche Bay, where deep water can be got by building a jetty out for some distance. The middle of the bay, opposite Mr. Herbert Smith's house, is 24 feet deep, according to the Admiralty chart, and it is said that a jetty 300 yards long would extend into 15 feet of water. With a seam of coal of the thickness seen in the tunnel, I estimate the coal ought to be delivered into store at Hobart for a total cost of 14*s.* or 15*s.* per ton.

The property has excited great hopes, and it is well that attention should be directed to it, as a coal mine in this part of the country means a great deal. No efforts should be neglected in the way of proving a field so near to the capital. Some definite result from the prospecting now going on will, however, have to be obtained before money is spent in working the seams at the observed outcrops. If the result is satisfactory, and any of the seams are shown to be continuous and maintain fair size and quality, the undertaking may be pushed on vigorously, for the conditions of work are favourable.

Catamaran.

I was glad to have another opportunity of looking at this field, which I examined but cursorily on the previous occasion.

The seam, where opened upon in the main shaft, is situate 1½ miles S. 17° E. of the Moss Glen tunnel, and is separated from it by a high spur, put down on the Admiralty chart as rising to 950 feet. The spur consists of sandstone on the slopes, with loose boulders of diabase rock higher up, which leads to the inference that the crest or axis is diabasic, though no solid rock can be seen, owing to the overburden of soil and the heavy timber.

South of Mr. Herbert Smith's, the solid diabase (dolerite) emerges at sea-level and continues south to the mouth of the Catamaran River and beyond, with the exception, perhaps, of some sandstone at Deep Creek, where the beach is sandy. The Catamaran River for two miles, or, at any rate, as far as the tramway bridge runs in diabase, and the flat ground to the immediate north of the river is probably diabase also, though concealed by soil and drift-sand. Mr. J. M'Dougall told me that he had bored 30 feet into the alluvial without touching the bed-rock. He was

then stopped by water, but I imagine that the foundation-rock had nearly been reached, as that would be about sea-level. On the western part of the flat I should recommend a trial to prove what the bed-rock is, and, if it be sandstone, then a bore-hole might be put down to test the measures, which would be geologically lower than the seams already tapped.

I saw, on this occasion, what I did not see on my previous visit, viz., a line of pits on outcrops further west from the main shaft, most of them showing coal. The first of these was along the tramway, about 10 chains W. of the shaft, and sunk for 10 feet through clay, striking sandstone at bottom, when work was stopped.

The next shaft, a few hundred yards further west, and now half filled with water, is deeper than the previous one, and has struck coal which resembles in appearance that of the main shaft, but if my reading of the strike of the former be correct, I do not see how this can be the same seam.

A few chains further along the north side of the tramway a tree has uprooted some good coal, which appears to be another outcrop of the seam struck in the previous shaft. In fact, about every hundred yards along the tram there are indications of coal.

The most westerly shaft is, perhaps, half a mile from the first. It goes down into boulders of blue shale, and then into a seam of good coal.

It is impossible to establish the mutual relations of these outcrops without clearing out the shafts and doing a little work in order to ascertain the direction of the strike or dip of the seams and strata. The only place where the inclination of the beds is seen is in the main shaft, and that is not sufficient for the determination of the true strike. According to that shaft, the apparent dip is to the N.W., and the strike, consequently, would be N.E. and S.W., but as we cannot tell whether the inclination observed is at right angles to the true strike uncertainty exists as to the precise directions of both strike and dip, as well as to the amount of the latter. This uncertainty cannot be cleared up without a little preliminary work, and the very best site for deep boring could be confidently selected only after such work.

My interpretation of the bearing of the country-rock, formed nevertheless under these disadvantages, is that the strata strike east of north and west of south, and the dip is to the west of north. The run of the beds is, therefore, similar to that on the Moss Glen property, and if the diabase

of the northern spur does not intercept, the country is continuous from one property to the other.

Under the above conditions the best direction for deep bores will be a little to the west of north of the original main shaft. The ground slopes in that direction to a flat before rising again on the north side. The flat is about 30 feet below the shaft-collar, or 18 feet below where the seam was cut in the shaft, and, as the seam dips apparently 8° in that direction, a test bore in the flat at a horizontal distance of 10 chains from the shaft should pierce the seam at a depth of 75 feet. The ground does not rise for nearly half-a-mile north of shaft, consequently, another bore at the base of the hill would strike coal at about 300 feet. This is assuming the apparent and true dip to be identical in amount, which is highly improbable. If the real dip is increased to say 17° instead of 8°, the depth at which the seam would be struck at the base of the hill would be 790 feet. A medium distance might advantageously be taken, say 20 chains from shaft, at which the depth, with 8° dip, will be 170 feet, and with 17° dip, 385 feet. To make a complete piece of work, I should recommend two further bores right and left, *i.e.*, E. and W., say at a moderate distance, 300 yards W. and 300 yards E. of the first bore, so as to prove the continuation of the seam in each direction. If the seam is thus proved to be continuous, it will give a high value to the property, and, in fact, until this necessary preliminary work is done, the exploitation cannot be safely undertaken. If the coal seam is shown to be unbroken over the area comprised within the bore sites and the shaft, it means that the existence for that area of 60,000 tons of coal for every foot thickness of seam may be reckoned upon.

The speed of boring in these beds with the diamond drill will average about 100 feet per week. The tramway to the shaft will assist in getting the drill to the mine, but to transport it to the flat a track will have to be made through the scrub.

At the main shaft an attempt might be made to confirm the existence of an alleged 7-feet seam below the clay floor, for, as far as I can learn at present, the statement is an unverified one. The drill-cores will show whether a second seam occurs below the upper one, but, if a fair quantity could be raised from the shaft, its quality could be tested in a more satisfactory way.

I may add that the sites for bores given above are approximate ones, and may be varied a little to suit convenience of transport of machinery and nearness of water for working.

SKETCH MAP OF COALFIELD AT RECHERCHE BAY

5 cm

SCALE 0 5 10 20 30 40 50 60 70 80 CHAINS

- Alluvium
- Boulders of Tertiary Basalt
- Workings, coal seams
- Proposed bores
- Dips of strata
- Mesozoic Diabase
- Boulders of diabase
- Mesozoic Sandstone

W.H. Twelvetrees
Government Geologist
May 1st 1902

D'ENTRECASTEAUX RIVER

R.D. Cuthbert 95.0.0 142.3.0
R.D. Cuthbert 25.0.0
R.D. Cuthbert 23.3.0
Rose Cuthbert 29.2.4
R.D. Cuthbert 24.2.0
R.D. Cuthbert 48.2.0
MILL
SCHOOL
LEPRENA

456 / 93M 201.2.0 Geo. H. Smith
TRAMWAY
79 M 36.0.0 G.H. Smith
23.2.23 R.D. Cuthbert
640 ac. Thos W. Brown
TUNNEL
SLACK
1
2
HOUSE
BENNETT'S POINT
20.0.0 T.S. Bennett
15.2.22 S. Bennett
8.2.16 John Mazey
40.0.0 RESERVE
19.0.28 W. Mazey
28.1.11 H. Mazey
Thos Watts
16.1.4 S. Connon
M. Driscoll
DEEP CREEK
16.0.0 R. Finn
96.2.0 W.C. & J.H. McDougall
W. McDougall
MILL
HOUSE

99.0.35 J. Ryan
SCHOOL
T. Dalco
21.0.12 J. Ryan
G. Cooper
W.L. Domeney 39.2.0
M. Driscoll
BLACK SWAN LAGOON
ELIZA POINT
THE IMAGES
BLIND OR SUNKEN REEF
SHAG ROCK
QUIET BAY
SULLIVAN'S POINT
RECHERCHE BAY

5248 / 93M 317 ac.
M.L. Hood
NORTH SHAFT
TRAMWAY
5
4
3
MAIN SHAFT
6
TRAMWAY
TRAMWAY
CATAMARAN RIVER
7
TRAMWAY
8
98.3.0
W. McDougall
TRAMWAY

This time I went to see the northern shaft on the lease. I found that it was not over the crest of the hill, as I had supposed, but on the southern flank, and it cannot be much more than half-a-mile N.N.E. of the main shaft, at a height of about 130 feet above sea-level. The disused northern branch tramway runs to within a few hundred yards east of it, and the remainder of the way is a foot-track through the bush. The hill is heavily timbered. This shaft was sunk 18 months ago, and is said to have gone down 33 feet, and, judging from the stuff at surface, through clay and a friable grey sandstone till it touched the coal, when the increasing water caused work to be discontinued. I could get no information as to size of the seam, its direction or dip, nor any data which would serve to connect it with the seam on the south side of the valley. As the tramway is in fairly good condition, a heavy drill could be brought to this spot without much trouble, and at first I was inclined to select a site for a bore-hole here, W. of the shaft, but all things considered, I think that the bores already recommended will answer requirements for the present. I am inclined to think that by clearing away the scrub, and trenching, the outcrop of this seam might be found lower down the hill, and driven upon.

South of Catamaran River.

I did not confine my visit to the sections already taken up for coal, but examined also the ground in the neighbourhood.

South of and adjoining the Catamaran River, about two miles from its mouth, is a 38-acre section in the name of W. McDougall. On this land a shaft has been sunk some 30 feet deep down to a small seam of coal. White sandstone was first sunk through, then shale, and at last nearly 5 inches of soft coal. The direction of dip appeared to be northerly. The shale yielded distinct impressions of the fossil fern *Thinnfeldia odontopteroides*, belonging to the Upper Coal Measures. There is little doubt that these strata are continuations of those north of the Catamaran.

Westward from here is a plain of marshy ground covered with Manuka, about a mile square. The Catamaran River north of it flows between sandstone banks, which may be seen at three miles from its mouth, where Mr. J. McDougall has a stationary engine hauling logs to his tram. It is safe to infer that the sandstones continue beneath the marsh, and it is easy to see that a prolongation of them south-west for three or four miles would reach the coast at South Cape

Bay, where coal sections are held by Messrs. Rathbun and Morrison. It is evidently one and the same run of country right through from Moss Glen (with a possible diabasic interruption under the northern spur), so that there is here really a wide area of coal measures sandstone which is well worth attention. The Manuka plain offers ideal sites for boring. It is Crown land, and I recommend a Government bore being put down close to the tramway a little east of the hauling engine, and where water can be got. This is at the western end of the plain. Anywhere along the tramway on the plain is suitable geologically. From the position of the marsh in relation to the shaft on W. McDougall's land, I conclude that the strata below it are Upper Mesozoic, and consider that there is a fair chance of meeting with coal seams, seeing that they occur in similar beds both north and south. I should also like to see a second bore put down in the eastern portion of the plain (also along the tramway), so as to pierce such of the lower strata as might not be reached with the bore further west. A good tramway, along which 12-ton logs are being transported to the saw-mill, will be of great use in conveying the drill to the actual spot. It would probably be desirable to put these bores down first, as the tramway is in good order, and in the meantime the old tram-road could be repaired, and the bush-track constructed to the sites north of the river.

To recapitulate, the bores which I have recommended are as follows:—

A.—*On the Moss Glen property:*

1. Above the tramway, near the shaft or 36-feet bore, 200 feet above sea-level;
2. At sea-level on shore of Recherche Bay, north of Mr. Herbert Smith's garden.

B.—*On Mr. L. Hood's section at Catamaran:*

3. About 20 chains N.N.W. of main coal shaft in the valley at the base of the hill-range to the N.;
4. At 300 yards to the E. of No. 3;
5. At 300 yards to the W. of No. 3.

C.—*On Crown land N. of Catamaran River:*

6. On the flat along disused tramway to the E. of Mr. L. Hood's east side-line, provided that preliminary work shows the bed-rock to be sandstone and not eruptive rock, well away from the side-line, as the dip will carry seams into the adjacent property.

D.—*On Crown land S. of Catamaran River:*

7 & 8. On the Manuka Plain, 3 miles from the mouth of the Catamaran River, along J. McDougall's working tramway. One bore in the eastern part of the plain, and another in the western.

These bores form a prospecting programme, which ought to prove any seams over a wide area of the extreme southern coal fields. To complete it, a bore would have to be put down at Ida Bay, near the mine works there, but there does not seem to be much interest taken in those seams, and the means of taking the drill there would have to be considered, more especially with respect to the landing-place.

I have to thank Mr. McDougall of Catamaran, Messrs. Herbert Smith and Hardwick of Glen Moss, and Mr. Tyler of Ida Bay for their kindness in furnishing me much help and information.

I have the honour to be,

Sir,

Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

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

REPORT ON DEPOSITS OF OPAL AT BOTHWELL, AND AN ALLEGED DISCOVERY OF GOLD AT HUNTERSTON, ON THE SHANNON.

Government Geologist's Office,
Launceston, 26th May, 1902.

SIR,

I HAVE the honour to report that, per your instructions, I visited the opal field at Bothwell on the 21st of January last, and proceeded from there to the Shannon, where abortive mining operations were carried on some years ago in the hope of proving a deposit of supposed gold-bearing stone.

Opal at Bothwell.

The township of Bothwell is situate on both banks of the River Clyde, about 1150 feet above sea-level. Crossing the Clyde at the township, and going west, the country is composed of white and buff sandstone, lithologically similar to that at Ross, and, like it, may be referred (though with some hesitation) to the variegated strata forming the lower beds of the Mesozoic. That there is, however, some of the Permo-Carboniferous present, would appear from the discovery of marine fossils on Barrack Hill, just west of the township.

Mr. Alex. Reid and Mr. Geo. Allison accompanied me to the field, about 1½ mile W. and N.W. of Bothwell, where the former started prospecting for opal five or six years ago. Eighteen months since, Mr. Petersen began to make a stir on this field, which comprises a large sandstone plain, bounded on the S.W. and N.E. by intrusive masses of igneous rock (diabase, dolerite, bluestone, &c.). On this plain for a long distance surface-stones and outcrops give indications of veins, seams, and nests of common opal, of milk-white, resinous, bluish, and brown jasperoid varieties. Some of the opal gives orange or reddish flashes when turned in the hand, and betrays a tendency to a play of colours. Greenish and agatoid varieties were seen, but no specimens of precious opal, and I was assured at Bothwell that the true fire had not been seen in any of the stone yet.

I saw Petersen's workings on Robert Swindel's property in a couple of pits which had been sunk in yellow crystalline

sandstone, seamed with facings and veins of common opal. The veins form thin facings on the bedding-planes and the joints at right angles to these. The adjacent stone is often very siliceous from the permeation of the silica solutions through its substance. In vughs I noticed mamillary chalcedony, a mixture of crystalline silica and opal. I was told that some fossicking on Barrack Hill had also resulted in finding a little opal.

