TASMANIA

REPORT

OF THE

SECRETARY FOR MINES

FOR

1900-1901

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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1901.

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REPORT OF THE SECRETARY FOR MINES.

Mines Department, Hobart,
13th September, 1901.

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, 1901.

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.
- Description of the Zeehan-Montana Concentrating plant by John Craze, Esq., General Manager.
- Petrographical Report by W. H. Twelvetrees, Esq., Government Geologist.

General Remarks.

There has not been such a marked progress in the Mining Industry during the year as in the preceding year.

The number of Sections applied for was only 521, embracing an area of 19,402 acres, as against 920 Sections, embracing an area of 39,706 acres, last year.

Mining enterprise in the State has suffered from the disturbance of financial equilibrium thoroughout the world, caused by the prolongation of the War in South Africa, and, to a less extent, from financial anxieties nearer home. No doubt, federation and the uncertainty as to the tariff, and the introduction of a new Mining Act, which is not yet properly understood, may also have something to do with the present depression, but as this state of things draws to a close indications of improvement may be anticipated. The metal markets are, most of them, not unfavourable. The price of tin is strong, and likely to remain so, the highest price reached being £146, and the lowest, £112; the average for the year was £127 5*s.* 9*d.* The world's consumption of copper is on the increase, the present over-production of lead will in due time act as an encouragement of consumption, which will bring about a recovery of prices, and it is not probable that the new Amercian lead trust will interfere with the Tasmanian product, and we shall therefore have the advantage of a rising market for lead-ores.

The new Mining Act and Regulations which came into force on the 1st January and 15th June respectively, have many advantages over the old Act and Regulations. Much correspondence has appeared in the papers recently with regard to the regulations, but I think the writers have not studied them or made themselves sufficiently acquainted with them to be in a position to critise them. If given a fair trial, I think time will prove that they are workable; if not, they can be amended as occasion requires.

In order to encourage the prospector to search for minerals in new localities, I would suggest that a monetary reward of, say £3000 or £5000, should be offered by the Government to the discoverer of a payable field of any mineral, such reward not to be paid to the discoverer until the field is on a sound basis, and shall have supported a stated population for, say 3 or 5 years. The distance of the field from any similar discovery should be taken into consideration. I feel sure that if the prospector had something of the kind to look forward to, it would be a great inducement for him to go out into new localities in search of minerals. The area of land granted to the discoverer of minerals a certain distance from any similar mineral is frequently of little benefit to the prospector who has not the capital to open up and develop the mine, and who has very often to be content with a small interest in a company formed for the purpose of raising capital to work it.

My attention has been drawn to the lack of safe storage places or magazines at Gormanston and Queenstown. I am aware that this is a matter which does not directly concern this Department. Suitable provision should be made for the safe storage of all explosive compounds, as, for the want of such provision, all parties now retailing these commodities in the places indicated, are placed at considerable risk and disadvantage.

The appended reports of the various Commissioners of Mines contain detailed information of the progress made in the districts under their charge, and it has only been necessary for me to give a brief outline of the work done during the year.

Gold.

Beaconsfield.—The total quantity of gold won during the year, is 79,543 ozs., a decrease of 4241 ozs., on the previous year.

The Tasmanian Gold Mining and Quartz Crushing Company's Mine still maintains its position as the premier gold mine of the State, and has, during the year, won 33,079 ounces of Gold, valued at £126,632.

The new main shaft is down to a depth of 1093 feet from the surface. In view of the large reserves of ore now being developed by the new main shaft, the company has decided to erect 40 additional stamps at the battery. The crushing capacity of the new plant will be about equal to that of the present mill.

The negotiations for the sale of this mine to an English Syndicate, which were being entered into about this time last year, have fallen through.

The amount paid to the shareholders in dividends during the year, was £24,000. The total amount of dividends since the formation of the company is £745,071 15*s.*, and the total quantity of gold won is 520,613 ounces 19 dwts. 17 grs., valued at £1,907,278 14*s.* 4*d.*

MONTEZUMA FALLS.

The Moonlight-cum-Wonder Mine is being assisted by the Department to the extent of £2000, under "The Deep Sinking Encouragement Act," in the proportion of 15*s*. for every £1 expended by the Company in driving and cross-cutting, and 30*s*. for every £1 expended in sinking the shaft below 620 feet. The shaft is now down to a depth of about 782 feet. At 646 feet the reef was again cut, showing fine gold, but at 654 feet, the underlay again took the gold out of the shaft.

The other mines working on this field are the East Tasmania, Tasmania West Extended, North Tasmania, Tasmania United.

Lefroy.—The New Pinafore Gold Mine which has been assisted by the Department to the amount of £2000 upon the £ for £ principle, is still persevering by driving at the 1200 feet level in the hope of cutting the reef. It would give a great fillip to mining in this district if the efforts of the company were rewarded by striking gold at that depth.

The Volunteer Gold Mine has been shut down. Several prospecting companies have been working on a small scale, with varying success.

Lisle.—This field still continues to give employment to about 40 miners, who are working the alluvial deposits for gold. The Lisle Dredging Company has nearly completed its Dredging Plant, and will shortly commence operations. Should the plant be able to work the low-lying and humid flats, there is every reason for believing that the result will prove highly satisfactory, as the ground has been well prospected and very promising results obtained.

Mathinna.—There has been a considerable revival in mining in this district during the past year. The principal mine, the New Golden Gate Mine, having crushed 19,675 tons of quartz from which 14,658 ozs. of retorted gold have been obtained at the battery, valued at £53,401 5*s*. 4*d*. One hundred and ninety-four tons of pyrites were also obtained by concentrating tables containing 1041 ozs. of gold valued at £3611 16*s*. 5*d*., and 37,374 tons of tailings, together with 1542 tons of slimes, have been treated by cyanide of potassium, which produced 2691 ozs. of gold valued at £9817 6*s*. 10*d*., making a total revenue of £66,830 8*s*. 7*d*.; total from all sources, 18,390 ozs. The total quantity of quartz now obtained from the mine is 182,856 tons, which has yielded 174,097 ozs. of gold, an average of 19 dwts. 1 gr. per ton, and which has realised £643,654 9*d*. The total amount paid in dividends is £300,000, or £9 7*s*. 6*d*. per share, and the total amount paid in dividend tax is £13,878 10*s*. Preparations are now being made to sink the main shaft another 200 feet.

The Volunteer Company has brought its plant from Lefroy, and is now working its property in this district. During the half-year ending 30th June, 52 tons of stone were crushed, from which 30 ozs. of gold were obtained. The blanket sand, which gives an assay value of 6 ozs. 5 dwts. of gold per ton, has been left for future treatment.

The other mines which have been working are the New Golden King, the City of Hobart, and Hickson's, most of which have been contributing to the gold yield of the district.

Mangana and Fingal.—The Mangana Gold Reefs shaft has been sunk a further depth of 200 feet during the year, and the company is now cross-cutting at the 600 feet level. Some very rich stone has been obtained from the Golden Entrance and Fingal Reefs Mine.

Mount Victoria.—The Ringarooma Gold Mining Company has ceased to carry on mining operations since the battery and mining and electric plant was burnt down last year. Prospecting work is being carried on, on a few small claims.

Warrentinna.—On Bailey's Leases a drive has been put in about 300 feet, and a reef exhibited, of payable size. A ten-head battery is being erected, and crushing will be commenced in a few months.

N.E. DUNDAS RAILWAY AND RING VALLEY MINE.

West Coast.—The King Golden Gate (late Harris Reward) mine has done a little work during the year, but operations are now suspended, pending the construction of the road from the King River Bridge. It is impossible to convey heavy machinery over the present track, and until the road is constructed these mines are likely to remain idle.

King River Prospecting Association.—Some twelve months ago, operations were resumed by tributers, who, in addition to driving some 700 feet, have brought in a water race, 1½ miles, for the purpose of sluicing away the loose clays on the hillside and exposing the pockets or bunches of stones which will afterwards be put through the battery. So far the work has, I believe, been unremunerative.

The Queen River Dredging Company has completed its dredge, and gold-dredging operations in the Queen River have been commenced. The Whyte River Dredging Company has also started gold dredging operations on the Whyte River. Full particulars of these dredges will be found in another part of the Report under the heading of "Dredging."

Silver.

West Coast.—There has been a decrease of 4842½ tons of silver-lead ore raised in Tasmania as compared with the previous year. This is owing principally to the low price of silver and lead, and to some of the companies having worked out easily-obtained ore.

It was rumoured that the Western Silver Mine, which is the deepest mine in the field, and has produced over 37,000 tons of ore, would probalbly have to close down, but it has since been reported that a new and important development at the No. 8 level has been disclosed. In the drive going N. from the E. cross-cut the main lode has been exposed for a width of 4 feet, composed mainly of carbonate of iron, which, upon assay, gave a return of 370 ozs. of silver per ton. Should the report prove true, and there is any quantity of such ore, there will not be any likelihood of the mine closing down at present.

The Silver Queen Mine has been let on tribute, about 70 men being employed. Some of the tributors are doing very well.

The Oonah and Silver Queen Extended Mines have also been let on tribute.

The Zeehan Montana Mine has produced 3847 tons of ore. The total output of ore from this mine up to the end of the year, was 19,812 tons.

The Mount Zeehan (Tas.) Mine has employed an average number of 130 men. The output from the mine being 4042 tons.

The Silver King, one of the oldest mines on the field, and which was closed down for some years, has again started underground work at the main shaft.

The South King tributors have erected concentrators for treating their second class ore.

The intention of the Government to connect the Comstock field with Zeehan by tramway, has resulted in renewed attention being paid to that district, and a number of small parties are prospecting in the locality.

A lengthy report by Commissioner Hall, on the work done during the year in the Zeehan, Dundas, and Mount Reid districts is appended.

North Western District.—The Magnet Silver Mining Company near Waratah is rapidly pushing on with the construction of the tramway to connect with the Emu Bay Railway. Very little work is now being done on the mine, pending the completion of the tramway which is expected to be open for traffic very shortly.

At Mount Farrell, work on a small scale has been carried on steadily. The North Farrell, which is the principle mine, has ceased producing, pending the construction of the tramway to connect with the Emu Bay Railway Line.

Payable ore has been raised at the Devon Mine and consigned to the Dapto Smelting Works. This mine is almost inaccessible, and, consequently, the cost of transport of the ore is very heavy.

COPPER.

Mount Lyell.—The Mount Lyell Mining and Railway Company has maintained its prominence, and still presents open and proved reserves that promise a continuance of supply for many years to come. Having purchased the South and Royal Tharsis properties, these mines are now worked under its supervision. During the year, 9243 tons of blister copper, containing 9132 tons of copper; 619,734 ozs. of silver; and 22,911 ozs. of gold, were obtained. The amount paid in dividends was £110,000, and a bonus of £13,750.

The North Lyell Mine has continued to work satisfactorily, 9243 tons of ore have been sent away to Kelly's Basin for shipment, and 30,083 to the Mount Lyell Smelters, for reduction. All work is proceeding satisfactorily, and the ore bodies continue to improve. The company is proceeding with the erection of a smelting plant at Crottyton, where a branch line connects the site selected with their permanent way.

Mount Lyell Blocks. The company has completed the erection of the winding, electric, and compressing plant purchased from the Volunteer Gold Mining Company, at Lefroy. The main shaft has been sunk to a depth of 430 feet, and a considerable quantity of ore has been stoped from a body that continued to produce about 70 tons of ore per day.

Lyell Tharsis Mine. About 60 tons of ore are produced daily by open cutting and stoping. Recently, fair ore was met with at the 100-feet level, where exploratory work continued.

Mount Lyell Comstock. Operations have continued with satisfactory results, the most recent being the opening of another pyritic body near one of the main adits.

Tasman and Crown Lyell Extended. Two adits cross the country, which, being easy, good progress is made. What may prove the cap of a galena lode has been met with in the top adit, and as the second adit will give an additional 300 feet of backs, its value may ultimately be of great importance.