North of Petersen's pits, on A. Reid's 1400 acres, I was shown a small shaft in white sandstone, veined irregularly in all directions with white and bluish common opal. At the surface the opal is very opaque and white; a little way down it changes to waxy yellow and other tints. It is noteworthy that a low bank of diabase rock is not far from this pit. Along a fence on the property the grass is strewn with stones of opalised and chalcedonic rock, evidently derived from some outcrop. This bears a resemblance to mineral veinstone. The stones belong apparently to a vein of chalcedony and semi-opal, and are plentifully sprinkled with white iron pyrites (marcasite). A sample was given to Mr. W. F. Ward, the Government Analyst, for assay, but he reports it as containing only traces of gold and silver. I have no doubt that the occurrence is due to the contact of the Mesozoic diabase with the sandstone, and consequently economic minerals need not be expected. Near the Shannon Road on this estate is some concretionary limonite, and ironstone gravel is seen on the road itself. This mineral is further evidence of contact.

S.W. of Petersen's workings a hill-range of moderate elevation runs N.W.-S.E., on the crest of which is diabase abutting against opalised sandstone, some iron ore also marking the contact. The opal is milk-white and bluish, in veins and mamillary forms.

I take it that the presence of the eruptive rock indicates the origin of the opal. The heat imparted by it would appear to have started the silica solutions in the adjoining sandstone. The silica has been derived, not from the diabase, but from the sandstone, through which the thermal solutions have slowly meandered.

Why common opal is so abundant and the precious opal is absent it is impossible to say, but it is probably due to the conditions of formation. The iridescence or play of colour in the noble variety is due to the diffraction of light by the striated walls of excessively-minute fissures in the stone; the varying sizes of the fissures condition the different colours. The fissuring is apparently not due to pressure or

shattering from rock movements, but to internal strain on hardening.

Hence, wherever common opal occurs there is no known reason for excluding the precious stone, though the latter is not necessarily found with it. Depth, too, has nothing to do with its occurrence, as is very plainly shown by the deposits of opal in New South Wales and Queensland, a few words concerning which may be acceptable.

At the White Cliffs opal field, in New South Wales, 60 miles N.W. of Wilcannia, the workings do not go down deeper than 40 to 50 feet from the surface. The industry supports 1500 persons, and the output for 1900 was estimated at £80,000. Some of the precious opal realises £40 per ounce, and £5 to £20 is a frequent price. Some only fetches 10*s*. per ounce. The common opal forms 95 per cent. of the whole. The gemstone is found in horizontal veins and bands in marine strata, associated with fossil wood and shells, or as cementing broken boulders of sandstone and quartzite. Common opal is regarded as the indication. At first the quality of the patches was thought to improve with depth, but later work has shown the relation of quality to depth to be purely accidental. As far back as 1890 the New South Wales Department of Mines reported that opals were found within a few feet of the surface in layers between a hard siliceous sandstone. In 1894 Mr. E. F. Pittman, Government Geologist, reported that this sandstone was an Upper Cretaceous grit opalised by thermal springs, and that there was no surface indication of the presence of the gem, which was being recovered chiefly from about 12 feet below the surface. He adds:—"And the workings have mostly been confined to this level, apparently under the impression that it would be useless to look deeper for the stone. I am of opinion, however, that this is a mistake, and that opal may be expected to occur at much greater depths than it has hitherto been found."

In Queensland the 1901 yield of opal was valued at £7400. It is found in Upper Cretaceous (Desert) sandstone, or in nodules derived therefrom, and here also Mr. C. F. V. Jackson, Assistant Geologist, says that fully 95 per cent. contains little or no colour. The average depth of the shafts is stated at 14 feet, the greatest depth 65 feet.

In Europe the occurrences are entirely different. Pockets of opal are found in decomposed trachytic rock in Hungary.

The fact that no noble opal has yet been found at Bothwell, in spite of some industrious fossicking, is somewhat dis-

couraging. Of course, it must be allowed that very little real work has been done in the way of exploration, and that has to count for something. It would be foolish to deny the possibility of gemstone existing there, as yet undiscovered. At the same time there is nothing disclosed so far which would justify any great outlay. The nature of the deposit makes the adoption of a methodical scheme of exploration costly. It may be described as a magnified open meshwork of infiltration veins, which swell out here and there into bunches and nests, most likely connected with one another by mere tracks and narrow channels, or possibly only by silicified country rock. The deposit can only be proved by a regular series of prospecting shafts in rectangular directions covering the whole ground. This obviously involves an expense which intending explorers would do well to consider, and the proportion of failures in striking precious opal must be low, or the work will not pay, for though the hydrous silica is found developed here and there at several points throughout the field, there does not appear to be very much of it at any one spot. The deposit is very irregular, and no continuous vein can be followed; hence, I am inclined to believe that if anything valuable is ever found here, it will be by fossicking at intervals over the area, rather than by the more costly search by shaft-work just mentioned, which scarcely seems warranted by present appearances.

Gold at the Shannon.

On the 23rd January I visited the River Shannon where it flows through the estates of Meadfield and Hunterston, 12 miles N.N.W. of Bothwell, and about 450 feet higher than that town. The bank of the river near Henry Tarr's cottage, on the Meadfield run, had been the scene of operations of the Golden Dawning Mining Company, which was formed in 1897, with a nominal capital of £30,000, to work what was described as an extensive pyrites deposit on a 100-acre flat. The flat and surrounding hills were stated to be a mass of pyrites veins, carrying gold and silver. The promoters stated that assays had been made of quartz, pyrites, and slaty matter, yielding—gold 1 oz. 6 dwts. 3 grs. and silver 13 dwts. 1 gr. per ton. I was told on the spot that some of the pyrites was assayed at the Ballarat School of Mines, and returned 2½ dwts. gold per ton. The samples which were sent by Mr. A. Montgomery to the Government Analyst for assay contained only traces of gold, and if Mr. Montgomery's report on this occurrence in 1895 had

been published at the time, the probability is that the investors in the Golden Dawning Mine would never have been invited to sink their money in an enterprise foredoomed to failure. They obtained a report in 1897 from Mr. J. Davies, of the Tasmania Mine, Beaconsfield, who, however, saw nothing very definite in the occurrence, and, after a few months' struggle, work was finally abandoned. A feeling that the deposit was ill understood, and that there might be something of value in it yet undiscovered, led to the instructions for my visit.

A series of nine or ten shallow pits, most of them 4 or 5 feet deep—one 18 feet—have been sunk on the east bank of the River Shannon from near Henry Tarr's cottage to Gage's Bridge. The country-rock consists of sandstone, carbonaceous and mudstone grits, belonging to the Permo-Carboniferous system. A general feature is the presence of pyrites disseminated through the rock, and more especially on the faces of the joint-planes. It is this pyrites which has been the *ignis fatuus* of the gold-seekers. No free gold has ever been seen here. The samples of stone which I brought away with me, when crushed and washed, yielded no colours, and the pyrites failed to show any trace of gold.

Secondary pyrites is common enough in these rocks elsewhere in the Island, sometimes resulting from the influence of organic matter, sometimes connected with the intrusion of diabase. The Permo-Carboniferous mudstones of Mt. Wellington are charged with pyrites within a short distance from the contact with the mountain mass of eruptive rock.

At the Shannon No. 1 and No. 2 pits are situate on the very contact-line of a dyke of pyriliferous diabase, which descends Castle Hill like a standing wall, projecting 30 or 40 feet from the ground. The dyke is about 8 feet wide, is vertical, traverses argillaceous grit, and crosses the river-bed in a direction N. 65° W. It is concealed easterly under the flat, but loose stones of it on Tarr's Hill indicate its extension below the soil in that direction. It is fine-grained and—an unusual thing for diabase in this Island—contains microscopic zeolites. Pyrites is disseminated through it. The pyrites in the sedimentary grit which it traverses has probably been developed under its influence. Although the sedimentary rocks carry pyrites at a considerable distance from any outcrop of diabase, yet the entire district is intersected by diabase dykes, and bodies of the eruptive rock may exist anywhere not far below the surface.

On the Hunterston estate, east of the woolshed, there is another zeolitic diabase dyke protruding from the grass

about 3 feet in width. This is an extremely fine-grained basaltoid diabase, bluish in tint, with a ground-mass compact and aphanitic to the eye, dotted with black porpyritic crystals of pyroxene (augite), also olivine and white zeolites Its direction is also N.W.

About 100 yards north of Manning's Bridge, over Blackman's Rivulet, on the Lake Road, a dyke of typical diabase occurs, about 100 feet wide. This also contains pyrites. Fossiliferous mudstone lies on the N. side, and limestone to the S. of the dyke, but I could not prove the actual contacts. Pyrites is present in all the diabase rock of the district, but its presence in the sedimentary rock is to be regarded as the result of a reducing action rather than direct impregnation from the igneous rock. The latter is much younger than the gold-bearing quartz reefs of the Island, and there is no proof anywhere that it has been a gold-carrier. It has never done anything beyond starting solutions of hydrous silica, or converting sandstones into quartzite at its contact with them, and originating a little quartz and iron ore at such places. This has given rise to Mystery and Puzzle shows *et omne hoc genus*, which are mysterious and puzzling only to those who expect gold-bearing reefs in country which was formed long after our gold reefs came into existence. Mr. George Allison took me to see one of these formations at Christian (or Crystal) Marshes, where a profusion of loose broken quartz was believed to indicate the existence of some concealed reef. I found it to be a fine illustration of contact metamorphism produced by the diabase impinging on sandstones. It is noteworthy that the proof of intrusion here is not that of a mere dyke, but it is the margin of the large body of diabase forming part of the Tier country. I drove over at least a mile of it. Blocks of quartz and quartzite are strewn about on the west bank of the Shannon on F. and W. Synnot's 640 acres, but the key to the occurrence is to be found in the bed of the river, where flat-bedded pinkish quartzite is seen at the water's edge between the bridge and opposite Mr. Hill's cottage. Just east of this is the boundary of a large area of diabase rock, which stretches east from here to Blackman's Rivulet. This rock rises into a little knoll close to Hill's, crosses the river, and its contact has undoubtedly altered the sandstone to quartzite, and developed in it veins of pure white quartz from an inch to nearly a foot in width. These veins are confined to the quartzite, and are absent from the diabase. As might be expected, the quartz does not carry gold.

On the hill east of Tarr's cottage, and about three-quarters of a mile from the latter, I was shown another

place where stones of quartzite, quartz, gneissose mica schist, granite porphyry, and other rocks occur loose in and on the surface of the soil. No solid reef has been found, and possibly a hidden diabase-sandstone contact exists here too; but, in view of the heterogeneous nature of the stones, foreign to the district, I am rather inclined to regard them as having been released from Permo-Carboniferous conglomerates, of the degradation of which they are the residue. The samples which I collected contained no gold, but Mr. Davies reports 1 dwt. 12 grs. per ton as the result of an assay from stone collected by him from here. If the quartz and quartzite have been derived from more ancient rocks, the mere presence of a little gold in some of the samples is unimportant from a mining point of view, as the stones are now widely sundered from their parent mass. If, on the other hand, the quartz has been abraded from a diabase contact, there is no use searching for gold. The fact of gold being obtained from Mr. Davies' samples is in favour of the theory that the quartz originally formed part of a conglomerate.

All these occurrences at the Shannon are illusive, and it is to be hoped that no further expenditure of time or money will be wasted on them.

The ground from Hunterston, a plain of Permo-Carboniferous grits, rises gradually to the foot of the Shannon Tier, which shuts in the northern horizon in a slightly-crescentic form. The Tier itself rises from the flat land about three miles north of Gage's Bridge to a height of 800 feet above White's and Westell's selections, or 1200 feet above Tarr's cottage, and 2800 feet above sea-level. The horizontally-bedded sandstones ascend the flank of the mountain to within two or three hundred feet of the top, when the Mesozoic diabase begins to show itself as columnar crags.

I was accompanied to the top of the Tier by Mr. George Allison, whose love of geological exploration and prospecting led a few years ago to his discovery of the interesting volcanic nephelinite and melilite basalt rock of Tertiary age occurring in the form of small cones, 30 to 50 feet high, which have been ejected through the diabase on the summit. The rock was described by Mr. W. F. Petterd and myself in 1899, and the description was published in your report for 1898-9.

North of White's is the largest cone, a double one, consisting of bluish-looking compact melilite basalt, breaking with a conchoidal fracture. This is known as the Haystack, and, owing to the small clearing in which it stands, it

can be seen from a good distance on the Hunterston plain. No ashes are preserved, and the cone is probably a surviving neck. Between the two cones, and at the base of the north side of the larger one, the grass conceals a very coarse nepheline-augite rock = nephelinite, composed of augite in long prisms and light-coloured nepheline. Much of the nepheline has decomposed into radiating snow-white natrolite, and Mr. Petterd has identified some beautiful zeolitic needles as Thomsonite. The long prisms of augite were surmised to be tourmaline on the first discovery of the rock. It was thought that some useful mineral might be disclosed, and accordingly a little work was done at this spot. The coarse nephelinite seems to penetrate and fill the joints of the finer basalt, presumably by a process of segregation, for the two rocks must be contemporaneous. It would be interesting to prove whether it underlies the cone. It varies occasionally into a rock of finer grain. Proceeding west along the edge of the Tier, over diabase rock, for half a mile, a smaller melilite basalt cone is met with, about 30 feet high, with a north and south basal diameter of 120 feet and 50 feet E. and W. This may be called the Beehive, and about 100 feet west of it is a still smaller cone, not more than 12 feet high, which is the Anthill. The discovery of these rocks was unique in Australasia; at the end of last year, however, the volcanic fayalite rock at the Alexandra Battery, Sandy Bay, was found to be also a melilite basalt. The rock at the Shannon is not likely to yield gold or any other metal of economic value.

The geological examination of the Shannon district shows that it offers little promise of payable lode-deposits, unless the underlying granitic bed-rock can be found exposed somewhere. The only chance which it appears to have would be the existence of coal seams in some of the higher sandstones on the slopes of the Tier, as, possibly, Mesozoic strata may be found at the higher levels.

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

W. H. WALLACE, ESQ.,
Secretary for Mines, Hobart.

REPORT ON GOLD AND COAL AT PORT CYGNET.

Government Geologist's Office,
Launceston, 31st May, 1902.

SIR,

AGREEABLY to your instructions, I have paid two visits to Port Cygnet, where alluvial gold was found as far back as 25 years ago, and abortive lode-mining was carried on in 1898-9.

The problem which has confronted the gold-seekers has been to find the source of the gold which has been won in quantity from the alluvium of flats and creeks. In 1898 a grain of what was claimed to be gold was shown to me at Lovett in a piece of stone from one of the shows then being worked, but it was never proved that it was not copper pyrites. A few days later the late Mr. J. Harcourt Smith noticed specks of free gold in some of the stone from Mt. Mary Mine, and his samples, assayed by Mr. W. F. Ward, Government Analyst, returned 4 dwts. 2 grs. gold per ton. Apart from this, no undoubted gold has ever been seen in the bedrock. As a good deal of gold has been shed from the hills, the search for its original home is of interest and importance. Though fruitless hitherto, it deserves attention, and ought to be persevered in quietly and steadily.

It is impossible now to find out exactly how much gold the district has produced from first to last, but the most trustworthy information which I have been able to collect places the figure at about 3000 ounces. Most of this came from the flats near Lymington, a township situate on the west side of the arm of the Huon called Port Cygnet, and 2½ miles south of Lovett, which is at the head of the inlet. These flats are surrounded by steep hills, from which the metal has beyond question been derived.

On Mr. Coad's ground in this flat a company worked successfully for a couple of years, and took out a lot of gold. At the mouth of the creek, Forster's Rivulet, north of Lymington, Mr. Lane sank in the drift just above the bridge seven or eight years ago, and got fine gold, averaging half a grain to the dish; the wash is said to have been very rough.

About 1½ mile west of Lymington I was shown wash near Mr. Lane's from which £60 worth of gold had been taken out. A shaft had been sunk in detrital quartzose porphyry* for 25 feet without bottoming on bedrock. Below the surface-soil is 3 inches to 1 foot of cement, forming a dark pug; then, below this, is an oxidised brown detrital clay, a false bottom 1 foot thick, then clay again below. The cement yields 20 or 30 colours per dish. A few holes have been put down here, and colours obtained. The cement, which is a white sand, with iron oxide and hornblende, thins out as it runs up the hill to the south. It is observed here, as elsewhere on the field, that the reddish stone carries the gold. The cement grains are angular, and have no doubt been derived from denudation of the hill-slope. The gold is coarse and jagged, some of it with curiously hooked points sharp enough to prick the finger. These forms suggest a solution and re-precipitation of the gold. The creek between Lane's and Devereux is said to have yielded coarse gold.

From here I went further south up the hill to Denis Murphy's property, where a little excavating work had been done. The creek gives colours of gold all the way up. A few feet have been dug into the soil, and then broken stone met with. The stone is reddish and variegated, and contains no visible metal besides a little iron and copper pyrites, but I was told that samples had been sent to the West Coast, and had assayed 2 dwts. gold and a little silver. On examining this parti-coloured stone closely I detected in it casts of the Permo-Carboniferous fossils, *Fenestella* and *Spirifera*, and saw at once that this was the contact boundary between the mudstones of that system and the intrusive alkali-porphyries. This contact-line crops out more or less horizontally along the northern slope of the hill about three-quarters of the way up, and is further indicated by several springs. Higher up to the west are beds of metamorphosed sandstone, grit, and shale; and Black Jack, the high hill further west, is said to have a similar covering in part. It seems to me very probable that gold has been precipitated along the contact-line. The hill at the back (S.W.) is a high narrow ridge, which descends on the south steeply to the River

* I use the word porphyry here in a field sense, and to make the description intelligible to residents in the locality, where the term is well known. It comprises all or any of the porphyritic soda-trachytes, dacites, sölvsbergites, tinguaites, nephelinites, and alkali and elaeolite syenites, which form the petrographical complex at Port Cygnet.

Huon. At the top the Permo-Carboniferous strata are permeated with opaline silica and chalcedony, and from the hill-saddle Kube's can be seen down the creek, where pieces of gold as large as a finger-nail have been found.

I next proceeded to Martin's show by going along the Back Road towards Wattle Grove and turning off to the east at Martin's cottage. On R. Lewis' ground a trench has been cut across the contact-line of the porphyry and Permo-Carboniferous shale. The section exposed in the cut is as follows:—

S.W.	Shale. (*a*)	Contact formation. (*b*)	Unaltered porphyry. (*c*)	N.E.

(*a*) is the ordinary laminated soft shale of the Permo-Carboniferous system.

(*b*) is stone which is partly altered porphyry traversed by veins of opal and chalcedony, and partly a development of hematite and quartz. The quartz is thickly studded with white iron pyrites.

(*c*) is not separated by any sharp line of demarcation from (*b*), but is porphyry gradually recovering its normal aspect.

The contact-stone (*b*) has a very favourable appearance, and the samples which I took, when assayed by Mr. W. F. Ward, the Government Analyst, returned 5 ozs. 11 dwts. 1 gr. silver per ton and a minute trace of gold. Mr. Robert Harvey, of Lovett, also submitted a sample to Mr. Ward, who reported 6 ozs. 18 dwts. 20 grs. silver and a trace of gold.

It is evident that some deposition of metal has taken place here, and it is quite possible that a portion of the contact might be found which would be rich enough to work. A little work here would not be out of place. It is as promising a spot as any which I have observed along the contact-line, and though the stone is not payable just where opened upon, richer patches may occur. At the same time, I must point out that we cannot reason from the surface indications that the stone is bound to improve in depth. It may or it may not. A feature of contact deposits is that they are extremely irregular and patchy, and anyone spending money on this outcrop must be prepared to take the chances.

Murphy's Outcrop.—This is about a mile north of Martin's. It consists of reddish porphyry, which denotes the line of contact, and is streaked with chalcedony or opal. At the time it was being worked it was reported to carry a little

gold, but this is not substantiated, and its general appearance is not so favourable as that of the other shows.

Mt. Mary Mine.—This is west of Lovett, and is now abandoned. We have here another unquestionable contact of alkali-porphyry with Permo-Carboniferous shale and mudstone grit. The usual reddish contact-rock has a brecciated and tuff-like appearance, but this may be due to crushing. When work was stopped the outlook was not promising, Mr. Harcourt Smith's sampling right across the formation yielding only traces of gold.

Livingstone Mine.—The shaft and tunnel at this mine are on the Livingstone Hill, two miles N.E. of Lovett, still in the porphyry belt, and about 600 feet above sea-level. Near a contact with Permo-Carboniferous strata the porphyry is laminated with parallel bands of quartz, in the aggregate 2 to 4 feet, and called the reef. A shaft was sunk 60 feet on the underlay. Some broken quartz on the surface towards the north-east indicates the continuation of the contact-line, and was thought to be derived from a reef forming the backbone of the hill ridge, but a tunnel has been driven into the hill upwards of 500 feet without intersecting any reef, though it is believed to have been extended far enough to do so if one existed.

The first assays which were made (in Victoria) of specimens from here returned 3 ozs. 23 grs. and 1 oz. 12 dwts. 6 grs. per ton. Then 48 lbs. of stone sent to Footscray gave 10 dwts. 13 grs. free gold per ton. The first trial of one ton returned 3 dwts. free gold and 2 dwts. from the pyrites. Later a parcel of six tons was sent, and yielded no free gold, but 3 or 4 dwts. per ton from the pyrites. A remaining ½ cwt. of the first ton was then assayed by Messrs. Parker at Footscray, but only yielded 13 grs. free gold to the ton. These poor results completely extinguished the hopes of the adventurers, who thereupon relinquished work.

There is here again sufficient evidence to connect the occurrence of the gold with the silicification of the rocks at the contact, but the results are not good enough to encourage much expenditure. The quartz does not belong to a true reef, and it is useless to look for such reefs in this zone of rock. The quartz is simply a contact development, sometimes perhaps in the form of segregation veins away from the contact. It may be expected to alternately swell and contract, and die away at intervals. It and the associated altered and brecciated line of country are the carriers of the free gold. There is evidence that the pyrites also contains gold, and as pyrites is disseminated throughout the eruptive

rocks of the district, the country-rock may contain small quantities of the precious metal. The gold in the alluvium is the result of long wearing-down of the hills which surround the present valleys. I fear that the concentrations of gold in the stone are not heavy, or there would be more gold in the creeks. Evidences point to the creeks yielding certain quantities and then becoming exhausted, from which I infer that the sources of supply are limited.

The conclusions I arrive at are:—

1. That the porphyries do not carry free gold indiscriminately throughout their mass. I have examined thousands of specimens, and have never seen a speck. Any gold which they may contain is probably confined to the pyrites.
2. That quartz reefs in the true sense of the words are not to be expected. The country is younger than our Silurian slates, which carry gold quartz reefs elsewhere in the Island, and the eruptive rock is not siliceous enough for its surplus silica to be available for anything beyond segregation veins.
3. That the concentration of gold is confined principally to the silicified and brecciated rock at the contact of the porphyry with the sedimentary strata. I do not deny the possibility of minute quantities being associated with pyrites in the mass of the porphyry, but I am of opinion that if at any time lode-mining be found payable, it will be in the neighbourhood of these contacts.
4. That the occurrence of the precious metal is highly irregular, and this patchiness discourages mining, which will only be remunerative when some rich contact patches are struck; and this will be a matter of prospecting. As nearly all the ground around Lovett is private property, systematic prospecting is not likely to be carried on.

On the whole, therefore, I do not see that there is any single point where much outlay could at present be advised; nevertheless, moderate prospecting along the different contact-lines might disclose some deposit above the average, and I look forward to this happening in the future sooner or later.

Geology.—The sedimentary rocks are, as has been mentioned, the lower marine mudstones, sandstones, and shales of the Permo-Carboniferous. These have been pierced and traversed by intrusive abyssal and dyke porphyries, varying lithologically, but forming related varieties of the division of

alkali-rocks. The belt of this porphyry country around Lovett is about three miles wide, and extends across the Huon south-west to Desolation and Surges Bays. I was told that stone from the quarry in Surges Bay has assayed up to 8 ozs. of silver per ton. In a N.E. direction this zone stretches to Little Oyster Cove, where the creeks bring down sand with flaky gold associated with garnets, zircons, and sphene, characteristic accessory minerals of the Port Cygnet porphyries. Whether any of the porphyries are, as I at first thought, contemporaneous lava flows, is open to question. Some of them are strongly fluidal in structure, but this circumstance is not decisive. A series of undoubted dykes are seen on the beach south of the Regatta Ground, where they are, as determined by Professor Rosenbusch, sölvsbergite and tinguaite porphyries. The first one, going south about half a mile from the Regatta Point, is a dyke of grey-bluish sölvsbergite at the water's edge, about 5 feet wide, and running N. and S. About 100 yards further S., is a dyke of sölvsbergite (or tinguaite porphyry), 2 feet wide, of a greenish hue from the aegirine present in it. Its bearing is N. 20° W. Still further south is a dyke of garnetiferous mica-sölvsbergite, containing a variety of garnet, to which Messrs. White and Macleod gave the name of Johnstonotite in 1899. This dyke is 2½ feet wide, bears N. 10° W., is vertical, and is flanked on the E. by mudstone conglomerate hardened by contact. Further south is another dyke, also on the beach.

At the Regatta Ground itself a promontory exists of alkali and elaeolite syenite, differentiating at its margin, and in other parts into nephelinite and other basic rock varieties. On Mt. Mary a wonderful variety of alkali-trachytic, tinguaitic, and allied rocks exist, some of which seem plainly intrusive. On the Lymington Back Road a large intrusive rock-mass occurs, granitic to the eye, but dacitic in structure, and containing large porphyritic crystals of rhomb felspars. Dykes are also numerous on Mt. Livingstone and on the eastern side of the Port. Many of the rock varieties are probably new, as they are not comparable with the familiar European types, and their determination will be a work of time. Analyses of them are highly desirable. That the porphyries are later than the Lower Permo-Carboniferous is beyond doubt. On the other hand, Mr. R. M. Johnston established the existence of an axis of diabase down the promontory from Mt. Wellington to Three-Hut Point, and, recently, Mr. F. J. Ernst, by a traverse of the country between Lovett and Oyster Cove, has shown

the Mesozoic diabase to be younger than the porphyry, the Lovett exposures of the latter being divided from those at Oyster Cove by the Mesozoic rock. We are now able to confine the porphyries to the interval between the Lower Permo-Carboniferous and the Upper Mesozoic.

Professor E. G. Hogg lately discovered stones on Mt. Mary derived from the Permo-Carboniferous conglomerate, and bearing scratches which he refers to ice-action during that period.

Mt. Cygnet Coal Mine.

The geological features of Mt. Cygnet are a repetition of those observed in so many of our coalfields. The summit of the mountain is diabase, and the flanks are sandstones, which, from the fossil plants preserved in the coal shales, *Gangamopteris* (a dwarf form), and *Vertebraria australis*, are referred by Mr. R. M. Johnston to an upper horizon in the Permo-Carboniferous, *i.e.*, somewhat younger than the Mersey coal seams. A section of the formations in the district would be in descending order:—

Mesozoic.

- Diabase, occupying the crest of the range, intrusive into coal-measure sandstones and porphyries.
- Alkali porphyries intrusive into Permo-Carboniferous mudstones, sandstones, and shales.

Permo-Carb.

- Sandstones, conglomerates, and shales, containing coal seams at Mt. Cygnet.
- Marine beds, with casts of *Spirifera* and *Fenestella*.
- Dark shaly mudstones.

The Mt. Cygnet Mine is situate 2½ miles E. of Gardener's Bay, and a wooden tram with horse-traction, 3½ miles long, furnishes the means of transport to the jetty. Work has been carried on intermittently for a good many years; at one time the production was 2500 tons a year. It eventually came into the hands of Mr. Robert Harvey, who has been working it of late years. When he took it over, in 1897, it had been closed down for 18 months, and it took a little time to bring up the output again. However, in 1898, 1899, and 1900, the annual output was raised to 1600 tons, and in 1901 to 3000 tons.

The samples which I took of the coal were assayed by Mr. W. F. Ward, the Government Analyst, with the following result:—

Fixed Carbon.	Ash.	Gases, &c.	Moisture.	Sulphur.	
69·5	16·4	12·7	1·4	Not determined.	No coke formed.