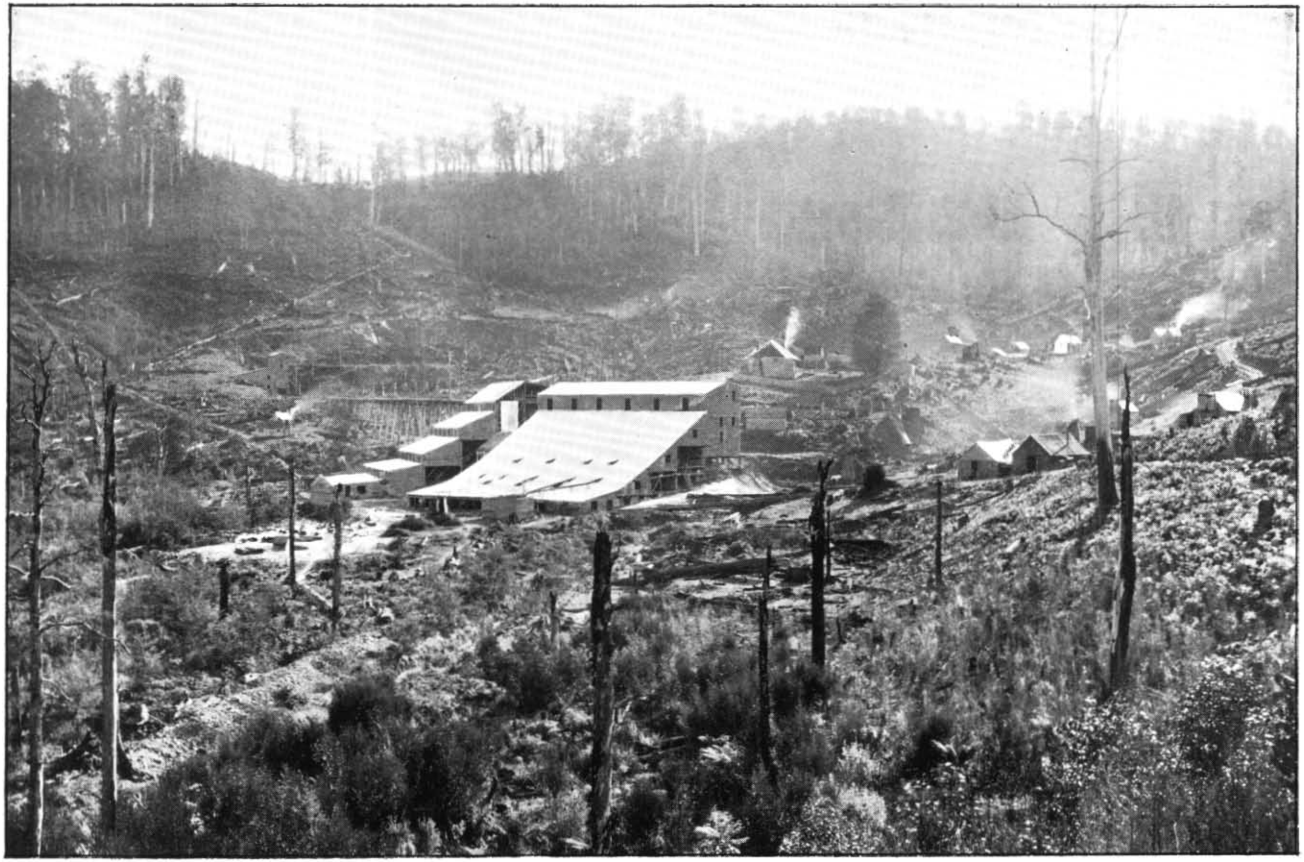
South Mount Lyell. This mine has been sunk to a depth of 718 feet. Towards the end of last year the buildings were destroyed by fire. The company has been assisted in its operations by the Department, under the Deep Sinking Encouragement Act, to the amount of £727.

In the Tasman Lyell, Peaks, Consolidated, Anaconda, and other mines, serviceable work has been done, but they are all in the prospecting stage. This, with the exception of the Mount Jukes Proprietary, applies to the mines in the Jukes and Darwin fields.

The systematic prospecting of the Birthday Copper Syndicate property, situated on the Coast, about 20 miles south of Macquarie Heads, has revealed what appear to be extensive copper lodes. Arrangements have made with some influential copper investors to thoroughly develop the property, which comprises 510 acres. A main shaft, with three compartments, is to be sunk on one of the leases, a careful geological survey of which has been made by Mr. W. H. Cundy, of Victoria, who will probably direct or supervise operations in the initial stage. The syndicate has conducted prospecting under many adverse conditions, owing, principally, to the great difficulty experienced in getting mining tools and supplies to the property. After the expenditure of considerable energy and money, a fairly good route to the field has been marked off, the starting point being near Liberty Point, about eight miles from Strahan. It is not unlikely that an attempt will be made to land mining requisites by sea, the surf-boat method being adopted. Whether the attempt will be successful, remains to be proved. The coast-line is very rocky, and on rare occasions only is the sea moderately calm. Should the property turn out to be as good as present indications warrant one in believing it to be, no doubt a tramway or railway will be constructed along the route recently marked off.

North-Eastern District.—The Eastern Proprietary Mine has been shut down for the present, owing to want of capital for sinking a main shaft and purchasing a pumping plant.

Barn Bluff.—The discovery of large deposits of copper-bearing pyrites has recently brought this field under prominent



ANCHOR MINE, LOTTAH.

notice, and Mr. G. A. Waller, the Assistant Government Geologist has reported on the Barn Bluff and other mines in the vicinity. His report is appended.

Tin.

The quantity of Tin ore produced is 337 tons less than last year. This is owing to the exceedingly dry winter, which has retarded mining operations in the Eastern and North Eastern Mining Divisions, and restricted the output of ore, many mines being unable to work full time, owing to the scarcity of water.

Waratah.—The Mount Bischoff Tin Mine produced 1646 tons of ore, yielding 1163 tons of metal, and paid away £97,500 in dividends.

Blue Tier.—The Liberator and Australian mines are all working on good payable stone, but have been greatly handicapped for the want of water. The Anchor Company is pushing on with the construction of its water-race. During the year the battery crushed 40,207 tons of stone, which yielded 152 tons of ore. The amount expended in wages was £10,726 16*s.* 5*d.*, and the expenditure on dead-work, race-cutting, stores, &c., was £5682 5*s.* 10*d.*

The Crystal Hill Company is working on some good stone, and is erecting a battery plant. Some years ago, Mr. A. Montgomery, the Government Geologist, when reporting on the Blue Tier Mines, reported that a large reservoir could be constructed on the top of the Tier for conserving water for working the mines below, and Mr. K. L. Rahbek, Hydraulic Engineer, has been employed by the Government to survey the site, and report upon the feasibility of conserving sufficient water to supply the mines in the neighbourhood. If such a scheme is feasible, and the Government decides to construct the reservoir, the mines can be supplied with sufficient water to keep them working full time all the year round, and there is sufficient payable ore in sight, I believe, to keep the Anchor Mine going for over a century.

Weldborough.—Good progress has been made during the year, and several new companies have started work with most encouraging results.

Ben Lomond.—Ben Lomond is situated about 14 miles north of Avoca, and the mining district, which is a large one, and will doubtless become a very important one in the near future, lies to the south of the mountain. Tin-ore is more or less freely distributed all over the district, and there are a large number of shows which are well worth opening up. The principal mine at work is the Mount Rex Tin Mining Company's, which is working upon a large mass of tin-stone from 60 to 80 feet in diameter. This field has recently been visited by the Assistant Government Geologist, and his geological report upon the mines inspected is appended.

St. Helens.—Several new companies have started operations in the Ruby Valley. The Royal Ruby has been obtaining fair results, and has just completed cutting a race to bring water on to the claim. Several dredging claims have been taken up on the foreshore at George's Bay, where it was reported payable tin was obtainable, but so far, operations have not been commenced.

Derby, Bradshaw's Creek, &c.—Great activity has been exhibited on the principal mines in these and other localities in the N.E. Division, and which have been reported upon at length by Mr. Commissioner O'Reilly, whose report is appended.

West Coast.—The Federation Tin Mining Company at Heemskirk has been working successfully. A new discovery has recently been made on this company's property, and the tributors have obtained 59 bags of tin-ore from about 164 tons of lode-stuff. The formation is decomposed ferruginous tourmaline rock, and has been proved to a width of 8 feet without reaching the wall. As the lode-stuff is easily worked, and

ANCHOR MINE.

there is plenty of hydraulic power for driving the stamps and dressing-plant, the discovery is regarded as important. A good deal of exploratory work has been done at North Dundas, in the vicinity of the Renison Bell Mine. A parcel of 5 tons of ore from the mine has recently been treated in Melbourne, and satisfactory results were obtained.

Coal.

The output of coal for the year was 43,010 tons, being a de-decrease of 3527 tons on the previous year, which may be accounted for by the strike at the Nicholas and Cornwall Collieries, which caused the suspension of work there for about ten weeks. The following is the output from the various collieries:—

Cornwall	21,799	tons
Nicholas	17,962	,,
Mount Cygnet	2345	,,
Dulverton	495	,,
York Plains	409	,,

The seams of coal known to exist on the East Coast, in the vicinity of the Denison and Douglas rivers, and at Llandaff, have attracted some attention, and the Government Geologist has recently inspected the localities, and is engaged preparing a report, which will shortly be published. While on the ground, the Government Geologist selected sites for boring by means of the diamond-drill. The large drill has been put in order, and is now employed in boring for coal. Some coal sections have been taken up in the Parish of Boultbee, East Coast, upon which it is stated three seams of first-class coal, 10 ft. 6 in., 4 ft. 9 in., and 2 ft. 7in., respectively, have been discovered. A Victorian syndicate is prepared to place £50,000 into the venture for working the mine, constructing a tramway to the Coast, and the erection of a jetty, if the coal prove to be of the size and quality stated. Several sections have been taken up about 6 miles below the junction of the Inglis and Calder rivers, south of Wynyard. A sample of the coal was analysed by the Government Geologist, and the following result obtained:—

	per cent.
Fixed carbon	50·0
Ash	5·4
Gases, &c.. lost at red heat	41·4
Sulphur	1·8
Moisture, lost at 212° F.	1·4
	100·0

The coke formed by this coal is firm and coherent. The proportion of sulphur is rather high, the coal being otherwise of excellent quality.

Boring operations by means of hand-rods have been carried on at Farm Cove, Macquarie Harbour, to a depth of 341 feet. At 114 feet, a seam of 3 inches of coal was passed through, at 208 feet, another seam of 2 feet 6 inches, which is stated to have been analysed, with the following result:—

	per cent.
Fixed carbon	67·32
Volatile hydro-carbon	27·23
Ash	5·23

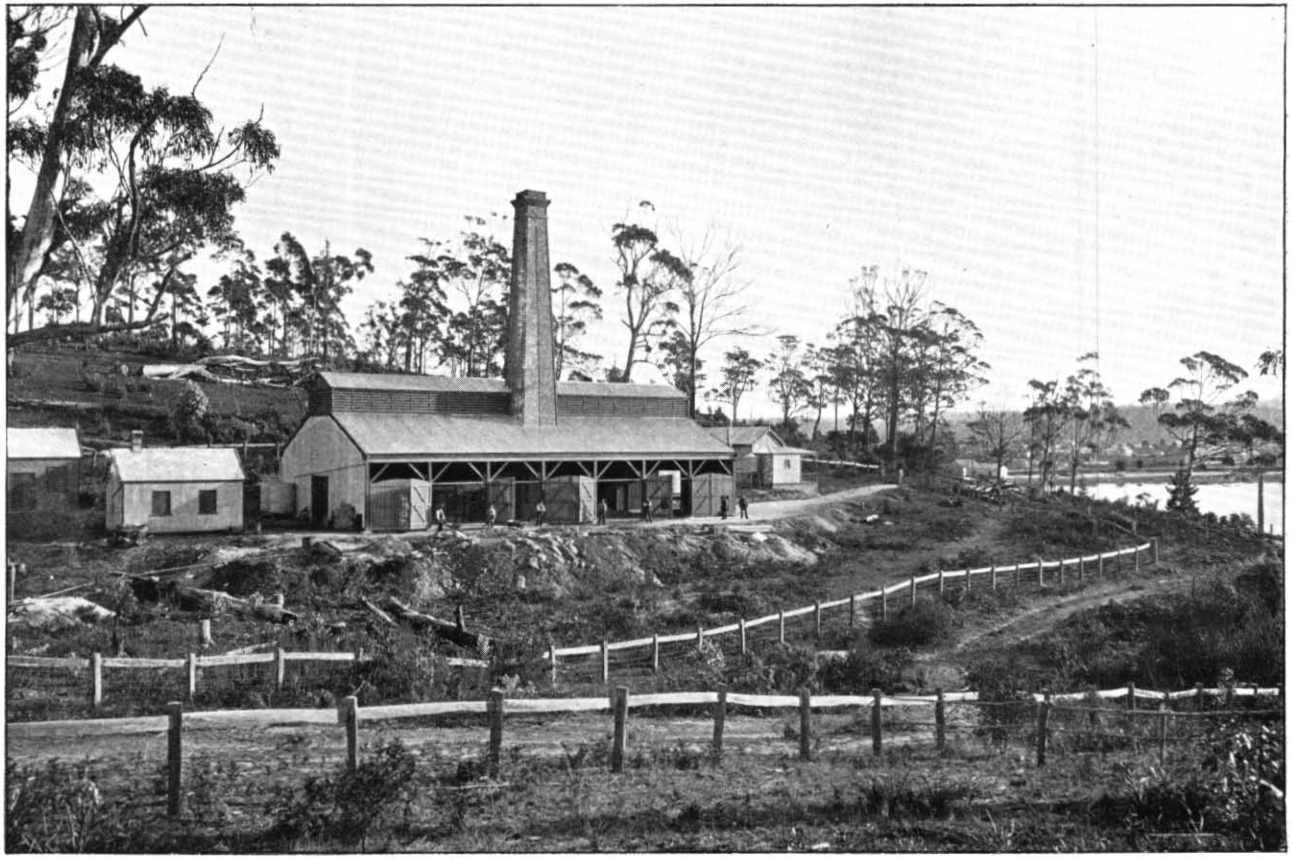
and a third seam of 3 feet 8 inches, coal of unproved quality was passed through at 330 feet.