The coal has been used for steam purposes by several firms in Hobart, at R. Harvey's fruit factory at Lovett, and at the mine. The steamers object to the residue, and it seems that in all cases the best effect is got by burning a little wood with it. It is a dull, compact coal, and answers well for domestic use, burning slowly without much flame, and without any spluttering. It gives out great heat in the grate, and remains alight for a long time without requiring to be replenished, burning quietly away to a soft ash. During the strike at Mt. Nicholas Colliery this coal was very favourably received in Hobart, and gained a distinct footing in the market. A feature of the coal is that, if left without stirring, it will remain alight for an indefinite time; this I have had an opportunity of observing upon more than one occasion.

The seam dips into the mountain in a S.S.E. direction, at an inclination of 1 in 8 = 7°, averaging 3 feet in thickness, but varying from 18 inches in bumpy ground to 4 feet when settled. Some of it is 3 feet 6 inches and 3 feet 9 inches, but it does not appear to exceed 4 feet. I measured 3 feet 6 inches, with an inch of parting dividing the upper part from the bottom, at about 1 foot from the floor. Twenty-five feet below it is another seam, but only containing a foot of coal; it is said, however, to be superior for steam purposes; and 12 feet below is a small 2-inch seam.

The floor is clay resting on dark sandstone, and is fairly regular. The roof is grey hard quartzose sandstone, which in places shows broad glistening surfaces, with a singular sheen, due to the reflection of light from the facets of the closely-packed quartz grains. Sometimes a conglomerate takes the place of this sandstone. The roof rolls a good deal, descending into the seam here and there. The incline goes down to the first flat sheet 800 feet on the slope, 100 feet vertical, and a road east has been opened out at this point for 15 chains, when the seam was stopped by a fault. The coal has been taken out as far as possible, and the working places have fallen in. The dip was continued another 100 feet, and 180 feet driven east from the bottom flat-sheet. Six stalls were being worked when I was there last, and the end of the road was getting into settled ground with a 3 feet 6 inches seam of good quality coal, having left the rolling part of the roof behind. I anticipate everything will go on smoothly till the 15-chain fault is reached.

Two or three hundred feet above the mouth of the tunnel is a bed of fireclay, which has been bored into for 10 feet. This deserves examination.

The mine appears to be on the edge of the coal basin, for to the west the measures run out into bands of fossiliferous stone, continuous with the coal. For the future of the mine, it is desirable to prove the ground east of the fault, which it is quite possible may be insignificant. The mine is a valuable little property, the working facilities are good, and it is within a convenient distance from Hobart, where there is a market for the output. The infusion of a little more capital into the undertaking would permit of the more extended development which it deserves.

While I was at Port Cygnet I received from Mr. Joseph Harvey, Mr. Robert Harvey, Mr. Tolland, and Mr. Langdon, the colliery manager, much information and assistance, which I desire here to acknowledge.

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

W. H. TWELVETREES,
Government Geologist.

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

REPORT ON DEEP SINKING AT THE MOONLIGHT-CUM-WONDER GOLD MINE, BEACONSFIELD.

[One Plan.]

Government Geologist's Office,
Launceston, 30th June, 1902.

SIR,

I BEG to report that, according to your instructions, I visited the Moonlight-cum-Wonder Mine at Beaconsfield on the 14th December last, and again on the 14th inst., in order to examine the nature of the strata and their possible bearing on the discovery of payable gold-bearing quartz at the depth attained in that part of the Cabbage Tree Hill.

The hill owes its name to the grass plant which grows upon it freely, and which in the early times was dubbed locally with the name of cabbage tree. The name has been transferred to the predominating rock, which is a quartz conglomerate with often fairly large pebbles, sometimes, however, sinking to the nature of a grit or coarse sandstone, with or without scattered pebbles.

The hill lies at the back or to the west of the town of Beaconsfield, is about two miles long, and the summit (at the north end) is 230 feet above the township, or 330 feet above sea-level. It runs N.W.-S.E. The hard sandstones and conglomerates are the axial formations of the range; they form the crest, having resisted denudation more successfully than the softer slates on the west flank and the friable sandstones on the east slope. The range is not an anticlinal. There are a few minor undulations of the beds in the centre, but these are insignificant, and do not affect the general dip of the strata, which is to the N.E., on the east side as well as on the west. The form of the hill is thus unmistakably the effect of erosion.

No fresh light has been thrown upon the geological age of these strata since Mr. Montgomery's report in 1891, in which he surmised the probability of their belonging to the Cambrian period. The few fossils which have been found do not enable any definite opinion to be formed, but from

the casts of orthis found by Mr. Joseph Davies in the workings of the Tasmania Mine it would seem that the age is not greater than Ordovician (Lower Silurian).

In the Wonder part of the hill gold-mining has been carried on for the last 23 years. The Little Wonder and the Moonlight companies amalgamated at the beginning of 1900, and in their ground is that of the Olive Branch, which was started in 1884. All the original companies obtained gold from comparatively shallow depths. Generally good stone was found as deep as 250 feet; it then grew poorer down to 300 feet.

The present main shaft was sunk by the Little Wonder Company to 400 feet, and opened out at 125 feet and 400 feet. The new company has carried the sinking down to 800 feet, opening out at 600 feet and 800 feet. Opening sets have also been placed at 500 feet.

125-feet Level.

This is not accessible. A drive N.W. was put in for 28 feet and S.E. for 60 feet, and a crosscut S.W. for 52 feet. I am informed that the stone was not so good in the drives as it was when cut in the shaft, and the country was broken and mullocky. The gold-bearing stone sunk upon from the surface for 50 feet was 6 inches to 1 foot in width, and is stated to have been worth about 1 oz. per ton. About 30 tons was raised from this place in the Little Wonder days. Where the stone was widest it is said to have been poorest.

400-feet Level.

At this level 347 feet of driving has been done from the Wonder old shaft workings along an ill-defined and unsatisfactory reef, which, I am told, returned no stoping stone. In the bottom of the level, at 105 feet east from the shaft, a winze was sunk to an alleged depth of 110 feet, and is said to have been stopped by an influx of water. Gold-bearing stone is reported to have come in a few feet from the bottom. There is some trustworthy evidence as to some of it yielding prospects, but none as to its being payable. No stoping was ever done in the 400-feet level. Mr. J. T. Stubs recommended in 1900 that an effort be made to find out what really does exist at the bottom of the winze. The east drive at the 614-feet level has now proved a formation which is probably the same as the lode formation in the 400-feet level, but it has proved altogether unsatisfactory at this depth. If the owners care to explore further they

might open out a level at the 500 feet, where opening sets are in position. A crosscut would have to be driven for about 30 feet, and then an exploratory drive extended to the bottom of the winze; and, if the appearance of the stone warranted it, a level west could also be driven. I must say the prospect is not very bright, as the level above had poor stone, and the level below is poor. Still, if it is not done, as will appear from subsequent remarks, the shaft will have to be abandoned.

614-feet Level.

At this level a crosscut N. 30° E. has been driven for 86 feet, cutting through a lode formation just north of the shaft, in hard, compact sandstone, dark in colour. North of the lode the crosscut has been built across to keep back the carbonic acid which, derived from the decomposition of carbonates, exudes freely from the country-rock in this mine. The manager informed me that the crosscut continues to pass through dark conglomerate and sandstone for its entire length.

The lode formation was met in cutting the north chamber, and at 20 feet north of the shaft a level S.E. has been opened upon it and driven 115 feet. The country is for the most part blocky, with soft patches between blocks of conglomerate. The formation has no walls, and its strike is identical with that of the encasing sandstone. It carries a run of lumpy and bunchy quartz; at first a few inches of fractured stone associated with pyrites, dwindling in some places to a mere track, and again swelling into a bunch of quartz 6 to 18 inches wide. Where the stone widens out its appearance is mottled and favourable—as nice a looking quartz as could be wished. Fifty-five pounds weight of stone was sent to Messrs. A. Parker and Co., of the Victorian Smelting and Metallurgical Works, Footscray, for treatment. They report as follows:—"Having crushed and well mixed the parcel of quartz received, we made three determinations, as follow:—1. Contents of crushed stone, gold equal to 2 dwts. 6 grs. per ton; silver, a trace. 2. Percentage of pyrites (ordinary), 2·2 per cent., which on assay gave gold equal to 5 dwts. 1 gr. per ton; silver, trace. Memo.—The gold is evidently in free condition; the free gold was carefully removed from the pyrites; still, if they were at all gold-bearing, far more gold than assayed should remain." The dip of the lode in this level is first about 45° to 50° to the south, but after 20 feet of driving it becomes steeper, and finally changes over to the north, and maintains

the new underlay to the end of the level. At 68 feet in the level the lode, carrying 6 to 8 inches of stone, has been heaved 11 feet to the north. The level was continued right across the fault, proving clean country beyond, consisting of hard crystalline dark sandstone. A seam of pug 1 inch wide marked the heave, and a little quartz followed the fault on a smoothly-polished wall. The lode was recovered and driven upon for 47 feet further. It was of the same appearance and width as on the west side of the fault. About 10 feet east of the heave the lode attained its maximum width—5 feet—but was poor in gold contents. The country-rock then changed to a black fine-grained brittle sandstone, with seams of carbonaceous pug, and the lode splits up into small portions at about three or four fathoms behind the end.

The country in the end of the drive is hard black sandstone, sometimes lumpy and gritty. A sinuous seam or string of quartz lies on the south wall in the face, and no other track or sign of any lode is visible. Behind the end short crosscuts (cuddies) have been put in N. and S. In the north crosscut the rock is hard black sandstone, and a bunch of quartz is visible on the west side. In the south crosscut some seams of pyrites appear, which are perhaps a part of the lode formation, and would bear a little south of the present end of the level; but as the lode began to split two or three sets back from here, all the strings could not be followed. The principal one was kept in the back of the level. The lode channel in the level consists of soft mullocky ground, between hard country on each side.

Enough has been done in this level to prove the value of the lode, which is simply nil, and I can see no indications to encourage further driving.

A long crosscut has been driven from the shaft at the 614-feet level for a distance of 382 feet S. 30° W. For 30 feet the crosscut passes through massive beds of hard dark sandstone, dipping N.E. at high angles. It then intersects 20 feet of broken sandstone, a course of shattered rock. This is loose, and requires false sets for a short distance, and then gives place to stone not quite so loose. The country has evidently been strongly shaken, and the probability is that the shattering took place in Tertiary times in connection with the basaltic eruptions. At 50 feet from the shaft the crosscut passed through a lode formation 9 feet wide, dipping N.E. with the enclosing strata, and consisting of broken country carrying lumpy quartz and pyrites. This

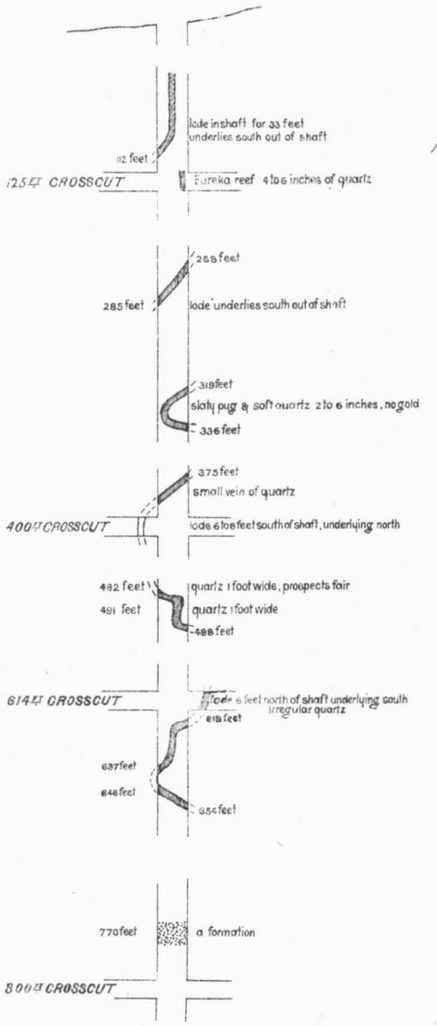
PLAN OF DEEP WORKINGS
MOONLIGHT & WONDER MINE

Scale of feet

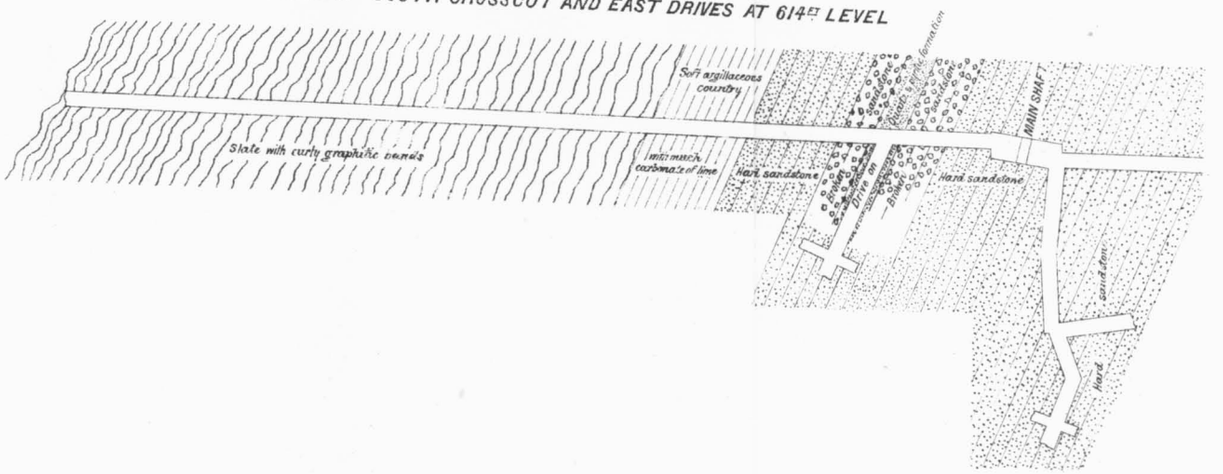
W. H. Twelvetrees
Government Geologist
30 June 1902

5 cm

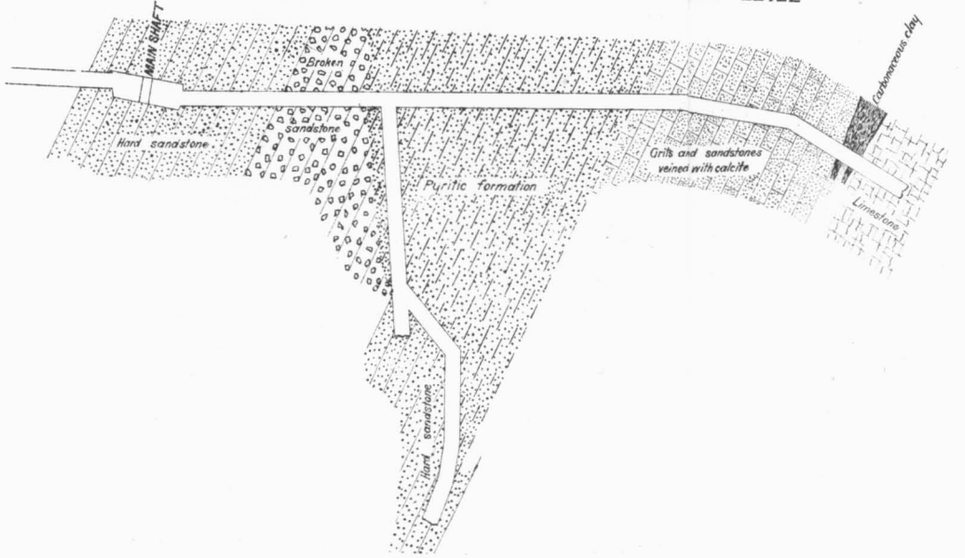
SECTION OF SHAFT



PLAN OF SOUTH CROSSCUT AND EAST DRIVES AT 614ft LEVEL



PLAN OF NORTH CROSSCUT AND EAST DRIVE AT 800ft LEVEL



was driven upon S.E. for 60 feet. The drive shows alternating hard and soft country, with strings and veins of quartz, yielding no gold in dish-prospects. Beyond a decrease in the quantity of pyrites there is no essential change throughout the 60 feet driven. The end of the drive is in clean country, and further driving is contra-indicated. Short crosscuts have been put in north and south behind the end, both in hard sandstone. In the south crosscut there is a little pyrites, but nothing to speak of.