Coal deposits at and near Recherche, have attracted attention, recently, and there is likelihood of their development in the near future.

The Jubilee Coal Mine at St. Marys is reported to be a very fine show. A tunnel has been driven over 150 feet in a six-foot seam (the full thickness of which is not exposed) of good-looking clean coal, with a 17-inch and a 1-inch band. The seam is persistent, and can be worked profitably. A tramway will be necessary to connect the mine with St. Marys, near the station. The distance is 3 miles, and the cost would probably be nearly £3000.

Iron.

The huge body of iron at the Blythe River, near Burnie, has been further tested during the year by tunnelling. It has been found to maintain its size and quality at the desired depth, and there is no reasonable doubt of its permanence as a deposit, nor of the suitability of the metal for industrial purposes.



ANCHOR SMELTING WORKS.

Arrangements for its exploitation are not yet reported as concluded, but the deposit, without question, will be found to form a highly important factor in the future industrial prosperity of the State.

Asbestos.

A new find has been made near Lynchford; some has also been discovered on the shores of Trial and Macquarie harbours. The Australasian Company's deposits at Anderson's Creek have been prospected somewhat desultorily, and indications of good-quality seams have been met with on neighbouring sections.

Dredging.

This new industry has recently been introduced into Tasmania, and hopes are entertained of its success. Some years ago, I believe the first dredge was constructed on the Ringarooma River for treating the accumulated tailings, but all efforts to save the fine tin proved unsuccessful. The dredge was a "Priestman," and was unsuitable for the purpose.

About three years ago, the Tasmanian Tin Dredging Company (an English Company) constructed, at considerable cost, a suction dredge on the Ringarooma River, at Derby, and commenced operations on the tin tailings in the river; but, owing to defective machinery, or to some alteration being necessary, operations were suspended, and have not been resumed.

The dredge remained embedded in the sand at the outlet of the Briseis Company's Tail-race, until quite recently, when, owing to the complaints made by the companies working in the vicinity, it had to be removed a few chains higher up the river.

The New Ringarooma Dredging Company, No Liability, has taken over the dredge constructed about 2 years ago by the Ringarooma Dredging Company. This dredge (suction) was built at a cost of £4000, for the purpose of working the low-lying flats in the vicinity of Mount Cameron. The engine is supposed to be capable of working up to 70 h.p., and should raise from 50 to 100 tons of dirt per hour; from actual experience, however, it is found that the dirt raised is from 25 to

40 tons per hour, the latter quantity being under the most favourable circumstances.

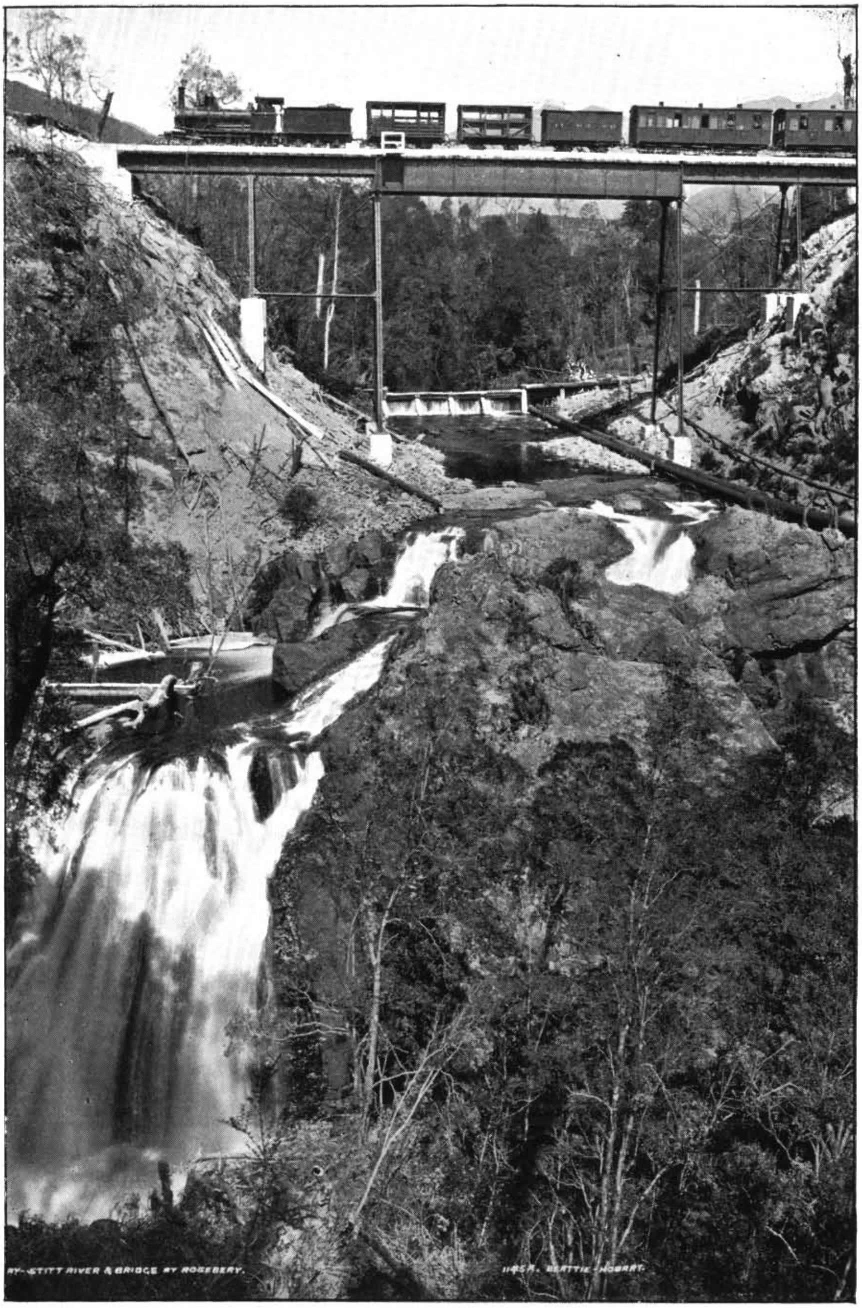
The company has been, until lately, most unfortunate, and is now for the first time on payable ground. From bores and shafts ahead, the ground is proved to be about 18 feet deep, and goes about 2 to 3 lbs. of tin to the ton of dirt. This is highly payable, as past experience proves ½ lb. of tin will pay all expenses. The ground ahead is proved for over 30 chains long and about 10 chains wide. The dredge has treated some thousands of tons of dirt, yielding about 2 ozs. of tin to the ton.

The Lisle Dredging Company has constructed a dredge for working the humid soil on the old alluvial gold-field, at Lisle, and work has recently been commenced. There are two separate plants on the barge, each of great power; one of these drives the pump (suction) and the other supplies a powerful body of water to the breaking-down nozzles. The cost of the plant, including erection, &c., was £5000. The quantity of dirt it will treat is guaranteed at 100 tons per hour; but it will probably not treat more than 50 tons per hour. This company has about 140 acres of ground, the whole of which is said to be payable.

The Queen River Dredging Company's dredge was completed in June last, and has commenced operations on the bank of the Queen River, near Lynchford, West Coast. This is a bucket dredge, and was designed by Messrs. Payne & Co., of New Zealand, and constructed by the Clyde Engineering Company, Sydney, under the supervision of that Company's engineer. The engine is about 20 h.p., and capable of treating about 100 cubic yards per 8 hours.

The quantity of gold won up to the present time has been rather disappointing, but hopes are entertained that when the dredge gets into the bed of the river the lead will be picked up and work will be successfully carried on.

Whyte River Gold Dredge. The dredge was built by Messrs. Bogle & Clark, of Launceston, to the designs of Mr. F. W. Payne, of Dunedin, N.Z., and is a perfectly up-to-date



STITT RIVER BRIDGE, EMU BAY RAILWAY, ROSEBERY.

machine of the best description, the following being a brief outline of the leading particulars:—

The pontoons are 90 feet long by 27 feet beam. The engine is a compound condensing one of 12 h.p., with cylinders 7 inches and 11 inches by 14 inch stroke. This is supplied by steam from a 20 h.p. Semi-Cornish Multitubular boiler of steel throughout, carrying a pressure of 130 lbs. The winch, consisting of 6 drums or barrels, and connected by spur-gearing and clutches, is built into a strong wooden framing, the levers and purchases being so arranged that they can be manipulated by the winchman moving but one step.

The ladder is 40 feet long and carries 24 buckets; in addition there are three pairs of steel grabs for the purpose of removing timber, boulders, and other obstructions. The speed of the buckets is, on an average, about 12 to the minute, and they deliver into a revolving screen which is perforated with holes, graded into three divisions, $\frac{5}{16}$, $\frac{3}{8}$, and $\frac{1}{2}$; the material passing through the holes of the screen is caught on tables underneath. These tables are 18 feet long, and are provided with cocoanut matting, and expanded metal or wire mesh, while a plentiful supply of water delivered in the form of spray thoroughly breaks up the wash and frees the gold which is deposited on to the mats, while the waste is swept into a tail-shoot alongside of the barge, and carried well out behind.

The coarser material, which cannot pass through the holes of the screen is delivered into an iron shoot in which is placed a series of angle iron ripples; this shoot also delivers back into the river, well at the rear of the dredge and clear of the workings.

The cost and erection of the plant was about £5000, and the incidental expenses, about another £1000.

Mine Managers' Examination.

Only two candidates presented themselves at the examination held in March last, one of whom succeeded in obtaining a Second Class Certificate.

Appended will be found copies of the examination papers set.

ZEEHAN SCHOOL OF MINES AND METALLURGY.

The number of students attending the school regularly during the year ending 30th June, 1901, averaged 43, being an increase of 6 students, as compared with the previous year.

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

	Students.
Mathematics	17
Mining Mechanics, Grade 1	8
" Grade 2	5
Mineralogy	7
Mechanical Drawing	8
Geology	2
Ore Dressing	6
Engine Driving	6
Mine Surveying	5
Analytical Chemistry	14
Theoretical Chemistry	17
Fire Assaying	9

The space in the Chemical Laboratory has been completely occupied throughout the year, so the increase in the number of students is mainly due to the increased interest being taken in the mining division of the school, owing to the completion of arrangements for the granting of diplomas in metal-mining.

It is, however, hardly necessary to mention that before classes can be held in all the subjects in the mining course, an additional instructor will be required. The time of the present instructor is entirely taken up by the above subjects. The committee trust, however, that the Government, recognising the good work done by the school, will increase the annual grant next year, so as to enable an additional instructor to be appointed.

The committee desire to express regret that Mr. Geo. A. Waller has resigned as Director of the School in order to accept the position of Assistant Government Geologist in Tasmania. Mr. F. W. Reid, Associate South Australian School of Mines, has been appointed to take the subjects formerly taught by Mr. G. A. Waller, and Mr. H. T. Waller has been appointed Acting Director of the School.

The committee hope to be able to start shortly on the erection of the proposed new buildings, a splendid site in Main street, in the centre of the town, having been secured. With the increased and more satisfactory accommodation that will be obtained, it is hoped that an increased attendance and interest in the different classes will result.

BEACONSFIELD SCHOOL OF MINES.

During the year, a school has been started at Beaconsfield, and, already, over 20 students have been enrolled. The Instructor, Mr. H. F. Michael, is a graduate of the Bendigo School of Mines and Industries. He was for some time Assistant Surveyor and Analyst of the Bendigo School of Mines and Industries, and took first class honours and certificates in mineralogy, metallurgy, assaying, theoretical chemistry, practical chemistry, mining, and geology. He has had a varied experience, practical as well as theoretical, in relation to cyanidation, concentration, and mining, and held the position of metallurgist to the Goldfields Limited, N.S.W.

Classes are conducted five nights in the week, and the following subjects are taught:—theoretical chemistry, practical chemistry, mineralogy, assaying, metallurgy, mathematics, and mechanical drawing. Mr. Gordon Douglas is the instructor in mechancial drawing, and Mr. H. E. Walduck, (Secretary), in mathematics.

MINERAL PRODUCTS.

The following return shows the quantity and value of minerals and metals produced during the year ending 30th June, 1901:—

	Quantity.	Value.
Gold won	*79,543⅓ ounces	£306,500
Silver ore raised	24,327½ tons	263,792
Tin ore raised	2993 tons	266,667
Coal	43,010 tons	36,387
Copper (blister)	9382 tons	781,949†
Copper ore	11,572¼ tons	153,584
Iron ore	2772 tons	3517
Asbestos	90½ tons	89
Wolfram	17¾ tons	620
TOTAL		£1,813,105

* Including 23,446 ounces obtained from blister copper.

† The value of the gold contained in the blister copper has been deducted from this amount.

This shows an increase in value of £39,302 on the previous year.

The total amount paid in dividends and bonuses was £291,476 4*s.* 6*d.*

Departmental Staff.

Three new appointments have been made during the year, viz.,—G. A. Waller, Esq., Assistant Government Geologist, Launceston; C. H. Curtain, Inspector of Mines, Queenstown; and F. C. Wills, Registrar of Mines, Burnie.