South of this drive the zone of broken sandstone continues for 14 feet, then growing solid for 33 feet, when it is replaced by soft argillaceous country, with much lime carbonate, for 40 feet. From there to the end of the crosscut is dark slate, much of it shining, graphitic, and twisted, and with parallel seams and lenticles of quartz. The face is in grey smooth slate, bearing N. 40° W., and dipping N.E. at 81°.

This crosscut has been driven quite far enough to show the character of the ground in that direction. It shows also the strata which would come into the shaft if the latter were sunk deeper.

800-feet Level.

Now, as regards the downward extension of the shaft lode. At the 614-feet level it was cut 6 feet north of the shaft in excavating the chamber, and had an underlay to the south. It was cut again in the shaft 4 feet below the plat, and continued nearly vertical for 19 feet, and then underlay south out of the shaft. At 32 feet from plat it was again met, with a north underlay this time, and walls 3 feet apart, carrying 6 to 9 inches of quartz on the footwall. Mortar tests gave prospects of fine gold. At 40 feet below plat it underlay north out of the shaft, viz., at 654 feet from shaft collar, and this is the last that has been seen of the lode; but, within 30 or 40 feet of the bottom, a formation was met in the shaft, which was considered might be the one followed in the east drive from the crosscut at 614 feet. This supposition cannot be accepted, as the steep dip of that formation would take it 200 feet below the present bottom of the shaft, and even a variation of 5° in the dip would still bring it 75 feet below the shaft. A drive of about 50 feet south from the shaft ought to intersect it.

At 800 feet a long crosscut has been driven north for 312 feet. The country at the shaft is dark sandstone, dipping at a high angle to the north-east. At 48 feet north of the

shaft this is succeeded by a zone of broken rock similar to that met with in the south crosscut at the 614-feet level, though, from what I have just stated, it cannot be identical with it. Veins and bunches of quartz occur in the loose blocks of rock, but do not pass continuously from one boulder to another. The shattering action has apparently taken place subsequently to any flexure of the strata. This belt continues in the crosscut for 36 feet, when a formation of grit and pug, with blocks of sandstone, veined and spotted with quartz, and carrying iron pyrites and galena (both powdered and in slugs), is passed through for 107 feet. There is no wall of division between this formation and the country; the edge of the broken zone is a ragged one. It was struck in the crosscut at nearly a right angle to its course, but its northern wall crossed in a south-east direction. When the formation was first broken into it yielded small slugs of galena, with blende and pyrites, and I am told that for the first 8 or 10 feet dish-prospects always yielded powdered galena. The gritty, crumbly material seems to contain more pyrites than the pug does. Samples which I took were assayed by Mr. W. F. Ward, the Government Analyst, but returned neither gold nor silver. The company crushed 25 tons of this, and obtained 14½ cwts. concentrates and 1 oz. free gold. Much weight cannot be attached to the quantity of gold, as it is not absolutely certain whether all of it belonged to the stone crushed. The concentrates were sent to Dapto for treatment, and 10 dwts. 9 grs. gold was obtained from 13 cwts. 1 qr. 10 lbs. of stuff. Further analysis of these concentrates showed them to contain 0·8% copper, 2·5% zinc, 33·2% iron, 38% sulphur, 22% silica. An assay was further made of three bags of the formation material, returning a trace of gold and 2 dwts. 8 grs. silver per ton. These results are, of course, in the highest degree unfavourable. The last few yards of the formation in the crosscut show dark-brown clay intermixed with sandstone and conglomerate, and the northern wall is nothing more than an irregular vertical division between the clay (with blocks of sandstone and conglomerate) of the formation and the grey calcareous conglomerate and sandstone of the country. The formation is vertical, or the dip, if anything, is slightly to the north-east. A drive east has been put in upon this formation for 176 feet. It was first driven 74 feet in the channel; then the latter was lost for 19 feet, the drive going forward in hard and irregularly-jointed conglomerate faced with calcite. This was stopped, and the drive at the 74 feet point bent to the north into the

formation, and pursued somewhat in the form of a semi-circular curve. The reason for taking this somewhat peculiar direction was that the formation being apparently in the shape of a wedge, its north wall was met with in the drive, and then followed until it thinned out.

This formation is a belt of shattered country—not a true reef-channel. It has not extended far to the east; at the same time, similar conditions re-appear further east in the Moonlight and Tasmania workings, where belts of broken rock occur in otherwise sound country. It is referred to by Messrs. Montgomery and Ward in their paper on "A Carbonaceous Deposit in Silurian Strata at Beaconsfield," 1892, in which they say:—"Here and there in the mines we come upon examples of free passage of water through the broken rock. In one of the branches of the West Tasmania reef the workmen followed blocks and strings of quartz which were interspersed through a large quantity of broken country-rock, filling a somewhat wide lode-channel. In places great holes were found still existing between the fallen blocks, and in many of these loose gravel and sand derived from the disintegration of the softer conglomerates were lying, evidently carried there by subterranean waters flowing with some velocity. In the western end of the Tasmania Mine a somewhat similar state of things occurs. One of the underground captains, in describing the condition of the country, said that the rock appeared just as if it had been blown up by a heavy explosion of powder and allowed to settle down again."

In the Wonder Mine there does not appear to be any inducement to test this formation westwards, and it has no great continuous vertical extension, as it does not occur overhead in the upper crosscut. The crosscut N., at 614 feet, has been driven far enough to intersect it, and the shattered formation in the south crosscut at that level ought to be still south of the shaft at the 800 feet. A crosscut has been driven south of the shaft at the 800-feet level for 38 feet, through the same hard rock as was passed through in the upper crosscut, and the southern belt of shattered country, with its accompanying formation, is, if persistent (which is uncertain), still to the south. Unfortunately, the experience gained of the formation is not encouraging enough for further extension of the crosscut.

It is unsafe to rely upon any calculations as to the extension of these formations, for their existence is due to the dislocations to which the Cabbage Tree Hill has been subject in not very distant times, geologically speaking. The large

loose blocks of stone in the zone of shattering denote severe displacing action. In the Eureka claim on this lease recent timber was found in the drive, 370 feet below the surface, associated with boulders of conglomerate. Mr. Heerey informed me that a large log of this timber, 3 to 4 feet in diameter, had to be cut with an axe; this semi-lignitic deposit extended for 40 feet. He also states that in Sam. Statton's find, at a depth of 132 feet, several years ago, the miners, while at work, heard a noise as if the shaft were coming together, and found that two fissures, 6 to 8 inches wide and 3 feet apart, had opened in the conglomerate. In Messrs. Montgomery and Ward's paper, referred to above, a deposit of brown coal is described as occurring in the Tasmania and Moonlight workings, at a depth of 422 feet in the latter mine, introduced from surface into the broken rock formation.

The crosscut north, after intersecting the pug formation, entered grits veined with calcite, and its present end is in grey limestone. The strata are jointed and interrupted by headings, making the ground bad for shooting. Where the beds are at all regular the dip is northerly, probably N.E. Behind the end the crosscut passed through a peculiar brown earthy carbonaceous deposit approaching in character to semi-lignite or brown coal. It is 9 feet wide on the west side of the drive, but is represented on the east side by only a couple of narrow seams a few inches thick. Despite the compact bedded appearance of the deposit, I am of opinion that it is the result of percolation from the surface subsequent to the laying down of the Silurian strata. It may be compared with the occurrences mentioned by Messrs. Ward and Montgomery. A sample has been analysed by Mr. W. F. Ward, with the following result:—

	Per cent.
Fixed carbon	13·9
Gases, &c., lost at red heat... ...	27·0
Mineral matter (ash)	21·0
Moisture lost at 212° F.	38·1
	100·0

The crosscut has been useful in that it has proved the country to the north, the only direction in which there was any hope of cutting a reef within a reasonable distance. It has now overlapped W. Statton's line of lode, which is a discontinuous formation. Statton drove a tunnel 250 feet long from the north-east side of the hill, intersecting a small

run of gold-bearing stone at about 150 feet from the surface, which has a direction crossing the present north crosscut. The stone was split into several leaders, and I am told that the formation contained a good deal of yellow sand. Statton's drive on this was discontinued within about 50 or 60 feet east of the Wonder crosscut, but the run of stone has not passed through the latter, although the crosscut has been extended beyond the line where it might be expected to intersect it. As no other reef is known to exist ahead, driving has very properly been suspended, and I do not see any reason for resuming it.

There remains the question whether the drive E. at the 800 feet should be continued or not. Some information has now been gained as to the nature of the formation upon which this has been driven. All its features are unfavourable. It is one of those exceptional occurrences which may easily mislead investors. I look upon the pyrites, blende, and galena as deposits of a later age than the (auriferous?) quartz veins which run through the substance of the shattered rock. The gold, which is present in small quantity, is probably a precipitate from re-dissolved gold at a much later date than that of the quartz reefs of the Cabbage Tree Hill. The most likely explanation is that mineralised waters, filtering downwards through the upper strata, deposited their metallic contents between the boulders of the shattered rock zone. The local shattering of the rock is thus largely responsible for the deposit, and when the workings emerge from these irregular patches of loose country the mineral instantly disappears. As there is no dependence to be placed on the continuance of any of these zones, it would appear extremely speculative to continue the drive for the purpose of following the mineralised formation.

I understand, however, that there has been an additional object in driving the level, viz., to bring the workings below the veins prospected on the Olive Branch section.

To do this a straight drive would have to be put in from the north crosscut, not following the meanderings of any formation, but taking a direct course to the objective point. Goninon's shaft on the Olive Branch is 578 feet from the north crosscut. This means a total length of 660 feet from the main shaft. There appear to me to be some strong reasons why the Olive Branch section should not be attacked from the Wonder workings. First, the air in the latter mine is peculiarly liable to contamination by carbonic acid gas, which, in spite of the blower, frequently interrupts work underground, and, long before the drive E. was

connected with the surface, serious trouble with the air would arise; secondly, to effect a connection with the surface for purposes of ventilation would be tedious and expensive; thirdly, to work the Olive Branch leaders from the present shaft would be more costly than following them down to comparatively shallow depths; fourthly, the depth at which the Wonder drive would come below the shallow workings, say 700 feet, is too great to warrant the entire resources of the company being used up for this special drive. The ground within 200 or 300 feet from the surface might be favourable, but it would be extremely hazardous to rely upon a continuance of payable shoots through unproved ground to so great a depth.

The Olive Branch system of veins seems to be a series of short runs of stone parallel to one another, but not continuous. Several pits and shafts have been sunk upon them, and some of the veins have returned small quantities of rich gold-bearing stone. Goninon's shaft was sunk to test some of these veins, and the present company has tributors at work in this ground.

I went into the Olive Branch tunnel to ascertain what promise the country gives at the nearest accessible point to this zone underground. It has been driven south-west right into the middle of the Cabbage Tree Hill, through sandstone strata dipping to the N.E. From near the end a long drive has been extended for 476 feet along what is supposed to be the Tasmania crosscourse, but no gold was obtained. At 92 feet in, a drive was turned off to the west and driven 224 feet. The ground enclosed in the angle formed by the two drives was evidently of value, as there is a great excavation here, 50 feet high, from which crushing-stone has been taken. A rise has been put up to within 90 feet of surface, and connects for ventilation with the bottom of what is known as the 90-feet shaft. The country is conglomerate, with numerous seams of quartz, up to 6 inches wide, intersecting in all directions, but with a general underlay to the west. The drive west appears to have been put in on the strength of a 3 to 4 inch vein of quartz, sometimes lying flat, sometimes vertical. The conglomerate country is very hard, and shows white quartz in patches. A narrow vein on the west side is said to have given very rich gold, but as a rule the veins are unproductive. They are much deflected by headings, and the quartz is of a vitreous aspect. In the end a head underlying east cuts off a set of small veins. A parallel 46-feet drive from a crosscut behind the main end shows tough pug and quartz on the west wall. The

end is in conglomerate, dipping N.E. Thin veins of quartz run between the bedding-planes, and are crossed at right angles by other veins.

I was informed that there is a drive N.W. over 100 feet from the bottom of the 90-feet shaft, and that very rich stone had been found in it, but that the vein was small and erratic.

As good gold was got in the old tribute leaders west of Goninon's shaft, and at 60 feet right back near the long S.W. tunnel, the shoot possibly comes down east. The main winze in the long tunnel has been deepened to 100 feet, but the 35-feet level was the deepest point to which I could get. The drive east was filled in; in the drive west a bunch of quartz has been risen upon, but no crushings taken out. The country is hard, and does not carry quite so much quartz as in the level above.

A winze was put down in the north drive this year to 36 feet on leaders 3 to 4 inches wide. These veins were sometimes 8 feet long, but not at all continuous; they only yielded small prospects. Thirty feet east has been driven from the winze this year, but only small veins met with.