The only changes which have been made have been the appointment of J. R. Quinn, Junior Clerk, Hobart Office, *vice* H. O'Brien, removed to the General Post Office; W. A. Birchall, Registrar of Mines, Queenstown *vice* F. N. Stops, removed to Hobart; Commissioner Hall, removed from Zeehan to Launceston, *vice* Commissioner Glover, resigned; and Commissioner Gilmore, removed from Queenstown to Zeehan, *vice* Commissioner Hall.

Although there has been a depression in the mining industry of the State, there has been no decrease in the work of the Department, and it gives me much pleasure to once again record my sincere thanks to the Officers for the loyal support during the year.

Mount Cameron Water Race Board.

The Report of the Board is annexed.

Diamond Drills.

The diamond-drills have been idle for some considerable time. No. 1. has recently been repaired, and sent to Llandaff, on the East Coast, to bore for coal on sites selected by the Government Geologist.

Revenue.

There is a decrease of £6811 6*s.* 8*d.* in the revenue as compared with the previous year. This is partly due to the abolition of Miners' Rights, Licensed Holdings, and Residence

Licences, from which a large amount of revenue was obtained, and to the continuance of the South African War and other matters referred to in the earlier part of my report, but there is no reason for believing that this depression will be of long duration, and a revival may reasonably be expected during the coming year, which will help to place the mining industry of the State upon a much sounder basis.

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

W. H. WALLACE,
Secretary for Mines.

The Honourable the Minister of Mines.

DIAMOND DRILLS.

Statement of Work done to 30th June, 1901.

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
	Total	...	49	16,350½	

	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
	Total	...	41	11,629	

Aggregate number of bores .... 90.
Total distance bored .... 27,979½ feet.

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

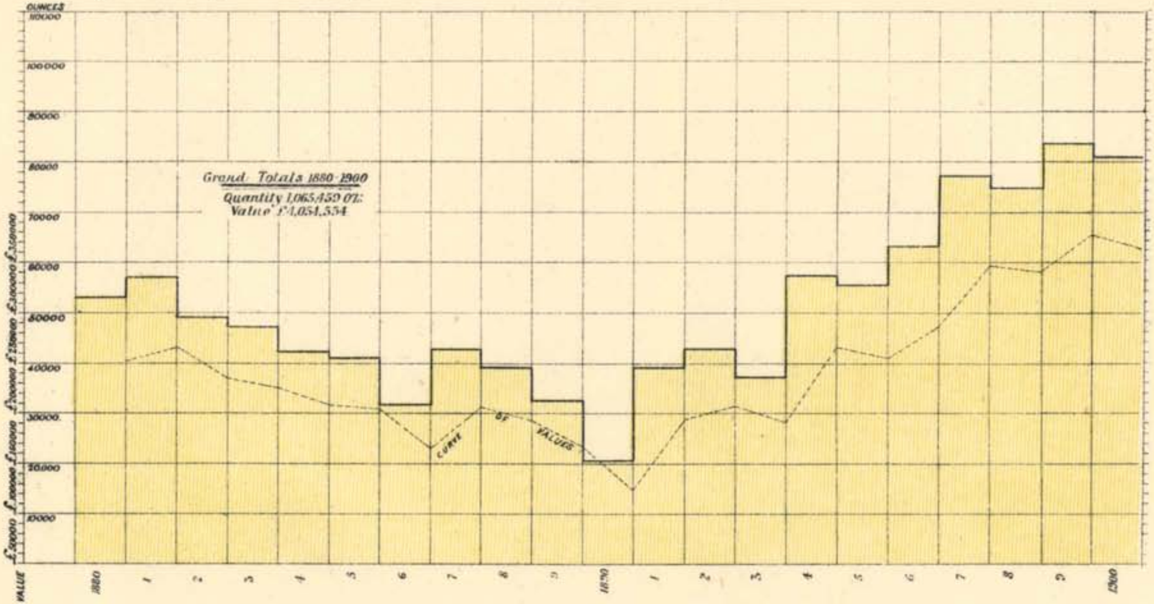
No. 1.

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, *and the first Half-year of* 1901.

Year.	Quantity.		Value.
	ozs.	dwts.	£
1880	52,595	0	201,297
1881	56,693	0	216,901
1882	49,122	6	187,337
1883	46,577	10	176,442
1884	42,339	19	160,404
1885	41,240	19	155,309
1886	31,014	10	117,250
1887	42,609	3	158,533
1888	39,610	19	147,154
1889	32,332	13	119,703
1890	20,510	0	75,888
1891	38,789	0	145,459
1892	42,378	0	158,917
1893	37,687	0	141,326
1894	57,873	0	217,024
1895	54,964	0	206,115
1896	62,591	0	237,574
1897	77,131	0	296,660
1898	74,233	0	291,496
1899	83,992	0	327,545
1900	81,175	0	316,220
1901, for the first Half-year	38,012	0	148,182
	1,103,470	19	4,202,736

XXIVA

Diagram showing Total Quantity & Value of Gold won in Tasmania for the years 1880-1900



No. 2.

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

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, for the first Half-year	37,617	146,652
	968,189	3,667,449

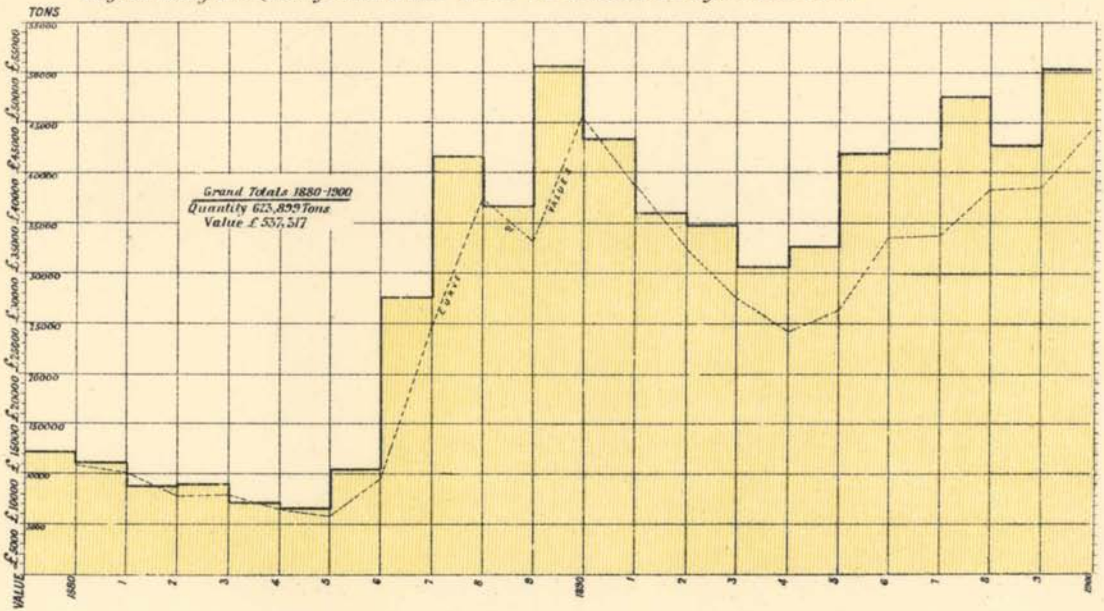
No. 3.

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, ***and the*** *first Half-year of* 1901.

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, for the first Half-year	16,146	13,553
	640,045	550,870

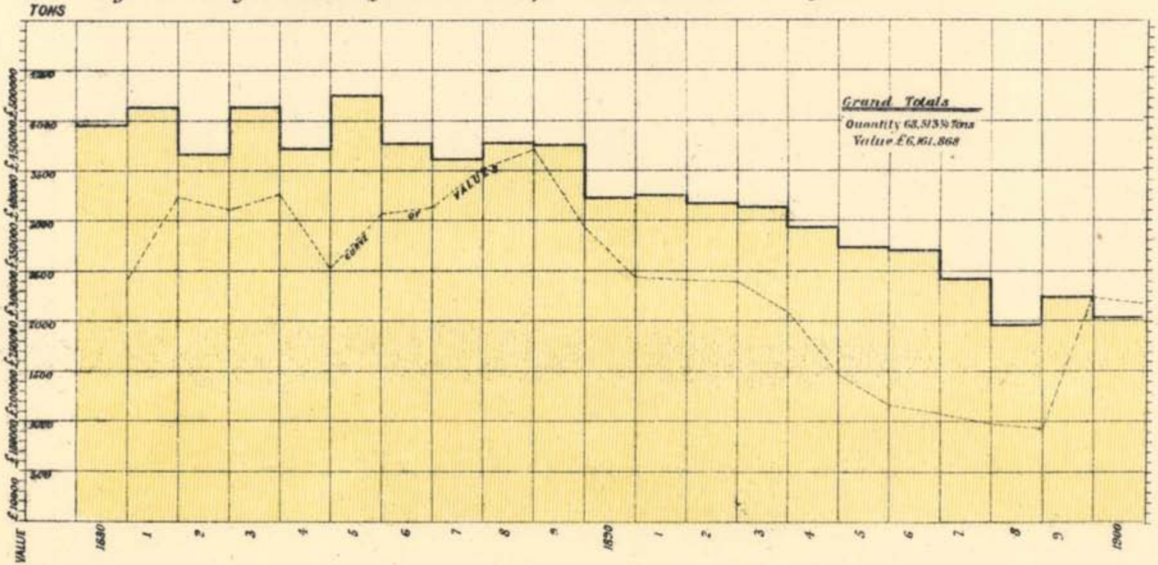
XXVI A

Diagram showing Total Quantity & Value of Coal Raised in Tasmania for the years 1880 to 1900



XXVIB.

Diagram showing Total Quantity & Value of Tin exported from Tasmania for the years 1880 to 1900.



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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, *and for the first Half-year of* 1901, *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, for the first Half-year	822¼	100,332
	69,335¼	6,262,200

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, *and the first Half-year of* 1901.

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, for the first Half-year	11,040	108,448
	194,341½	2,061,635

No. 6.

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

Year.	Quantity.	Value.
	tons.	£
1896	41½	1245
1897	4700	322,500
1898	4955½	400,668
1899	8598	735,305
1900	9449	907,288
1901, for the first Half-year	4713	439,378
	32,457	2,806,384

No. 7.

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

Year.	Quantity.	Value.
	tons.	£
1896	34	1020
1897	75	2250
1898	394	8128
1899	1695	26,833
1900	4221½	63,589
1901, for the first Half-year	7361	90,115
	13,780½	191,935

No. 8.

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

Year.	Quantity.	Value.
	Tons.	£
1897	894	812
1898	1598	1598
1899	3577	3474
1900	5375	5995
1901, for the first Half-year	210	115
	11,654	11,994

No. 9.

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

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

No. 10.

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

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

No. 11.

RETURN *showing the Number of Persons engaged in Mining during the Years* 1880 *to* 1900 *inclusive, and first Half-year of* 1901.

Year.	Number.	Year.	Number.
1880	1653	1891	3219
1881	3156	1892	3295
1882	4098	1893	3403
1883	3818	1894	3433
1884	2972	1895	4062
1885	2783	1896	4350
1886	2681	1897	4510
1887	3361	1898	6052
1888	2989	1899	6622
1889	3141	1900	7023
1890	2868	1901, first Half-year	6904

No. 12.

RETURN showing the Number and Area of Leases held under "The Mining Act, 1900," in force on 30th June of each year since 1895.

Nature of Lease.	In force on 30th June, 1895.		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.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.
		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.
For Tin, &c., at a rental of 5*s.* an acre	720	31,207	738	33,077	1150	56,493	1290	66,981	1207	64,339	1487	70,500	1388	60,865
For Coal and Slate, at a rental of 2*s.* 6*d.* an acre	37	6551	37	5946	38	6105	41	5943	39	6002	52	7258	55	7566
For Gold, at a rental of 20*s.* an acre	455	4366	602	5712½	615	5789	702	7190	652	6725	647	6623	566	6091
Water Rights, Mineral and Gold, at a rental of £1 per sluice-head..	176	755 sluice-heads.	160	808 sluice-heads.	155	774 sluice-heads.	159	784 sluice-heads.	200	933 sluice-heads.	225	1004 sluice-heads.	267	1318 sluice-heads.

D

No. 13.

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

Nature of Lease	In force on 1st July, 1900.		Issued during Year ending 30th June, 1901.		Cancelled during Year ending 30th June, 1901.		In force on 30th June, 1901.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.
		Acres.		Acres.		Acres.		Acres.
For Tin, &c., at a rental of 5*s.* an acre	1487	70,500	426	17,838	525	27,473	1388	60,865
For Coal and Slate, at a rental of 2*s.* 6*d.* an acre	52	7258	12	1726	9	1418	55	7566
For Gold, at a rental of 20*s.* an acre	647	6623	127	1217	188	1749	566	6091
Water Rights, Mineral and Gold, at £1 per sluice-head per annum	225	1004 sluice-heads.	61	387 sluice-heads.	19	73 sluice-heads.	267	1318 sluice-heads.

No. 14.

COMPARATIVE Statement of Net Revenue from Mines, being Rents, Fees, &c., paid to the Treasury for the Years ending 30th June, from 1880 *to* 1901.

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

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

No. 15.

TOTAL Number and Area of Leases in force on 30th June, 1901.

Minerals.	Number.	Area.
		Acres.
Gold	566	6091
Minerals	404	22,330
Silver	290	14,137
Copper	124	5813
Tin	526	16,343
Coal	31	4199
Limestone	17	1856
Iron	14	609
Slate	1	200
Wolfram	17	894
Asbestos	9	519
Precious Stones	1	80
Lithographic Stone	2	194
Marble	1	317
Graphite	2	100
Shale	3	800
Bismuth	1	40
TOTAL	2009	74,522

No. 16.

AVERAGE Number of Miners employed during the Year ending 30th June, 1901.

	Europeans.	Chinese.
Northern and Southern Division	854	...
North-Eastern Division	480	148
Eastern Division	756	72
North-Western Division	298	...
Western Division	4412	...
	6800	220

No. 17.

MINING Companies registered during the Year ending 30th June, 1901.

Number of Companies.	Capital.
25	£46,376

In addition to the above, 21 Agents for Foreign Companies, and 8 Syndicates, under 60 Vict., No. 51, were registered.

No. 18.

TOTAL Area of Land applied for during the Year ending 30th June, 1901.

Mineral.	No. of Applications.	Area.
		Acres.
Asbestos	1	70
Coal	8	2000
Copper	29	1916
Gold	140	1342
Iron	9	471
Limestone	4	110
Lead	1	58
Monazite	1	80
Mineral	133	7944
Silver	20	1070
Tin	166	4177
Wolfram	2	120
Machinery sites	7	44
TOTAL	521	19,402

In addition to the above, 24 applications for Mining Easements, 44 applications for Dredging Claims, and 94 applications for Water Rights (396 sluice-heads) were received.

XXXVIA

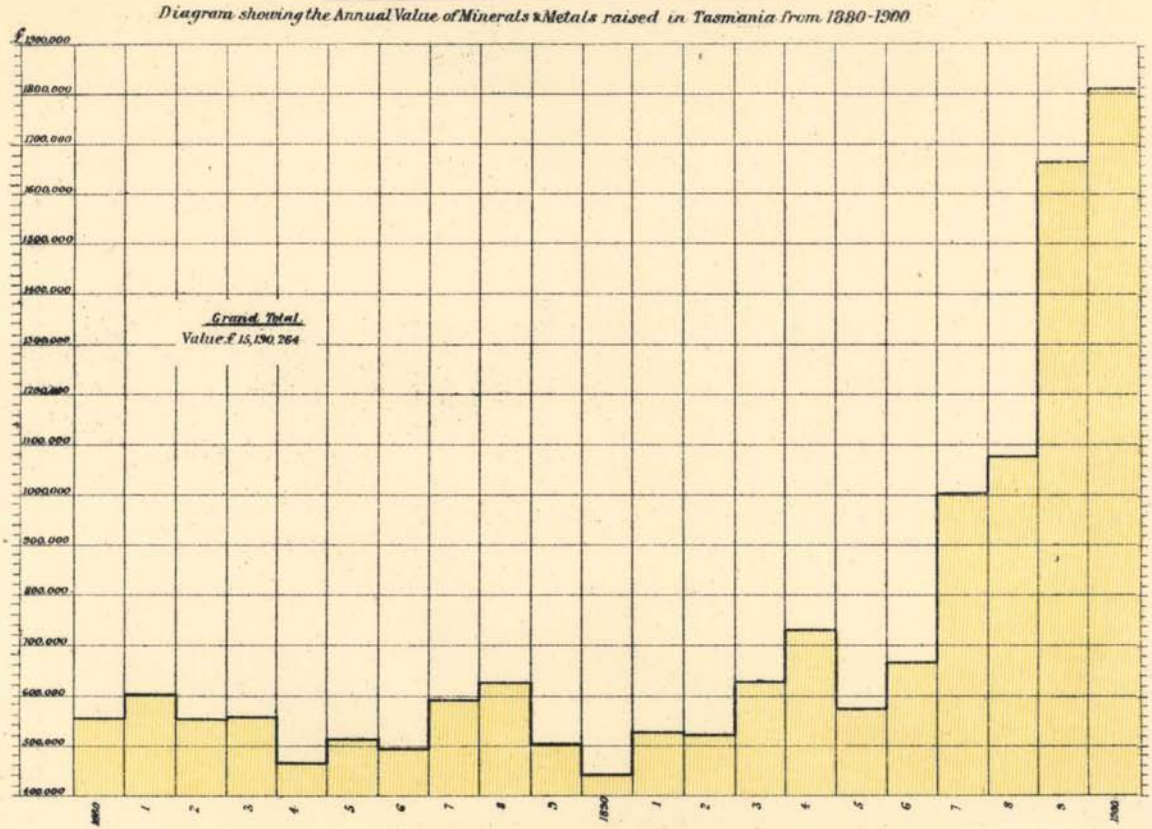


Diagram showing the Annual Value of Minerals & Metals raised in Tasmania from 1880-1900
Grand Total
Value £ 15,190,264

PROGRESS OF TASMANIA 1816 TO 1900

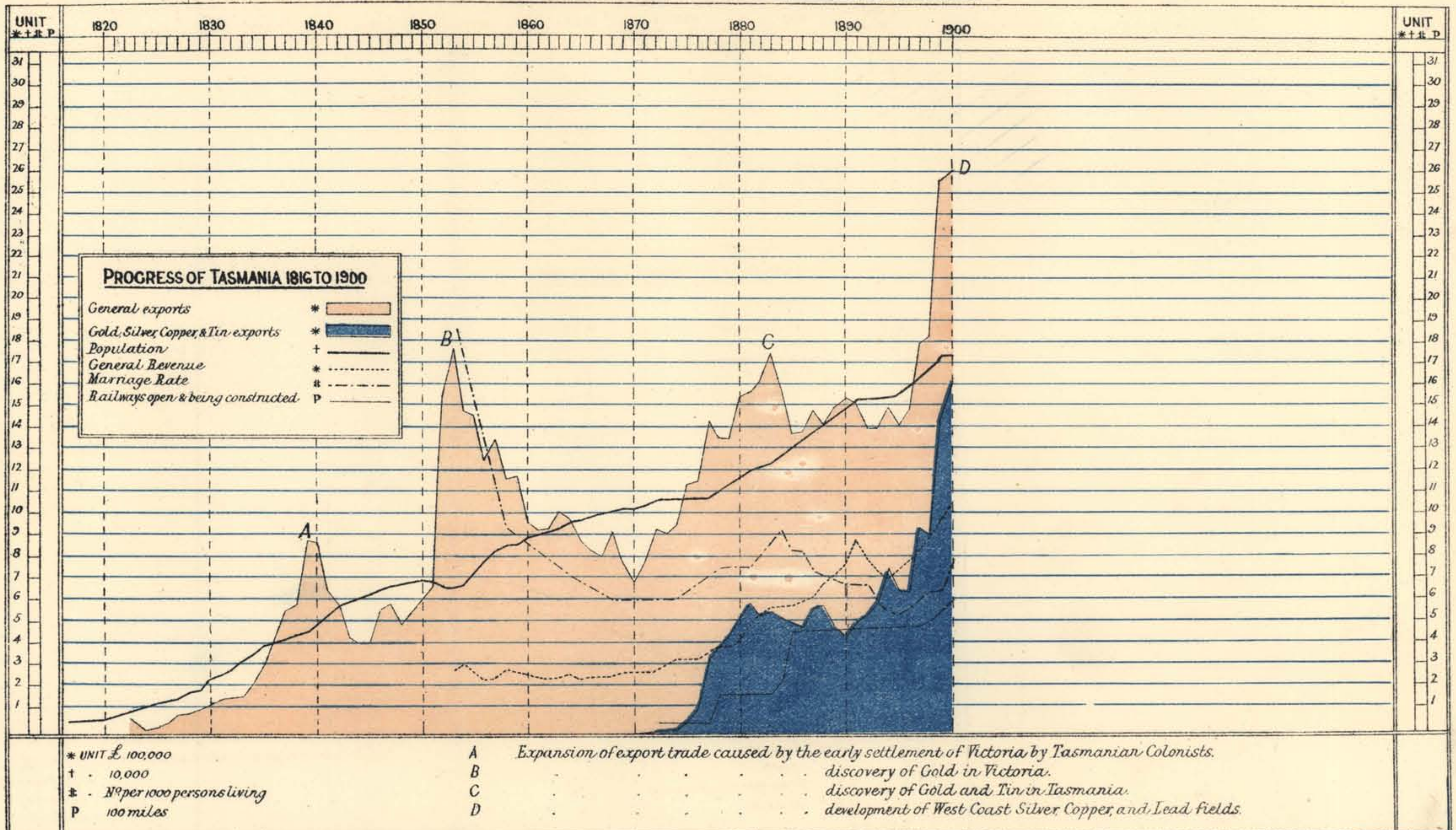


Photo-lithographed at the Government Printing Department Hobart November 1901

R. M. Johnston

No. 19.

TOTAL Amount of Rents, Fees, &c., received by the Mines Department during the Year ending 30th June, 1901.

Head of Revenue.	Amount.		
	£	s.	d.
Rent under "The Mining Act, 1893," for Gold ...	4726	7	5
Fees " " " ...	15,059	7	11
Rent " " for Minerals	405	8	0
Fees " " " ...	1378	1	10
Survey Fees	3005	13	10
Rent of Diamond Drills	—		
TOTAL	24,574	19	0

No. 20.

RETURN showing the Amounts paid in Diviaends and Bonuses by Mining Companies during the Year ending 34th June, 1901.

Mines.	Dividends.			Bonuses.	Total.		
	£	s.	d.	£	£	s.	d.
Copper	110,000	0	0	13,750	123,750	0	0
Gold	53,600	0	0	—	53,600	0	0
Tin	97,500	0	0	—	97,500	0	0
Silver	15,417	15	10	—	15,417	15	10
Coal	1208	8	8	—	1208	8	8
	277,726	4	6	13,750	291,476	4	6

REPORT OF THE MOUNT CAMERON WATER-RACE BOARD FOR THE YEAR ENDING 30TH JUNE, 1901.

19th July, 1901.

SIR,

WE have the honour to present the Report of the Board for the year ending 30th June, 1901.

The Board has held two meetings during the year. The total receipts for the year amount to £1291 11*s.* 10*d.*, as against £1538 6*s.* 9*d.*, and the expenditure to £929 8*s.*, as against £737 12*s.* 6*d.* during the preceding year.

The water supply was more than sufficient for requirements during the first three months of the year, there being about 38 heads coming into the race, being equal to 114 heads for distribution.

In October, the supply was sufficient for requirements (about 90 heads). During November and December, the supply averaged only 70 heads, and some of the royalty-scale applicants could not get their full allowance. By the end of January, the supply was down to 12 heads, equal to 42 heads per week. February and March continued dry, and the supply was reduced to a minimum for the year of 8 heads, equal to 28 for week. A fairly good rainfall in April brought the supply up to 100 heads per week; since then it has been equal to requirements.

Race.

The syphon-pipes are in a bad state all round. Nos. 1, 2, and 3 span deep gullies on the first five miles of the race from the main intake on the Great Mussel Roe River. These pipes are 2ft. 6ins. in diameter, and, when examined by the manager a year ago, seemed, to all outward appearances, good enough to last for several years to come. Several breaks, however, have since occurred, and they are now almost as bad as Nos. 4, 5, and 6. These latter are three feet in diameter, and span the open valleys on the northern extension. Nos. 4 and 5 (each ¾-mile in length) are giving a lot of trouble; bad breaks have to be mended with plate-iron bands. No less than 99 of these bands, varying from 12 to 30 inches in width, have been used on these two syphons. During the past twelve months the cost of band-making and repairs—principally to these two—amounted to £59 0*s.* 6*d.* Add to this the loss of water wasted during the time repairs were going on (equal to 44 sluice-heads, at an average of 7*s.* 9d.), £17 1s.; total, £76 1*s.* 6*d.*

A good supply of bands is kept on hand, but the difficulty of getting the pipes to stand after a bad break occurs, and the water has been off for a time, is great. One bad break in No. 5 syphon, at the end of May, caused a dozen others to occur, through the water being turned off while repairs were being done; and it took five days to get the column going again. We are of opinion that it will be imposible to keep these pipes going for another year.

The flumings at the southern end of the race are in a bad state of repair. One of these, No. 23, connecting the Little Mussel Roe, was losing so much water (about seven heads per week) that the Board deemed it advisable to have it replaced by 1200 feet of syphon-piping 14 inches in diameter, and made of 18-gauge black iron, dipped in asphaltum. The cost of this, with concrete weir and intake works, was £202 17*s.* 11*d.* There was danger of the whole fluming collapsing, and as this stream represents one-third of the whole supply, it was deemed advisable to put the repairs in hand at once The statistics for the year are as follows:—

Average per week of claims supplied, 14.

Greatest number supplied in any one week, 19.

Present number supplied, 15.

Total number of heads of water supplied, 3007.

Tin ore raised, 30 tons 2 cwts. 0 qr. 5 lbs.; royalty scale, 48 tons (approximate) fixed scale. Total, 78 tons 2 cwts. 0 qr. 5 lbs.