We are here about 150 feet from the surface, or at the bottom of the main winze—250 feet—and, judging from the appearance of the country and the irregularity of the veins, any opinion as to whether the Olive Branch leaders now being prospected at surface will make into anything more defined is purely speculative. The indications, however, do not appear to me to justify either a long drive from the Moonlight-cum-Wonder crosscut or much further exploration from the Olive Branch underground workings, though the latter is the more feasible of the two.

Whether these veins of quartz unite within a reasonable depth to form a good-sized reef is problematical. If the quartz be, as is assumed, the expelled residuum from the crystallisation of deep-seated granite, it will most likely be found in better-defined courses at a greater depth; but no rule for predicting the deposition of gold can be stated where the conditions of its precipitation are unknown. In the Tasmania Mine the reef-development has persisted upwards. The difference in behaviour of the Moonlight-Wonder system of veins from that of the Tasmania reef supports the theory that the two systems are distinct. Notwithstanding the popular local theory of the Tasmania reef splitting and giving off legs, one of which is the Moonlight-Wonder lode, Mr. Montgomery's opinion that the reef has been heaved southwards at the western crosscourse has

never been disproved by actual trial. It is difficult to imagine the mere displacement of the reef by a fault as sufficient to bring about such a radical difference in its nature as is seen in these two lode-systems.

The ground to the west of the Wonder main shaft has been tested pretty well from Statton's, Eureka, and Pyrites shafts, and does not invite the expenditure of more capital upon it.

A prospecting shaft has been sunk at the base of the hill below the battery, with a view of finding a lode which is said to have yielded some gold in old days. This shaft is down 34 feet, and a drive is being opened out at 30 feet. The work is not of great importance as affecting the company's future.

Looking at the property as a whole, it has been prospected with remarkable perseverance, but with the result that the work has failed to disclose a reef of any value. The only part which might be further explored from the shaft is at the 500 feet, but the work done at the 400-feet and 614-feet levels makes the discovery of permanently-valuable ground at an intermediate horizon doubtful.

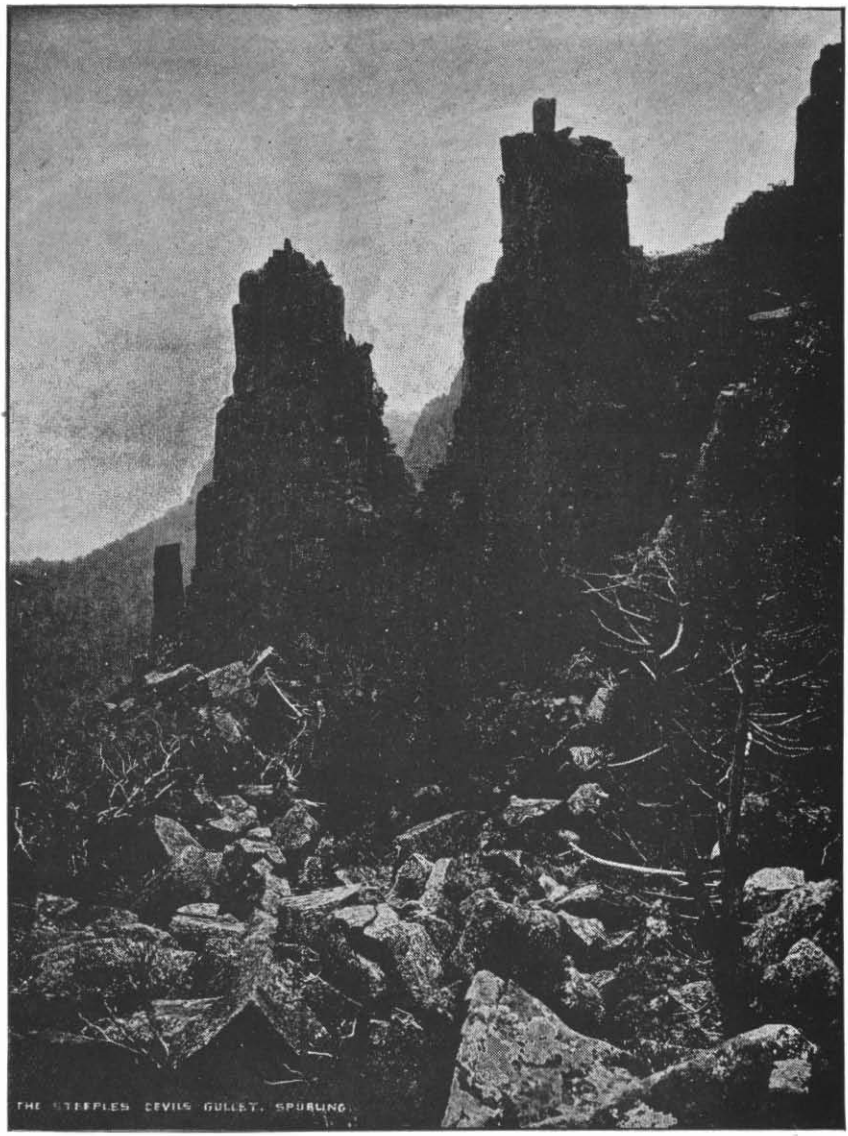
Apart from this the right thing is being done in prospecting the Olive Branch leaders from the surface, with a view of following them down when payable stone is discovered.

I have to acknowledge my indebtedness to Mr. T. H. Walduck, M.H.A., and to Mr. Luke Heerey, the mining manager, for much information during my visit.

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

W. H. TWELVETREES.
Government Geologist.

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



STEEPLES, DEVIL'S GULLET.

REPORT ON SOME DISCOVERIES OF COPPER ORE IN THE VICINITY OF POINT HIBBS.

Zeehan, 30th June, 1902.

SIR,

ACTING on your instructions, I left Zeehan on the 20th of May to examine and report upon the discoveries of copper ore in the vicinity of Point Hibbs, in the County of Macquarie, and have now the honour to forward you the following report. I was accompanied by several gentlemen who are interested in the district, and to whom I am indebted for much local information.

The sections which have been taken up are situated on the sea coast, about nine miles north of Point Hibbs and 17 miles south of Cape Sorell. Nineteen sections have already been surveyed in the district, representing a total area of 1150 acres.

Access to the sections is gained at present by means of a foot-track from Pebbly Beach, a small cove on the southern shore of Macquarie Harbour. This track is about ten miles in length, and is good for foot-traffic, but, owing to the presence of one steep gorge, it would be impossible to bring a horse along it in its present state. Another route, however, has already been marked out. This passes northward from the copper discoveries along the Ocean Beach for about three miles, and then strikes across in a north-easterly direction to Liberty Point, which is some five miles north-west of Pebbly Beach. This route is a little longer than the track from Pebbly Beach, but, owing to the absence of any serious gorge, it is more suitable for the formation of a road.

In fine weather a fishing-boat can be landed at several places along the beach on the surveyed ground, and by this means the stores for the mines can be cheaply brought on to the spot. The only objection to this means of transport is that often considerable periods of rough weather are experienced, which might be the cause of great inconvenience were there a large amount of work being carried on in the district. While, however, the district is passing through the preliminary prospecting stages, this means of access is practically all that could be desired. I understand that about

two miles south of the discoveries of copper ore there is a boat harbour, at which a boat may be safely landed, except in very stormy weather.

The country-rock of the district consists of ancient sandstones, quartzites, slates, claystones, and dolomites, which have often been distorted and crushed to a remarkable degree. Considerable bands of tightly-cemented "crush breccia" may often be seen along the sea-coast, and minor faults and distortions are very common. The strike and dip of the strata are very irregular, but I think that where the rocks are least disturbed it will be found that the strike is about north and south and the dip to the west at high angles. Many contradictory observations, however, were recorded, so that it is impossible to speak definitely on this point. Along the beach where the strata are exposed I did not find any of the old eruptive rocks which are usually associated with our metalliferous deposits, but a short distance inland, on the banks of Birthday Creek, I found a very decomposed rock, which may turn out to be a quartz porphyry or felsite. The rock was too much decayed to determine with certainty. To the north-east of the surveyed ground, on a section which has been lately pegged by Mr. H. Cook, there is, however, undoubtedly an igneous rock—a biotite syenite rich in black mica, and containing small quantities of pyrite. This rock appears to occur as a dyke about two chains in width. It is exposed in the bottom of a small creek. This discovery is a very interesting one, for rocks of a similar nature are found in the vicinity of deposits of pyritic ores in several parts of the West Coast. Thus at Mt. Lyell a syenite porphyry is known in the vicinity of Lynchford, and I have been told that this rock has been found even closer to the deposits of copper ores at the head of the Linda Valley. At Mt. Read and Mt. Black a soda syenite porphyry (keratophyre) occurs in abundance. This new discovery therefore makes it highly probable that the deposits of copper ores throughout the West Coast are connected with eruptive rocks of intermediate basicity.

All the sedimentary rocks of the district are traversed by innumerable quartz veins and stringers. Some of these are the so-called "buck quartz" veins which are so common throughout the West Coast, but others, and especially those in the vicinity of the copper discoveries, are of a more complex nature. These latter are composed of fibrous quartz and dolomite, with a little chlorite, and in places a good deal of specularite (crystalline hematite), together with copper and iron pyrites. The structure of these veins differs from

the common type of fissure vein in that there is no symmetrically banded or combed structure. The fibres of quartz, dolomite, and often specularite, extend from wall to wall without any intermediate space or parting. In my recent report on the ore deposits of North Dundas I have called attention to a very similar class of vein which accompanies the sulphide deposits of Mt. Read and Mt. Black, and which I have also found in connection with the North Lyell deposits. I believe that these veins, though worthless in themselves, may serve as valuable indicators of the presence of larger bodies of sulphide ores.

The Birthday Copper Syndicate.

This company holds Sections 5054, 5053, 5139, 4983, 5138, 5034, 5013, 5021, 5014, and 4982—all 93M—with a total area of 510 acres. With the exception of Nos. 5013 and 5014, all of these sections are situated along the ocean beach, which is held by the syndicate for a distance of nearly two miles.

The work done up to the present has been confined to the sinking of prospect-holes along the beach, where in a great many places the rocks are stained with a thin coating of copper carbonate. In many cases the latter has been leached out of the small quartz veins which traverse the strata, and which contain copper pyrites in small quantities; in other cases the claystones are themselves impregnated with the latter mineral.

What is known as the main rock is situated in the northern portion of Section 5034. It is a mass of hard, slightly calcareous claystone, standing out into the sea, and surrounded, except at very low tide, by water. On the southern end of this rock two prospect-holes or cuttings have been made, while on the eastern side the surface of the rock has been shot away in several places. This work has shown that the claystone is traversed by small quartz veins carrying iron and copper pyrites, while the whole rock is rather sparingly impregnated with the latter mineral. The dark blue cooellite (CuS) is also present in small quantities. There is undoubtedly some nice copper ore showing in these workings, but I regret to say that its amount is very small in comparison with the amount of barren or nearly barren rock through which it is distributed. It is a most difficult matter to obtain really reliable bulk samples from a formation of this nature. Indeed, nothing short of shooting out many tons of stone, and having this crushed and quartered down,

would give accurate results. I could not do this, so contented myself by chipping the stone at short intervals over the face of the exposures. This is not an accurate method, and I do not think that, in a patchy formation of this kind, it can be relied upon to give results nearer than 50 per cent. of the actual value.

The results, as furnished by Mr. W. F. Ward, Government Analyst, of three samples taken from these workings are as follows:—

No. 1 copper, 1·2%
No. 2 „ 0·9%
No. 3 „ 1·0%
} No appreciable gold or silver was detected in any case.

Sample No. 1 is a bulk from a cutting 10 feet long on the south-west edge of the main rock.

Sample No. 2 is a bulk from a cutting 13 feet long on the south-east end of the main rock.

Sample No. 3 is a representative sample of some of the stone lying at grass.

From the above it is evident that, even allowing a much larger margin of error than 50 per cent., the stone is far from being payable in bulk.

About 250 feet west of the main rock there is a cleft in the low cliffs forming the margin of the beach in the end of which a shot or two has been made. The stone is copper-bearing, and about half a ton is at grass. I am informed that it assays 2 per cent. of copper.

Seven and a half chains north-east of the main rock is what is known as No. 2 workings. These consist of two prospect-holes about 4 or 5 feet in depth. The largest of these has been sunk on a similar claystone formation to that exposed on the main rock. The hole is 4 feet 8 inches in width, and throughout this distance copper pyrites is distributed through the stone. I took two samples from here, No. 1 representing a bulk of the whole of the stone exposed, No. 2 representing a bulk from about 2 feet of somewhat better class stone in the centre of the cutting. These samples yielded the following results:—

Sample No. 1 copper, 0·9%
Sample No. 2 „ 1·2%
} No appreciable gold or silver detected.

Besides these exposures there are a number of quartz veins in the vicinity carrying a little copper and iron pyrites, and occasionally nice bunches of ore may be seen. I do not consider that any of these are of economic importance.

About 30 chains north-east of these workings, near the south-east corner of the 10-acre Section, No. 5139, is what is

known as the glance lode. This at first gave promise of being a valuable discovery. Unfortunately, it has turned out to be only a rich patch of very limited extent. There is here a bed of dolomite, altered in places to a compact hornstone containing blebs of red oxide of copper, carbonate of copper, and copper sulphide (chalcocite). In one place there is a larger mass or bunch of rich gossan containing a good deal of chalcocite, and some of the latter is almost pure. Two tons of this ore have been sent away, yielding something like 40 per cent. of copper. These two tons have, however, nearly exhausted the ore in sight. There is still a little ore in the bottom of the trench, but it has been sunk through, and appears to be lying on a hard quartzite impregnated with pyrites. It is probable that this bunch is due to a surface concentration at the contact of the dolomite. The strike of the formation is about 30° W. of N., which would bring it just about in line with the southern workings already described. The country is, however, so broken that it is impossible to trace any continuity between the two.

On the most southern of these sections held by this company, No. 4982, there is a considerable area of copper-bearing rock, on which no work has as yet been done. It is traversed by numerous quartz veins, and the claystones are much stained with copper carbonate. I could, however, find no indications of an ore deposit which gave promise of affording any quantities of payable ore.