Average number of miners employed—Europeans, 24; Chinese, 31. Total, 55.

Total receipts for the year, £1291 11*s.* 10*d.*

Cost of maintenance and management—Salary and wages, £577 4*s.*; repairs and maintenance, £107 3*s.* 3*d.*; renewals, £202 17*s.* 11*d.*; travelling expenses, &c., £42 2*s.* 10*d.* Total, £929 8*s.*

Paid to Public Debts Sinking Fund, £1900 (including moiety of rents of mineral land served by the race, £31 10*s.*), £723 9s. 6*d.*

Total amount paid to Public Debts Sinking Fund, £6985 13*s.*

Rate of interest for the year upon cost of purchase and construction, 2.11 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.

The Hon. the Minister of Mines.

MINE MANAGERS' EXAMINATION.

MARCH 27, 1901.

Questions set.

SECTION A.—MINING.

1. A mine having extensive underground workings has a large quantity of ore exposed, including some exceedingly rich bunches. Should the working force be concentrated on the rich ore only: if not, why not?
2. Describe some of the methods which you are acquainted with for the economical and safe working of the following:—
   (*a*) A gold quartz lode, whose width may be taken to average from 20 feet to 50 feet.
   (*b*) An oxidised formation of great width, traversed by rich streaks and veins of valuable minerals.
3. Describe the method you would adopt to keep the shaft timber from crushing, and, consequently, the cages from wedging and destroying the shaft in swelling ground.
4. Describe how you would open out for a platt 10 feet high from the shaft, in heavy ground—
   (*a*) If the ground would not stand for a height of 5 feet.
   (*b*) If opening out in alluvial drift liable to run.
5. A crosscut driven west has cut and passed through a lode 4 feet wide, bearing north 30° west, and dipping westerly 60°. Timbering required. Give a sketch showing system of timber and arrangement of tramlines.
6. Describe how you would charge a hole with dynamite. What precautions should be taken during the charging, and also when the charge has not gone off.
7. What precautions should be observed in the handling of and storing of dynamite? How do you recognise whether the dynamite is in good order and condition or not?

8. Describe the working parts of a Cornish plunger and draw-lift pump, and explain why and how water is raised by the pump.
9. Make a sketch showing the various patterns of detaching safety hooks used on cages which you have seen.
10. Describe how you would construct a dam with concrete in an underground working to keep back water from an adjoining mine.
11. Give detail sketches showing parts and system of signal lines for a shaft 1000 feet deep.

Section B.—Ore-dressing and Sampling.

1. A crosscut has been driven across a lode formation for a length of 60 feet, a number of veins of rich mineral has been encountered traversing the formation. How would you conduct the sampling of this formation with a view of ascertaining what system is best adapted to the successful mining and treatment of the ore ?
2. In the concentration of the silver-lead ores ot Zeehan it is notable that the loss in silver is much greater than that in lead. Can you give any reason why this should occur ?
3. In designing a Plant for concentrating purposes, what system do you prefer (Hillside or Flat-country) ?

   State on what grounds you prefer the one, and your objection to the other.
4. What, in your opinion, are the principal factors in concentration ?
5. What is the difference between a stamp battery for the treatment of free gold ores and one for treating tin ores?

Section C.—Mining Geology.

1. Define the terms—normal fault, reversed fault, thrust planes. Illustrate these by diagrams.
2. What are the most obvious features of fissure veins; How do you distinguish veins of segregation and of infiltration from fissure veins?
3. Through what changes in their upper parts do the following classes of mineral veins pass, rendering their appearance along their outcrop different from that of the same veins at some depth below :—(*a*) Cupri-

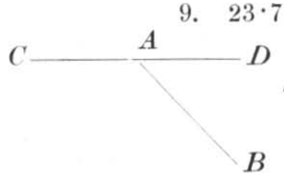
ferous veins, (*b*) galena veins, (*c*) auriferous quartz veins?

4. Explain how local metamorphism is produced, and what are the agents of general or regional metamorphism.
5. Name the genera of fossil plants and animals which you would expect to find in Silurian and Permo-carboniferous strata respectively.
6. What is the difference between slate and schist? What kinds of rocks have been altered to serpentine?
7. Distinguish between the cleavage and the stratification of slate.
8. Describe any physical features in a mine which may influence the metallic contents of ore veins favourably or unfavourably.
9. Name the different ores of lead, and state their composition.
10. Enumerate the divisions of the geological record so far as they apply to stratified rocks in Tasmania, beginning with the most ancient.

Section D.—Mining Surveying.

1. Describe two ready methods of drawing parallel lines without the use of the parallel ruler.
2. Calculate the latitudes and departures of the following traverse, and the direct bearing and distance of station 9 from station 1:—

	Feet	Bearing
1.	74·50	N. 0° 15′ W.
2.	82·83	N. 14° 00′ W.
3.	63·00	N. 27° 39′ W.
4.	30·16	N. 84° 57′ W.
5.	23·75	S. 74° 06′ W.
6.	192·00	N. 67° 44′ W.
7.	96·50	N. 88° 00′ W.
8.	34·00	S. 84° 06′ W.
9.	23·75	S. 52° 00′ W.

3. 

AB is a lode which has been intersected and dislocated by a crosscourse *CD*. In which direction should the heaved portion of the lode be sought? In your answer state your reasons.

4. How do you proceed in determining the variable width of a level from which the ore has been extracted irregularly ?
5. In levelling on a hillside by vertical angles with the theodolite, the following angles were observed :—

From	To	Horizontal lengths in feet	Vertical angles
1	0	100	9° 45′ rise
1	2	100	7° 15′ ,,
3	2	100	9° 30′ ,,
3	4	100	10° 15′ ,,
5	4	100	3° 30′ fall

Calculate the height of station 5 above station 0.
6. Describe some methods of prolonging a line beyond an object which cannot be chained across or seen over. The line is supposed to be accessible at both ends.
7. Describe how, in a surface survey, you would prolong your base line where the level ground is too limited for the measurement of the whole of the line.
8. Describe fully how you measure horizontal angles with the theodolite.
9. Describe the method of plotting without a protractor by means of chords.
10. How would you determine the cubical contents of an irregularly-shaped dump-heap ? Work out an example.

Section E.—Surface Work.

1. (*a*) Find the safe working load for a hemp rope (round) 6 inches in circumference.
   (*b*) Find the safe working load for a steel wire rope (round) 3 inches circumference.
2. A 20-head battery makes 75 drops per minute, The weight of the shank, disc, head and shoe is $7\frac{1}{2}$ cwt., with a lift of 8 inches. What actual horse-power will be required for the battery ? (Assume an allowance for friction.)
3. What weight will a double-cylinder steam winch lift whose stroke is 10 inches, diameter of cylinders 6 inches, diameter of pitch line of pinion 10 inches, diameter of pitch line of large pinion 36 inches, diameter of drum 10 inches, pressure at boiler 30 lbs. per square inch,

cuts off at $\frac{3}{4}$ stroke? (Assume an allowance for friction.)

4. A safety-valve has a lever weighing 10 lbs., the centre of gravity of which is 9 inches from fulcrum; ball 80 lbs.; valve 5 inches diameter, weight 10 lbs., centre of fulcrum pin to valve is 3 inches. How far must the weight be placed from the centre of fulcrum to blow off at 50 lbs. per square inch?
5. Pass your opinion on the indicator card shown here, and calculate the horse-power. Scale of spring $\frac{1}{40}$ inch, stroke of engine 3 feet; 50 revolutions per minute; diameter of cylinder 20 inches.
6. On a 2-ft. gauge tramway, two straights, with an included angle of 120°, are to be connected by a curve of 300 ft. radius: how would you set out centre line with 100 ft. tape?
7. What do you consider proper grade for a water-race? Give detail sketch of flume, 2 ft. wide, across gully 60 ft. deep by 120 ft. wide.
8. Give sketches, from which working drawings may be prepared for surface-hopper to contain 200 tons of quartz, with details of all joints, and notes of your reason for adapting same, also details of loading chutes and gates.
9. What safety appliances would you instal in connection with head-gear to a main shaft?

Subject F.—Book-keeping and Mine Accounts.

1. In evaporating 7 lbs. weight of lead ore to dryness, the loss in weight is 2 ozs. 3 drs. What would be the deduction for moisture on a parcel of 70 tons of such ore?
2. Six men can sink a shaft at the rate of 3 fathoms per month. The whole cost for explosives and stores is £11 10*s*., and the wages allowed are £3 10*s*. per man per month. What will be the total cost per fathom sunk?
3. If four men and a boy earn £55 10*s*., and the boy is to have one half of a man's share, how much must each receive?
4. What is the value of 4 tons 6 cwts. 3 qrs. of copper ore at £4 12*s*. 6*d*. per ton?

5. In a mine under your charge you are required to keep productive and unproductive expenditure separate. Describe the forms of accounts and the headings which you would use for this purpose.

Subject G.—Mining Law.

1. What is the maximum quantity of gunpowder or other explosives which may be stored in any mine, and what distance should same be stored from any travelling road?
2. What is the maximum quantity which may be taken for use into the workings of a mine, and how should same be carried?
3. How may the fumes arising from any nitro-glycerine compound be neutralised or rendered innocuous if same cannot be effectively dispersed by ventilation or spray of water from the mine?
4. What time must elapse before returning to a charge which has hung fire, or is supposed to have missed fire?
5. What kind of tools are prohibited when drawing or drilling out a charge which has missed fire?

ANNUAL REPORT OF THE GOVERNMENT GEOLOGIST.

Government Geologist's Office,
Launceston, 30th June, 1901.

SIR,

I HAVE the honour to submit my Annual Report as Government Geologist for the year ending 30th June, 1901.

During the year under review I have, agreeably to instructions received, reported upon the following mineral districts:—

1. On the mineral districts of Zeehan and neighbourhood; 27th October, 1900.
2. On the mineral districts of Mounts Huxley, Jukes, and Darwin; 30th November, 1900.
3. On the Mount Farrell district; 20th December, 1900.
4. On the Blythe River iron ore deposit; 30th January, 1901.
5. On the tin-bearing capabilities of the Gladstone district; 11th May, 1901.

The continued growth of the mining industry necessitated the appointment of an Assistant Government Geologist in January, and Mr. Geo. A. Waller, pursuant to your instructions, has visited and prepared reports upon districts, as under—

1. On the mining districts of the Scamander River and St. Helens; 4th June, 1901.
2. On the Ben Lomond tin-mining district; 30th June, 1901.

I now beg to offer a few general remarks upon the fields covered by my reports.

Zeehan and District.

This is one of our settled fields, and is subject to the vicissitudes usual wherever mining is carried on continuously and on a large scale. Under such conditions, there must be ups and downs in the history of individual mines. Some of these are disappointing to shareholders, but a broad view of the mining at Zeehan discloses nothing which might not have been foreseen. Failure to keep on sinking in prosperous times is bound to land the Zeehan mines in difficulties, and companies which are guilty of this neglect offend against the common weal, because, if two or three of them get into trouble at one and the same time, the town and district sustain a shock from which it takes long to recover. Fortunately, although two or three mines are at present under a cloud, the mining horizon generally is extending. The policy of the Government in pushing forward a tramway to the Comstock is resulting in a stimulus being given to the development of mining properties there, and this source, ere long, may be expected to swell Zeehan's output. At Dundas several galena sections have been recently taken up, and tin-mining, both there and at Heemskirk, is receiving renewed attention. Increased activity is also noticeable at the mines on Mount Read, and the large deposit at the Colebrook is again being actively prospected.

Mounts Darwin, Jukes, and Huxley.

Operations here during the year have tended to confirm my forecast of the need for extensive and judicious prospecting. The outlay on the field has been utterly inadequate, but the little work which has been done is encouraging. At the Jukes Proprietary prospecting has met with some success, and further mining, both on Jukes and Darwin, ought to locate more than one deposit, for indications are frequent. Several drawbacks have retarded the progress of the field. It is naturally inaccessible; the North Lyell smelters, which will afford an outlet for its output, are not yet ready, and many of the small Queenstown companies which took up sections do not command sufficient resources for their exploitation. The absence of defined lodes is also perplexing. Nevertheless, a despairing view of the field must not be taken. The mineral belt is of such enormous extent, and the scratching which has been done on these mountains, as well as at Tyndall, Red Hills, and Mount Farrell, relatively so insignificant, that the real work of exploration has still to be done. The examination of the geology of this zone has convinced me that its ore deposits are closely related to those of the Lyell field, perhaps more closely than can be demonstrated just at present, and the past year's work strengthens my belief that this mineral belt has great possibilities.

Mount Farrell.

The report prepared by me on this district expresses my conviction of its importance. The temporary shutting-down of the North Farrell Mine has retarded the development of a property of distinct promise, and has also thrown the whole field back for a time. When tramway communication is established with this centre, both lead and copper sections are hoped to come to the front.

The Blythe River Iron Ore Deposit.

I inspected this property twice. Nothing seems more certain than that the magnificent ore-body forms a valuable part of our mineral resources.

The Gladstone District.

In February, March, and April, I visited this district with a view of examining the extent of its tin-ore deposits. The Government water-race at Mount Cameron needs repairs and renewals, and, in order to test the ground for hidden tin deposits prior to any further heavy expenditure on the race, I recommended bores to be put down by the Government at selected points in the drift. This work is now being carried out.