As regards these discoveries of copper ore on the beach, I fear that they are only valuable as showing the presence of copper ores in the district. The indications, in my opinion, are not sufficiently favourable to warrant the large expenditure which would be necessary to test their value in depth. It is true that, as far as work has gone up to the present, the copper contents show a decided improvement in depth, but this fact loses much of its significance when it is understood that the maximum depth attained is not more than 7 feet. As a matter of fact this increase in the first few feet is just what we should expect under the circumstances. The copper contents of the rock become leached out close to the surface, and to some extent become concentrated a few feet below. There is no reason to believe that they will continue to increase below the permanent water-level. On the other hand, I think that it would be worth while spending a little more money in conducting prospecting operations on the rising ground inland, especially on Sections 5013 and 4985. In the south-western portion of the latter section there is

a large bog-iron formation on the south bank of the Birthday Creek. A good trench put across this would quickly show whether it is the capping of a lode, as is very possible. For the rest, the ground should be gone over carefully, and any gossan formations which are met with should be similarly dealt with.

The Strahan Copper Company, No Liability.

This company holds Sections 5022, 5023, 5024, and 5025—all 93M—total area 320 acres. The sections are situated east and adjoining those held by the Birthday Syndicate. The only work done on the sections is situated in the north-western portion of Section 5024. There is a curious decomposed lode formation here, some 20 feet in width, consisting of graphite slate, with some pyrites and bunches of gossan. The graphite slate is cleaved by numerous slickensides, and there are evidences of considerable movement. Samples of the gossan have been assayed, and have yielded 2 per cent. of copper, a trace of gold, and 7 ozs. of silver. This formation has been cut by a tunnel at a depth of about 35 feet. Here the whole formation is still very much broken up and decomposed, and, with the exception of some small seams of copper pyrites, nothing of value was found. By driving north on this formation from the tunnel a considerable amount of backs would be gained, and it is not unlikely that a shoot of ore may be met with. I think, however, that the formation should first be prospected more thoroughly by surface trenching along the course of the lode. If it contains shoots of ore it should be possible to locate some of their outcrops at the surface with a comparatively small outlay, while if nothing of a promising nature is found by surface trenching it is useless to go underground. Quite apart from this lode formation, however, I believe that the sections are well worth prospecting. Much of the country is very highly mineralised, and very little surface work of any kind has as yet been done to test it.

Conclusions.

Notwithstanding the fact that the prospecting operations which have been conducted up to the present have not succeeded in discovering any deposits of economic value, I believe that the district is one which is well worth the attention of prospectors. The indications are of a favourable nature, being in several respects almost identical with those at Mt. Lyell and other districts on the West Coast, where large

pyritic ore-bodies are known to exist. It is true that the stratified rocks are of a different character, but we have no reason to believe that they are less favourable to the processes of ore deposition. There is practically only one belt of country which has been carefully examined in the district, namely, the portion of the beach where the naked rock is exposed to view between high and low water-mark. But since the beach runs approximately parallel to the strike of the country, it follows that in reality only a very narrow section is exposed. Moreover, the rocks which are exposed on the beach are those which have been longest able to withstand the disintegrating influences of the tremendous seas of the West Coast. All the softer rocks have been worn away, and are hidden under a covering of sand or shingle, so that even in this narrow section it is only the hardest rocks which have been examined. It is therefore very evident that the district has not yet had anything like a fair trial. The country to the north of the surveyed ground specially suggests itself as likely to be productive, for here we already know of the existence of those old igneous rocks with which our ore deposits on the West Coast are so frequently associated, while the presence of copper ores, and of the characteristic quartz-veins which I have described, afford evidence that the same processes of ore deposition have been in operation which have produced valuable deposits of ore in other parts of the Coast. I can recommend this district to the earnest attention of prospectors.

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

GEORGE A. WALLER,
Assistant Government Geologist.

W. H. WALLACE, ESQ.,
Secretary for Mines, Hobart.

NOTES ON UNRECORDED AND OTHER MINERALS OCCURRING IN TASMANIA.

By W. F. Petterd.

The following notes, in conjunction with a paper upon the subject published in the proceedings of the Royal Society of Tasmania, 1897, embrace the work done to elucidate the mineralogy of the State since the publication of the "Minerals of Tasmania, 1896."

They comprise many interesting substances of more recent discovery, including one, or perhaps two, which are quite new to mineralogical science. It will be found that 40 species hitherto unknown as occurring in this Island have been added to the already voluminous catalogue, and additional localities and associations are recorded for several previously known. An important feature is the record of several complete analyses of complex substances, for which I am indebted to Mr. S. Pascoe, of the Magnet Silver Mining Company, and Mr. O. E. White, of Hobart, to whom I return my sincere thanks for their ready and valuable assistance. Such work is invariably a welcome addition to mineralogical investigation, and I am sure it will be duly appreciated by those interested in this field of enquiry. In many cases it is only by such means, coupled with crystallographic characters, that the specific identity can be attained with reasonable certainty. It is almost needless to say that in this department much yet remains to be done before we can possess a comprehensive knowledge of the minerals known to occur in this State.

1 Analcite.—(*Hydrous silicate of sodium and aluminium.*)

Somewhat abundant in the haüyne phonolite of Port Cygnet.

2 Anorthoclase.—(*Triclinic soda-potash-felspar.*)

In rhombic sections of a shining milky-white. Sölvsbergites of Port Cygnet.

3 ARSENOPYRITE.—(*Sulph-arsenide of iron.*)

In peculiar minute crystal trillings implanted in cavities in hard gossan. Magnet Mine.

As minute needles abundantly scattered throughout siderite gangue. Block 291, Ringville.

Analysis of this Mineral.

Fe	=	32·95,
As	=	43·20,
S	=	21·48,
		97·63,

with about 2 per cent. of antimony.

4 AUGITE.—(*Variety of pyroxene.*)

The embedded crystals of the nephelinite of the Shannon Tier are of a shining black colour, and often of remarkably large dimensions, sometimes one inch and a half in length.

5 BERESOWITE.—(*Chromate and carbonate of lead.*)

Occurs as small, in many cases almost microscopic, lamellæ implanted in gossan. The colour varies from pale yellow to orange-red. It is sometimes changed to crocoisite. Magnet Mine.

6 BERYL.—(*Metasilicate of beryllium and aluminium.*)

At the Shepherd and Murphy Mine, Bell Mount, specimens have occurred several inches in length, wholly changed to gilbertite, fluor, and chlorite. At the same locality small slender crystals have been met with of a pale green colour, intermixed with quartz, topaz, molybdenite, and cassiterite. The crystals are commonly embedded in a thin film of pyrite.

7 BOURNONITE.—(*Sulphantimonite of lead and copper.*)

In bright well-developed orthorhombic crystals, which gave the following result upon analysis:—

S	=	13·62	per cent.
Sb	=	28·68	,,
Pb	=	42·39	,,
Cu	=	11·93	,,
Fe	=	1·97	,,
		98·40	

8 BRUCITE.—(*Magnesium hydrate.*)
Radiating, massive, and white, near the workings, Mt. Bischoff.

9 CALCITE.—(*Carbonate of calcium.*)
Some remarkably fine crystals have been obtained at the Mt. Lyell limestone flux quarry at Queenstown. (H. W. Judd.)

10 CAMPYLITE.—(*Lead arsenate.*)
In very characteristic barrel-shaped crystals aggregated together. The colour is very pale, almost white. Britannia Mine, Zeehan.

11 CARMINITE.—(*Arsenate of lead and iron.*)
In minute orthorhombic groups of crystals coating fractures and vughs in gossan. It is of a reddish colour, and adamantine lustre. The Magnet Silver Mine.

12 CASSITERITE.—(*Dioxide of tin.*)
Pseudomorphous after orthoclase. Mt. Rex Mine, Ben Lomond.

13 CERUSSITE.—(*Carbonate of lead.*)
Analysis of the characteristic form of a yellowish-green colour from the Adelaide Proprietary Mine, Dundas, by Mr. J. C. H. Mingaye, F.C.S., of Sydney, N.S.W.:—

PbO	= 83·07 per cent.
CO_2	= 15·97 ,,
Cr_2O_2	minute trace.
Gangue	·62 per cent.
	99·66

14 CHALCOPHANITE.—(*Hydrated manganese and zinc protoxide.*)
As an amorphous black metallic brilliant substance, somewhat rare. Dundas.

15 CHALCOCITE.—(*Copper sulphide.*)
Occurs massive in several of the Mt. Lyell mines and at the King Jukes Mine, Mt. Jukes. Small crystals have been obtained disseminated in schist, with bornite, at the North Lyell Mine.

In slugs up to many pounds in weight, associated with native copper, at the King Lyell Mine. (H. W. Judd.)

16 CLINOCHLORE.—(*Basic magnesium and aluminium silicate.*)

In large masses and occasionally crystalline bunches of a pale metallic green colour. Near Mt. Heemskirk.

Abundant in fine groups of hexagonal crystals of a dark olive-green to black colour. The plates are often over one inch in diameter. Near the Hampshire Hills Silver Mine, Hampshire Hills.

At Anderson's Creek in minute, almost microscopic, radiating bunches of a dark colour. (W. H. Twelvetrees.)

17 CHLORITE.—(*Basic silicate of magnesium and aluminium.*)

In schist, and as beautiful bright green fan-shaped crystals in honey-combed quartz—Crown Lyell Mine—species undetermined. (H. W. Judd.)

Occurs pseudomorphous after felspar—Block 4891-93M, Ben Lomond. (Waller, "Report on the Ben Lomond District," 1901.)

18 COPIAPITE.—(*Hydrous basic ferric sulphate.*)

Results from the decomposition of pyrites, Colebrook Mine, Ringville, Khaki Mine, Whyte River, and at Barn Bluff. The rock from the last-named locality, when freshly broken out, soon becomes coated with this and other sulphates.

19 CROCOISITE.—(*Chromate of lead.*)

Rare as small crystals in gossan at the Silver Queen Mine and at the Colonel North Mine, Zeehan. (H. W. Judd.)

A full detailed description of the typical and well-known Dundas occurrence of this beautiful mineral, by C. Palache, may be found in the "American Journal of Science" for 1896, page 389.

20 DEWEYLITE.—(*Hydrous basic magnesium silicate.*)
In thin seams, sometimes reaching a foot in width, traversing serpentine. Harman's Rivulet, near the Parson's Hood Mountain.

21 DOLOMITE.—(*Carbonate of calcium and magnesium.*)
Analysis of the pure white form from the Magnet Mine. (F. O. Hill.)

Ca O	31·72	per cent.	= Ca Co_3	56·64	per cent.
Mg O	15·60	„	= Mg Co_3	32·76	„
Fe	3·92	„	= Fe Co_3	8·26	„
Mn	1·80	„	= Mn Co_3	3·76	„
				101·42	

22 DUNDASITE.—(*Hydrous carbonate of lead and aluminium.*)
"Minerals of Tasmania," 1896, page 33.
Dana, "First Appendix to the Sixth Edition of the System of Mineralogy," page 23.
The following is a complete analysis of this new species:—

Pb =	38·84	per cent =	Pb O	41·86
			$Al_2 O_3$	26·06
Fe =	3·85	„ =	$Fe_2 O_3$	5·50
			H_2O + Co_2	28·08
				101·50

Mr. Pascoe states that the Fe_3 and O_3, or a portion thereof, may be foreign to the substance, as it is next to impossible to perfectly separate it, since it almost invariably occurs as an incrustation on the mineral from the original locality at Dundas. A trace of P_3O_3 was also found; this was certainly obtained from an extremely thin coating or skin of pyromorphite, which is often present, and gives an external green colouration to the surface of the mineral. At the Hercules Mine, Mt. Read, a mass of snow-white cellular quartz has been obtained, throughout which are scattered crystals of cerussite, gibbsite, and numerous patches of dundasite, the whole forming one of the most attractive associations of minerals as yet obtained in this State.

23 DUFREYNOYSITE.—(*Sulpharsenite of lead.*)
Analysis:—

Pb	=	32·88	
Cu	=	9·08	
As	=	21·60	
Sb	=	8·53	
Fe	=	6·42	
S	=	21·79	
Ag	=	0·22	= 73 ozs. 3 dwts. 11 grs. per ton.
		100·52	

Occurs in thick orthorhombic crystals, which are deeply grooved longitudinally, colour lead-grey, highly polished, and implanted on and in the cavities of crystalline siderite. Many of the beautifully developed crystals exceeded 1″ in length and $\frac{3}{8}$″ in width. Locality, Block 291, North-East Dundas.

24 ELÆOLITE.—(*Orthosilicate of sodium, potassium, and aluminium.*)

Occurs as a constituent in the elæolite syenite of Port Cygnet.

25 EPIDOTE.—(*Basic silicate of calcium, aluminium, and iron.*)

Occurs very well crystallised and of good colour on the Melba Flat, North Dundas. (H. W. Judd.)

26 EVANSITE.—(*Basic phosphate of aluminium.*)

Analysis of this mineral from Zeehan, by Mr. H. G. Smith. (Proceedings Royal Soc., N.S.W., 1895.)

P_2O_5	=	18·11
Al_2O_3	=	40·19
H_2O	=	41·27
		99·57

27 GILBERTITE.—(*Variety of potassium mica.*)

Of a yellow to green colour and glimmering lustre with tin ore in granite. Mt. Rex Mine, Ben Lomond, Anchor, Liberator, and other mines, Lottah.

28 GIBBSITE.—(*Hydrate of aluminium.*)

Apparently abundant in botryoidal masses, associated with native copper and earthy lode-material. It varies in colour from clear pellucid glassy to pale green, and more rarely to golden yellow with a bronze lustre. It decomposes to a white powder. Rio Tinto Mine, Savage River.

29 GMELINITE.—(*Hydrous sodium, calcium, and aluminium silicate.*)

A fine lot of perfect crystals of this zeolite have been obtained loose and coating a vugh in Tertiary basalt at Bell Mount. Middlesex.

30 HAUYNITE.—(*Sodium, calcium, and aluminium orthosilicate with sodium sulphate.*)

In micro-crystals sparingly in the fayalite-melilite basalt from One Tree Point, near Hobart.

31 HEMATITE.—(*Sesquioxide of iron.*)

At Zeehan this occurs pseudomorphous after cubical pyrites. (R. F. Waller.)

32 HISTRIXITE.—(*Sulphide of antimony and bismuth.*)

An apparently new substance occurring in radiating groups of prismatic crystals, which are occasionally in confused bunches, and commonly stained externally with a dark brown coating. The crystals are orthorhombic, with acute but indistinct terminations, and striated longitudinally. They sometimes reach over 2 in. in length by $\frac{3}{8}$ in. in width. Slightly sectile, with a hardness of about 2. Lustre eminently metallic, shining on fresh crystalline surfaces. Colour and streak, steel-grey. When massive, it presents a foliated structure, and tarnishes to blue and purple iridescent colouration. The crystals occurred interpenetrating a vugh from a bedding of a mixture of iron and copper pyrites. It was found in a somewhat massive body of tetrahedrite, with which were associated bismuthinite and pyrites, and appeared to be of very exceptional occurrence.

Result of two analyses of the pure material:—

S	= 24·05	S	= 23·01
Bi	= 55·93	Bi	= 56·08
Sb	= 10·08	Sb	= 9·33
Cu	= 6·86	Cu	= 6·12
Fe	= 5·18	Fe	= 5·44
	102·10		99·98

Answering to the formula—

$$7\,Bi_2\,S_3 + 2\,Sb_2\,S_3 + 5\,Cu\,Fe\,S_2$$

(Locality, No. 1 Curtin-Davis Mine, Ringville.)

33 HUASCOLITE.—(*Sulphide of lead and zinc.*)

A massive, fine-grained, dark-coloured and somewhat dull substance—Comstock Mine. Zeehan.

34 HYDROMAGNESITE.—(*Basic carbonate of magnesium.*)

Occurs in solid, almost white, radiating bunches—Comstock Mine. Zeehan.

35 HYPERSTHENE.—(*Magnesium and iron metasilicate.*)

In basalt, Circular Head; in granite, St. Mary's Pass.

36 JAMIESONITE.—(*Sulphantimonite of lead.*)

Analysis of a sample from the Magnet Mine:—

Ag	= 0·12 per cent. = 39 ozs. 4 dwts. 10 grs. per ton.
Pb	= 40·82
As	= 2·44
Sb	= 21·48
Fe	= 4·91
S	= 17·51
Insol	= 11·51
	98·85

Analysis of a sample from the Silver Spray Mine, Zeehan, by W. F. Ward, Government Analyst:—

Pb	= 40
Sb	= 29
S	= 18
	87

Analysis of a columnar and striated sample from Mt. Bischoff:—

Ag	= 0·12
Pb	= 32·08
As	= trace
Sb	= 26·74
Fe	= 5·56
S	= 17·82
$Si O_2$	= 14·28
Al	= trace
	96·60

37 JOHNSTONOTITE.—(*A new manganese garnet. Pro. Roy. Soc., Tas., 1898-99.*)

Occurs abundantly distributed in the mica-sölvsbergite of Port Cygnet. The cavities containing the garnet are often lined with a thin coating of purple fluor and arsenical pyrites.

38 KNOXVILLITE.—(*Hydrous basic sulphate of chromium, iron, and aluminium.*)

Occurs as a granular sugar-like substance of a pale green colour. From adit at the Victoria Gold Mine, Salisbury.

Analysis:—

$S O_3$	= 30·32	per cent.
$Cr_2 O_3$	= 8·47	,,
$Al_2 O_3$	= 2·48	,,
$Fe_2 O_3$	= 15·86	,,
Loss on ignition	40·56	,,
	97·59	

The identification is somewhat doubtful. Associated with this sulphate is another of a fibrous habit. It has been found in large compact felted masses, which are extremely tough under the hammer, and comparatively heavy from contained hygroscopic water. The fibres are minute, short, and silky-white; the surface often nodular and rough from protruding fine spiculæ.

An analysis of this substance gave the following result:—

SO_3	= 27·20
Fe_2O_3	= 14· 0
Cr_2O_3	= 10·64
Loss on ignition over	39·19
Gangue	10·77
	101·80

Before the blow-pipe the substance swells and forms a brown-coloured mass, which is easily powdered. With soda, after trituration, it leaves a loose powdery residuum, which is readily attracted by the magnet. The fused mass with borax bead gives reactions of iron and chrome oxides. It is readily soluble in water, and if kept in dry situation it gives up much of its hygroscopic moisture. If a new mineral species, which is highly probable, I propose it should be called "Sclerospathite."

39 LEUCHTENBERGITE.—(*A variety of chlorite poor in iron.*)
In the variolite rock at the Magnet Mine.

40 LILLIANITE.—(*Sulphobismutite of lead.*)
Found disseminated in association with bismuth, sulphide, and other minerals in a quartz matrix at the Osborn Blocks. Mt. Farrell.

41 MAGNETITE.—(*Sesquioxide and protoxide of iron.*)
In bunches of well-formed crystals—Tenth Legion Mine, Zeehan. (H. Waller.)

42 MARGARITE.—(*Basic aluminium and calcium silicate.*)
In irregular radiating bunches in schist. Locality, west slope of Hamilton Hill, near the Hercules Mine.

43 MELILITE.—(*Complex silicate.*)
As microscopic rock-forming crystals in the melilite basalt of the Shannon Tier and One Tree Point, near Hobart.

44 MICROCLINE.—(*Triclinic potash soda felspar.*)
Occurs abundantly in the hypersthene granite of St. Mary's Pass.

45 MILLERITE.—(*Sulphide of nickel.*)
In the characteristic capillary patches in quartz, with pentlandite—near the Colebrook Mine. Ringville.

46 MONAZITE.—(*Phosphate of cerium metals.*)
This mineral has been obtained in a fine granular form in alluvial at the following localities, in addition to those quoted in the "Minerals of Tasmania":—Stanley River, South Esk Tin Mine (Ben Lomond), Briseis Tin Mine (Derby), the Pioneer Tin Mine (Mt. Stronach), and at the Khaki Mine at the foot of the Meredith Range).

47 NATROLITE.—(*Hydrous sodium and aluminium silicate.*)
Somewhat abundant in massive pure white masses and pockets, which often exhibit distinct rhombic crystals agglutinated together. Nephelinite, Shannon Tier.

48 NEPHELITE.—(*Orthosilicate of sodium, potassium, and aluminium.*)
In microscopic crystals, as an essential constituent in the nephelinite of the Shannon River.

49 NONTRONITE.—(*Hydrated iron silicate.*)
A green variety of chloropal. Occurs of a pale yellow-green colour. Middlesex.

50 OSMIRIDIUM.—(*Iridium and osmium in varying proportions.*)
A fine nugget of this substance was recently obtained in the Whyte River, near its junction with the Pieman. The specific gravity was 19·5, and weight 60 grains.

51 PECTOLITE.—(*Metasilicate of sodium and calcite.*)
Occurs in fibrous radiating bunches of a pure white silky subvitreous lustre—Upper Emu River. W. R. Bell.

52 PENNINITE.—(*Basic silicate of magnesium, aluminium, and iron.*)
In dark, almost olive-green, masses and crystals, the latter sometimes over $\frac{3}{4}''$ across. It is invariably associated with quartz—Tharsis Copper Mine. Mt. Lyell.

53 PEROFSKITE.—(*Titanite of calcium.*)
Microscopical crystals in the melilite-basalt of the Shannon Tier.

54 PETTERDITE.—(*A new oxychloride of lead. Pro. Royal Soc., Tas., 1901.*)
Occurs implanted and in bunches of pseudo-hexagonal crystals—Britannia Mine. Zeehan.

55 PHARMACOSIDERITE.—(*Hydrous basic iron arsenate.*)
Found as coatings of microscopic cubic crystals of an intensely green colour and bright lustre—Magnet Mine. (R. F. Waller.)

56 PHOSGENITE.—(*Chlorocarbonate of lead.*)
Some fine adamantine crystals of this somewhat rare mineral have been obtained at the Comet Mine, Dundas, with anglesite and cerussite.

57 PICOTITE.—(*Aluminate of magnesium and chrome.*)
Chrome spinel is stated to occur in the vicinity of Zeehan. (Krausé, "Mineralogy," p. 245.) Abundant in the alluvial of the Heazlewood River.

58 PROSOPITE.—(*Hydrous fluoride of aluminium and calcium.*)
Occurs as a granular powder, and often kaolinised. It is associated with decomposed green tourmaline (zeuxite), which is so characteristic of Mt. Bischoff Tin Mine.

59 RHODONITE.—(*Metasilicate of manganese.*)
Massive, in a somewhat impure form as a boulder in a large asbestos seam in serpentine on the ground leased to the Australasian Asbestos Company at Anderson's Creek, west of Beaconsfield. Called "red quartz" by the miners. (W. H. Twelvetrees.)

60 SAPONITE.—(*Hydrous magnesium and aluminium silicate.*)
Occurs in patches of a yellow to brown colour and glimmering lustre, with chrome ochre and quartz on the hanging-wall of a reef at the Duchess of York Mine, Salisbury.
White and amorphous at Trial Harbour. West Coast.

61 Scapolite.—(*Hydrous silicate of aluminium and calcium.*)

This mineral was found as loosened rounded boulders in a seam of asbestos occurring in the serpentine at Anderson's Creek, near Beaconsfield. It was mistaken by the miners for quartz, which it somewhat resembles. It has, however, a slightly greenish tinge, and its hardness is only between 5 and 6. It is soluble with difficulty in HCl.

Microscopical characters.—Confusedly crystalline, with the larger crystal faces obscurely divergent. The crystals often form rosettes. Double refraction, strong; interference colours higher than quartz; extinction straight in longitudinal sections; no sensible absorption.

Scapolite is mostly found in schists and gneiss. It also occurs in amphibolites and ophites. When it is found in gabbro, it has been derived from felspar, and this may have been the case here, though there is some reason to believe that the serpentine was originally pyroxenite. Scapolite is undeniably a secondary mineral, and was here formed during the hydro-metamorphic process of serpentinisation. (W. H. Twelvetrees.)

62 Scheelite.—(*Tungstate of calcium.*)

Analysis of a sample of this mineral from Mt. Ramsay:—

WO_2	= 79·77
MO_3	= trace
Ca O	= 19 65
	99·42

(Dana, "System of Mineralogy," page 987.)

63 Schrötterite.—(*Hydrous aluminium silicate.*)

A soft brittle white to honey-yellow coloured gum-like substance, occurring as an incrustation and in patches in a fissure in Silurian slate. It decomposes to a white powder. Occasionally it is stalactitic or mamillated, and easily falls to pieces. Obtained near the Pieman River.

64 SIEGENITE.—(*Sulphide of cobalt and nickel.*)
Occurs massive, of a steel-grey colour, intermixed with magnetite, pyrite, and niccolite. Rocky River Mine.

65 SODALITE.—(*Chloro-silicate of sodium and aluminium.*)
In the elæolite syenite of Port Cygnet, changed to natrolite.

66 SPODUMENE.—(*Aluminium and lithium metasilicate.*)
Variety, *triphane.*
Several thin flakes of this substance have been obtained in alluvial tin workings near Mt. Cameron, with quartz, topaz, and sapphire. It is of the very characteristic yellow-green colour, and quite indistinguishable from the clear samples found in Brazil. It might easily be mistaken for a variety of corundum—Oriental topaz—or even quartz; in fact, it is highly probable that it is more abundant than supposed, but has been overlooked from its resemblance to the minerals mentioned. Some minute bright green specks in granite from Ringarooma are probably the same mineral.

67 STILBITE.—(*Hydrous sodium, calcium, and aluminium silicate.*)
In large radiating masses of a yellow-brown colour imbedded in basalt vitrophyre. Bell Mount, Middlesex.

68 STRIGOVITE.—(*A basic silicate of iron and aluminium.*)
A chlorite-like mineral consisting of a black shining aggregate of minute plates, in the fractures decomposed to brown. Occurs as a narrow band a few inches wide in granite—near the Great Republic Tin Mine. Ben Lomond.

69 STROMEYERITE.—(*Sulphide of copper and silver.*)
Analysis of an amorphous slug from the Mt. Lyell Mine:—

Ag	= 13·80	= 4507 ozs. 19 dwts. 23 grs. per ton
Pb	= 1·60	
Cu	= 32·46	
As	= 3·17	
Sb	= trace	
Fe	= 19·26	
S	= 38·27	
	98·66	

70 SULPHUR.—(*Native.*)
Found in minute blebs on crystallised and other galenite. Magnet Mine.

71 SYMPLESITE.—(*Hydrous iron arsenate.*)
Occurs thickly coating gossan in small radiating blue-green tufts, of great attractiveness under the lens. Magnet Mine.

72 TENNANTITE.—(*Sulpharsenite of copper.*)
Analysis of a sample from No. 4 adit, Mt. Lyell Mine:—

Ag	= 0·54
Cu	= 16·17
As	= 13·82
Sb	= 17·10
Fe	= 16·39
S	= 30·77
	94·79

73 TEPHROITE.—(*Orthosilicate of manganese.*)
Occurs in crystallised masses of a dark reddish-brown colour and greasy lustre. Blyth River.

74 TETRAHEDRITE.—(*Sulphantimonite of copper.*)
Variety, *Freibergite.*
Analysis of a pure sample from the Hercules Mine, Mt. Read:—

Ag = 9·82	per cent.	= 3201·32 ozs. per ton.
Au = ·0019	,,	= 13 dwts ,,
Cu = 29·76		
As = 2·69		
Fe = 4·56		
S = 27·21		
94·7319		

Balance, insoluble matter.
Occurs in well developed crystals at the 650-ft. level, Western Mine, Zeehan.

75 THOMSONITE.—(*Hydrous sodium-calcium-aluminium silicate.*)
In bunches of white capillary fibres coating vughs in the nephelinite of the Shannon Tier.

76 VARISCITE.—(*Hydrous phosphate of aluminium.*)

As incrustations, often with a uniform surface. General character somewhat dull, but of a bright emerald-green colour, and thus sometimes mistaken for an ore of copper.

Associated with wavellite. Back Creek.

Implanted in the cleavages of quartz. Lefroy.

77 VOLTZITE.—(*Oxysulphide of zinc.*)

Formed as an incrustation of a thin lamellar structure and globular; colour, clove-brown. Very Rare. Silver Crown Mine, Zeehan.

78 WAVELLITE.—(*Hydrous basic phosphate of aluminium.*)

Occurs in small white discs, with the characteristic radiating structure implanted in the cleavages of sandstone. Ballast Quarry, Zeehan—Comstock Line.

79 WOLFRAM.—(*Tungstate of iron and manganese.*)

An unusual occurrence of this mineral is in small patches, associated with stannite and pyrite, at the Oonah Mine. Zeehan.

Occurs in the form of small brown crystals in quartz. Mt. Bischoff Mine.

80 ZEUXITE.—(*A ferriferous tourmaline.*)

A peculiar variety of tourmaline of a dark green colour, of remarkable habit. It is confined to and characteristic of the tin-deposits of Mt. Bischoff, where it occurs in great abundance, often forming rock masses of considerable size. Its common habit is in short acicular crystals, which are interlaced together into irregular bunches. Both colour and habit are very constant.

JOHN VAIL,
GOVERNMENT PRINTER, TASMANIA.