East Coast.

In June I examined the Mesozoic coal measures at Llandaff and on the Denison and Douglas rivers, where small seams of good quality coal have for a long time been known to exist. The best coal is somewhat high up in the mountains, and at some distance from the coast, but I advised boring with the diamond drill in the sandstones at the foot of the range, in the hope of meeting with the same seams faulted, or similar seams, in lower country, where a tramway can be easily constructed for transport of the output to a place of shipment in Cole's Bay.

I also examined tin ground on Schouten Main, where there appears to be a favourable opening for a small dredging enterprise. The lode tin formation in the locality does not offer much prospect at present, but further search may possibly result in the discovery of something better.

Buckland.

In June I also inspected some quartz country at Cutting Grass Marsh, near Buckland, where a quartz formation in Mesozoic sandstone has been prospected. The quartz tried did not prove to be auriferous, and the geological indications are discouraging.

Port Cygnet.

I paid a visit during June to the abandoned goldfields near Lovett and Lymington, to try and settle definitely whence was derived the alluvial gold which was won here several years ago. Gold has never been seen in the adjacent rocks, nor have any real reefs been discovered. Assays of vein-stuff and country-rock made by the Government Analyst have shown no more than traces of the precious metal. From the examination which I made on this occasion, I am satisfied that the source of the gold is to be found in the line of contact of the soda-trachyte and nepheline-syenite porphyries with the sedimentary permo-carboniferous rock. The silicified rock at this contact is also silver-bearing, but, up to the present, has not been found to be payable.

I also inspected the Mount Cygnet coal mine. An improved demand has set in for the product of this colliery.

York Plains Colliery.

I inspected this mine at the end of June, and found that it has a limited output of coal used for malting and chemical purposes.

Stone Quarries.

During the year I visited freestone quarries at Ross, where grindstones and door and window sills of excellent quality are being turned out in some quantity. In the coming year I hope to examine the quarries at Oatlands, Campania, and Brighton, and to issue a report upon the whole. The industry is entitled to special attention and encouragement.

Geological Survey.

Inquiries continue to be received from miners and visitors for geological maps of the State. It is useless to issue charts purporting to represent geological features unless they are based upon actual survey; and as the permanent usefulness of this branch of the public service depends largely upon geological mapping, I consider it my duty to continue to urge the appointment of a geological surveyor, whose sole work shall be, under my direction, to survey and map the geological formations of the State, beginning with those of the mining fields. Until such an appointment is made, I am unable to take any measures which would satisfy the justifiable demands of the public in this direction. A useful preliminary would be a full report upon the system found to work satisfactorily in one of the other States, the probable expenses, and all necessary details.

Progress Reports on the Mineral Industry.

I have compiled four of these quarterly reports during the year. They have dealt strictly with actual facts, and, as such, have disclosed the real state of the industry during the periods covered by them.

Office.

Mr. Frank Sneyd Grove, as draftsman and clerk-in-charge, continues to discharge with efficiency the duties devolving upon him. The work is increasing.

Examination of Minerals and Rocks.

Prospectors and others interested in mining have forwarded numerous specimens for determination, with inquiries as to their value as indications of workable deposits. I have endeavoured to afford all information possible, short of actual assay. I beg to append detailed list of the examinations made during the year.

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

W. H. TWELVETREES,
Government Geologist.

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

GOVERNMENT GEOLOGIST'S OFFICE.

Report on mineral determinations made for the public during the year ending 30th June, 1901:—

Sender.	Locality.	Substance examined.
20. M. Callaghan	Barn Bluff	Pyrrhotite. Fe S.
21. T. H. Jones	Magnet	Websterite porphyry.
22. J. F. Birkett	North Magnet	Micaceous sandstone.
23. A. Plumstead	Anderson's Creek	Chalcedony.
24. E. A. Woodbery	Deloraine	Carbonaceous clay.
25. Ditto	Ditto	Oxide of manganese.
26. A. Boag	West Devonport	Quartz.
27. Ditto	Ditto	Conglomerate.
28. J. Dennison	Forth	Serpentine.
29. G. R. Bell	M'Cusack's Creek	Quartz-felsite.
30. F. M. Clerk	Miami Mine	Fahl ore and arsenical pyrites
31. P. Everett	Tongatabo	Titaniferous iron sand.
32. J. S. Munro	Mt. Heemskirk	Greisen.
33. T. H. Jones	North Magnet	Grit.
34. J. Harrison	Lynchford	Hornblende asbestos.
35. W. Johnston	Westbury	Grits and sandstones.
36. F. Bottomley	Liffey	Quartzite.
37. Ditto	Ditto	Sandstone.
38. Ditto	Ditto	Granite.
39. Ditto	Ditto	Permo-Carboniferous conglomerate
40. Ditto	Ditto	Quartz schist.
41. J. B. M'Arthur	Alberton	Pyritic lode quartz.
42. E. F. Goninon	Latrobe	Tasmanite.
43. F. J. Rich	9-mile Creek	Hornblende schist.
44. A. E. Murrell	Lebrina	Pyritic quartz.
45. J. Merrick	Alberton	Quartz-mica rock with pyrite.
46. Jno. Wood	—	Reef quartz.
47. F. R. Duke	Alberton	Vein quartz with arsenical pyrites
48. F. M. Gill	Swansea	Tin Granite.
49. R. Atkinson	Lefroy	Reef quartz with arsenical and iron pyrites.
50. H. B. Atkinson	Ditto	Iron pyrites. FeS_2.
51. D. Finlay	Tasman Comstock	Quartz felsite.
52. Prof. E. Hogg	Victoria	Various rock slices.
53. James Wilson	Turner's Marsh	Clay ironstone.
54. J. F. Sullivan	Gormanston	Vein quartz.
55. Ditto	Ditto	Graphitic pug.
56. Allan Innes	Duck River	Carbonate of lime.
57. Ditto	Ditto	Bog iron ore.
58. Ditto	Ditto	Micaceous slate with FeS_2.
59. Ditto	Ditto	Magnesian limestone.
60. T. S. Rutherford	Stowport	Clay with iron pyrites.
61. Ditto	ditto	Quartz ditto

Sender.	Locality.	Substance examined.
62. G. A. Grigg	Franklin	Quartzite with sulphide and carbonate of copper.
63. Ditto	Ditto	Siliceous gossan with iron pyrites.
64. Ditto	Ditto	Quartz and micaceous iron.
65. R. Quiggin	Wynyard	Fossiliferous Silurian sandstone.
66. Ditto	Ditto	Magnesian limestone with FeS_2.
67. Allan Innes	Duck River	Earthy hematite and limonite.
68. Ditto	Ditto	Hematite.
69. Ditto	Ditto	Limestone.
70. W. Georgetti	Darwin	Magnetic iron ore with copper and iron pyrites.
71. Allan Innes	Duck River	Magnesian limestone.
72. F. Goninon	Latrobe	Micaceous iron gossan.
73. J. H. Cahill	West Coast	Fossil resin, copalite

W. H. TWELVETREES, *Government Geologist.*

ANNUAL REPORT OF THE ASSISTANT GOVERNMENT GEOLOGIST.

Government Geologist's Office,
Launceston, 30th June, 1901.

SIR,

I HAVE the honour to submit the following report on the work done by me from the 1st of February, the date of my appointment, up to the 30th June, 1901:—

During this period I forwarded to you the following reports, the result of my examination of the districts referred to.

3rd April.—Report on the Districts of Bell Mount, Five-Mile Rise, Dove River, Mount Pelion, and Barn Bluff.

In this report, an account of the general geology of the district in the vicinity of Bell Mount is given, together with a geological sketch map of the district, showing the relative positions of the various rock formations. The Shepherd and Murphy Tin Mine, the Bell Mount Hydraulic Gold Mine, and other sections, are described.

In the Dove River district, the Devon Mine was the only one at work. This mine is described, and means of access discussed. The prospects of other sections in the district are also gone into.

In the Five-Mile Rise Goldfield, the Golden Hill, the Golden Cliff, the Glynn, and O'Rourke's hydraulic mines, are described, and the prospects of the district discussed.

The geological features of the country on the route from the Forth Bridge to Mount Pelion are described, and an account is given of the discoveries of coal at Mount Pelion and of the old copper mine north of this mountain.

In the Barn Bluff copper district, the principal interest is centred in the Barn Bluff Copper Mine. This mine had only been at work for 2½ months prior to my visit. An account is given of its development up to that date. Several other shows in the district of essentially the same character are described. Means of access are also discussed.

4th June.—Report on the Mining Districts of the Scamander River and St. Helens.

This report deals with the copper deposits north of the Scamander River. The most important of these is the Eastern

Proprietary Mine. The latter had suspended operations at the time of my visit, but, in my opinion, there are excellent reasons for testing the lode in depth. Should this mine prove the existence of payable deposits of copper ore below water-level, there is no doubt that the whole district would go ahead. There are many other lodes of a similar nature in the vicinity. An alluvial tin-mining proposition in the Scamander River is reported on, I regret to say, unfavourably.

Three wolfram mines, situated between the Scamander River and St. Helens, are described. I regret that I was not able to speak more highly of them.

An account is given of alluvial tin-mining at St. Helens, and the possibilities of Thureau's Deep Lead proving payable in its lower gravels are discussed.

30th June.—Report on the Tin-mining District of Ben Lomond.

This district proved not only intensely interesting from the point of view of the mining geologist, but promises shortly to arouse the interest of mining men generally. An account is given of the general geology of the district, together with a geological map. Two classes of quartz veins are described, one of which is believed to be barren, and the means by which they may be distinguished are discussed.

The Mount Rex Mine is described, and a favourable report is given. An account is given of the Mount Rex Company's water scheme, and an estimate formed of the available water supply. Other mines in the district are also described, and, on the whole, the district is looked upon as one likely, in the near future, to become the centre of an important mining industry.

The South Esk Tin Mine is described. A supplementary report to that of the Government Geologist on the Roys Hill Mine is appended to the report on this district.

I have the honour to be,
Sir,

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, 1901.

SIR,

I HAVE the honour to submit my Annual Report on the inspection of mines for the year ending 30th June instant. Annexed are 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 miners, &c., employed in the State this year has been 7017, against 6834 the previous year; 8 men lost their lives by accident, against 7 the preceding year; and 23 were injured, against 16 for the corresponding term. The death-rate from accidents per 1000 persons was 1.140, compared with 1.024 the preceding year.

I beg to append hereto tabular statement No. 1, which gives the statistics for several years past, and table No. 2, in which the accidents for the past year are classified and arranged for easy inspection.

In this connection it is of interest to compare the death-rate in British mines with our own, though the comparison cannot be legitimately used to its fullest extent, owing to the great preponderance of coal mines in the United Kingdom; for instance, in the year 1900, 780,052 workmen were employed in the collieries of Great Britain and Ireland, while the number of men in metalliferous mines totalled only 34,465. For that year the ratio of mortality from accidents in and about coal mines per 1000 persons employed was 1.30, and in and about metalliferous mines 1.10, or, in both combined, 1.21.

It may be mentioned that the figures referring to non-fatal accidents are necessarily not so useful for statistical purposes as in the case of fatalities, for the standard of the seriousness or triviality of an accident is far from fixed. In the discrimination of accidents both inspectors and mining managers may differ. Some accidents are too trivial to be reported. However, in our register all real accidents have been recorded.

During the year one prosecution was conducted, and another has been decided upon as necessary.

Inspector Harrison visited the mines at Broken Hill this year, with the special object of examining the system of open working adopted there. The result of his inspections was to convince him that the practice followed in this State would compare well with methods elsewhere.

Owing to our geographical insulation, there is constant danger lest we fail to keep abreast with modern and improved methods of work, and I take this opportunity of recommending that each of our Inspectors of Mines be commissioned periodically to visit one or more mining centres on the Mainland, to gather information specially useful for mine inspection here.

The increasing number of mines and mining claims on the West Coast has necessitated the appointment of an additional inspector, and, on the 18th January, Mr. C. H. Curtain was appointed to the Lyell district and the field immediately south and adjoining.

The new Mining Act contains improved provisions for the regulation of work in mines, and for facilitating the task of inspectors. One of the most important additions from this point of view is a clause under Section 83, empowering inspectors to order the immediate cessation of work in any mine or portion thereof which they may consider unsafe.

The quantity of fresh air required to constantly circulate underground is now fixed by Statute, and anemometers are being supplied to the Inspectors, who will see that this provision of the Act is duly observed by mine-owners.

Special regulations have been prepared for the safety of men working in coal mines and in open cuts.

The new Act requires all mine-owners to furnish, in January each year, copies of plans of the extension of their underground work, without waiting for a Ministerial demand, as before. It is hoped that this will be noticed by those whom it concerns. The work of getting in plans from dilatory senders, and of reminding defaulters of the necessity for registering all appointments or changes of mining managers, continues to create considerable trouble in this office.

During the year I inspected the coal mines of Mount Cygnet and York Plains, which are too distant to be visited by any of the other Inspectors on their rounds.

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* 1901.

30 June to 30 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	2·057	5·877
1894 - 1895	3789	26	4	24	28	7·390	1·058	6·332
1895 - 1896	4160	22	7	16	23	5·529	1·682	3·847
1896 - 1897	4303	36	7	31	38	8·831	1·627	7·204
1897 - 1898	5530	36	13	33	46	8·318	2·351	5·967
1898 - 1899	6180	35	9	34	43	6·957	1·465	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

TABLE showing the Number of Persons killed and injured in and about the Mines of Tasmania during the Year 1900-1901.

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	5	...	...	...	...	...	2	1	7
Shaft accidents—														
Suffocation by natural gases	1	1	...	...	...	...	...	...	...	...	...	...	1	1
Overwinding	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ropes or chains breaking	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Machinery	...	...	...	...	...	...	...	...	2	...	...	...	2	...
Falling in or into shafts	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Things falling into shafts	...	...	...	...	...	...	...	...	...	...	...	1	...	1
Explosives	...	...	...	...	...	...	...	...	...	1	1	...	1	1
Miscellaneous	...	...	...	...	...	...	...	...	...	1	...	2	...	3
Total	1	1	...	...	...	...	...	...	2	2	1	3	4	6

Miscellaneous (underground).														
Explosives	...	...	...	...	...	..	...	...	...	...	...	...	...	...
Suffocation by natural gases	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Haulage :—														
On inclined planes	...	...	...	...	...	...	...	...	...	...	...	...	...	..
Ropes & chains breaking	...	...	...	...	...	...	...	...	...	...	...	...	...	...
By trams and tubs	...	...	...	...	...	...	...	...	...	...	...	2	...	2
Machinery	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sundries	...	...	...	..	...	...	...	...	...	...	...	...	...	...
Total.........	...	...	...	...	...	...	...	...	...	...	...	2	...	2
Total underground	1	1	...	...	1	5	...	...	2	2	1	7	5	15
On Surface—														
Machinery	...	...	...	...	...	...	...	...	...	...	...	1	...	1
Boiler explosions	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tramways	...	...	...	...	...	...	...	...	...	1	1	...	1	1
Explosions	...	...	...	...	1	1	...	...	1	...	...	...	2	1
Falls of ground...........	...	...	...	2	...	...	...	...	...	...	...	2	...	4
Miscellaneous	...	...	...	...	...	1	...	...	...	...	...	...	...	1
Total on Surface	...	...	...	2	1	2	...	...	1	1	1	3	3	8
Gross Total, 1900-1 ...	1	1	...	2	2	7	...	...	3	3	2	10	8	23
Total, 1899-1900..........	...	2	...	1	1	2	1	1	2	3	3	7	7	16

ANNUAL REPORTS OF THE INSPECTORS OF MINES.

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

I respectfully beg to submit my Annual Report as follows:—

Accidents.—Fatal, 5; serious, 2; non-serious, 4; total, 11. In each case that proved fatal the cause of the unfortunate victim's death was traced to his own want of thought or attention to what he was doing.

Ropes and Cages.—Ropes and cages have been attended to; several of the former have been condemned.

Ventilation.—The ventilation of the mines of the district is good throughout.

Magazines.—So far, nothing has been done towards erecting a public magazine for the Zeehan district, except the construction of a tramline to site of building, while the town is extending towards the three private ones. Their output per month is now, approximately, about 165 cases, exclusive of gunpowder. In the Lyell district we have some first-class underground magazines constructed, which have proved most effective while bushfires were raging.

Legal Proceedings.—Legal proceedings were taken against a mining manager for neglecting to properly secure his mine, but I failed to obtain a verdict.

Open Cuts.—As we have now eight open cuts going on the Coast, with the prospect of more in the near future, it was considered advisable that I should go to Broken Hill, New South Wales, and take notes of the system adopted there. I visited that field in May, but failed to see anything in the working of open cuts there that would be of any assistance to us; possibly, on account of the exceedingly dry climate, the managers are able to take chances that would be highly dangerous on this coast with our heavy rainfall.

Prospects of the Field.—Although the heavy slump in the price of lead has been keenly felt by some of the mines, I am pleased to state that none of them have found it necessary to close down on that account. The monthly output has been well maintained, and I have good reason to hope there will soon be a considerable increase. The steam tram now under construction to the Comstock district will bring that somewhat neglected district into touch with the railway, and allow the low-grade ores to be mined to advantage. At Mt. Heemskirk tin-mining is again looking up; some very favourable developments have taken place there during the year. The appointment of Mr. C. Curtain as Inspector for the Lyell district has given me more time to attend to this large and scattered field.

LIST of Accidents for Year ending 30th June, 1901.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
6 Sept.	Mt. Lyell	Mt. Lyell	Fell off stage	John McCarthy	Married	Back hurt	Fell off stage in shaft; neglected to nail stage boards.
28 Sept.	Western	Zeehan	Fell down man-way	Charles Bird	...	Fractured ankle	Stated no one to blame but himself.
19 Oct.	Oonah	Ditto	Ran truck into empty shaft	Frank Higgins	Married	Badly smashed up; fatal	Higgins was trucking below; ran truck into empty shaft, and went with it.
17 Nov.	Lyell Blocks	Mt. Lyell	Fall of *débris*	A. Miller	...	Broken leg	Repairing main drive when fall took place.
17 Dec.	Mt. Lyell	Ditto	Lifting full truck on to road	F. Bailey	...	Small bone of leg broken	
19 Dec.	Prince Darwin	Mt. Darwin	Explosion	Joseph Cahil	Single	Fatal	While endeavouring to light second fuse, first one went off; no one present at the time.
12 Jan.	Mt. Lyell	Mt. Lyell	Ran over by truck	Wm. Parkes	Ditto	Fatal; internal	Truck got away on an incline tram.
20 Mar.	Hercules	Mt. Reid	Truck came off incline tram	Peter Wheeler	...	Broken leg	
3 April	Flux Quarries	Zeehan	Struck by a stone	Joseph Martin	Single	Fatal; head fractured	After shot was fired, Martin was found dead; it is surmised that he left his cover too soon, and that a stone shot to a height came down and killed him.
20 June	Mt. Reid	Mt. Reid	Explosion	Robert Johnstone	...	Burned about face; not serious	
20 June	Montana	Zeehan	Fell down shaft	Ernest T. Miller	Single	Fatal; badly smashed.	Ran truck into shaft as sinkers knocked cage to bottom.

Fatal, 5; serions, 2; not serious, 4—Total, 11. In every instance the 5 unfortunate victims were the cause of their own death, by want of attention to what they were doing.

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

For the past five months the casualties that have happened in my district are as follows:—

Mount Lyell Blocks Copper Corporation:—

(1.) Octavius Blockey, lander, married, aged 60; lost his left arm by being caught between the tension-pulley and the hauling or running-rope on the aërial ropeway, while engaged oiling the axle of the former. He exhibited great nerve and presence of mind at the time, and is now convalescent.

(2.) William Stephens, a general hand, single, aged 40; was struck on the head by a small piece of firewood that was thoughtlessly liberated by a boy when passing the wood chute. A few days' rest, and Stephens resumed work.

(3.) John Chismon, miner, married, aged 38; received scalp wounds, concussion of brain, and dislocated thigh, through the fall of a small piece of clay schist from the roof of a chamber he was working in. These injuries were considerably augmented by Chismon being knocked against the edge of a piece of timber he was assisting to land. This accident happened on the 26th of last month, and Chismon is still an inmate of the Queenstown Hospital, where he is doing as well as can be expected.

North Mount Lyell Company, Limited:—

(1.) Angus McPherson, general, aged 59; had his leg broken by a piece of mullock rolling off the tip. McPherson was some distance from his usual place of labour, and was warned (sang out to) of the approaching danger, but, being slightly hard of hearing, could not profit by it.

(2.) William Pinkerton, miner, married, aged 45; through his own inadvertence in directing a set of points, was slightly jammed between an empty truck and a side leg in one of the main adits.

Mount Lyell Mining and Railway Company, Limited:—

In one of the open benches, a machine man, named William Kinsella, aged 23, single, was slightly injured through being jammed between a piece of ore and the tripods of his machine. He is again working.

Lyell Tharsis Company, No Liability:—

John H. Fry, general, single, aged 23; sustained a slight shaking through falling down a pass he was barrowing spoil into. A few days' rest, and he resumed work.

This concludes the whole, and, with the number of men engaged in the industry in this portion of the State, it may be submitted as satisfactory.

LIST of Accidents from date of Inspector Curtain's taking charge of District to 30th June, 1901.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1901. 30 Mar.	Mt. Lyell Blocks	Mt. Lyell	Caught in machinery	Octavius Blockey	Married	Loss of left arm	Arm torn off by becoming caught in running gear of aërial tram
13 April	North Mt. Lyell	Ditto	Rock rolling from tip	Angus McPherson	Ditto	Broken leg	Struck by rock rolling from tip.
9 May	Mt. Lyell Mining and Railway.	Ditto	Rock slipping	Wm. Kinsella	Single	Bruised	Got caught between a piece of rock and the tripod of boring machine.
18 May	Mt. Lyell Blocks	Ditto	Struck by piece of wood.	Wm. Stephens	Ditto	Scalp wound	Struck by piece of wood coming down chute.
14 June	Lyell Tharsis	Ditto	Fall down chute	John H. Fry	Ditto	Bruised and shaken	Barrowing spoil from open face and fell down chute.
26 June	Mt. Lyell Blocks	Ditto	Fall of stone	John Chismon	Married	Concussion of brain, and dislocated thigh.	Was cutting out a chamber, when piece of stone fell and struck him, knocking his head against timber.
28 June	North Mt. Lyell	Ditto	Crushed by truck	Wm. Pinkerton	Ditto	Severely bruised	Caught between truck and sill leg.

Fatal accidents, 0; serious, 3; non-serious, 4—Total 7.

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

I have the honour to submit my Annual Report on Mines inspected in the Northern and Eastern Districts of the State to the 30th June, 1901.

Accidents.—I am sorry to report an increase in the number of accidents as compared with the preceding year, there having been 13 in all; three fatal, seven serious, and three not serious.

Fatal Accidents.—Joseph Mozley was employed with a mate timbering dangerous ground in one of the stopes of the New Golden Gate Mine; he walked forward from the protection of the timber set up, to examine a pass, when he was struck down by a large lump of quartz falling from the roof or backs, the injuries received causing death within half an hour. No person was to blame for this accident. Mozley went into danger without being required to do so, and met his death through his own incautiousness. At the Anchor Tin Mine open cut workings, George Polkey went, with other men employed at the face level, into a place of safety behind a tank during the time shots were being fired; he was seen to step out from the shelter of the bank to play with a dog, and was struck on the head by a flying fragment of rock from a blast just exploded. In this, as in the preceding accident to Mozley, no person was to blame. At the Moonlight-cum-Wonder Gold Mine, William J. Thomas and William Fox were employed shaft-sinking at a depth from the surface of 750 feet. The country-rock is charged in places with carbonic acid gas. A Root's blower is in use for ventilating the mine and shaft, and when properly used is generally effective in producing a sufficient current of air for this purpose. The engine-driver in charge of the winding and blower engines, when the accident took place, had hurt his hand, and stopped the blower, so as to use the air-pipes for a speaking-tube to communicate with the men below, who then came to the surface, where they remained for an hour or so at crib time. The engine-driver sent for a man to take his place, but left the engine and mine before being relieved by the man sent for; he also neglected to again start the blower engine. When the driver sent for arrived and took charge of the engine, the men went below, descending by the cage to the plat at 600-feet level. Thomas then got on the bucket, and was lowered to the bottom of the shaft; his mate, Fox, standing by the knocker-line, and looking down, noticed Thomas' light go out; the bucket then touched bottom. Fox called, but got no answer from below; he then summoned the assistance of two men working in a drive at the level, and then descended on the bucket, and made a brave attempt to rescue his mate, whom he found lying at the opposite end of the shaft from where the bucket landed; but was in turn overcome. At this juncture Edmunds—one of the men at the plat—signalled for the blower to be started. His prompt action in doing this saved Fox's life, for it was a good many minutes after the air was turned on before Cornelius, a fourth man, after several daring attempts, reached the bottom, and rescued Fox alive. Cornelius immediately afterwards descended again, and brought up the dead body of Thomas. The fatal termination of this accident may be attributed, mainly, to the action of the engine-driver in not again starting the blower-engine after he had stopped it, or leaving any message for his fellow-driver to do so. The men themselves showed great carelessness in descending—after over an hour's absence—to the shaft bottom without first testing the nature of the air by ordinary means; also in not giving any instructions to have the blower started. All the men working in the mine were on contract, and had free use of the blower; they could have it stopped or started at any time, to suit their convenience.

Non-Fatal Accidents.—John Adams charged a five-feet vertical hole in the open-cut rock face at the Liberator Tine Mine, and, after having spit the fuse, stood by until the charge exploded. He received a bad scorching about the face and eyes, also some severe cuts and contusions about the head and face, through falling down the face of the rock-mass that was thrown out sideways by the force of the explosion. Adams has lost the use of his right eye, but is otherwise none the worse for the accident. He is unable to give any explanation of how he came to remain beside the drill-hole after lighting the fuse; probably it was temporary aberration of the mind that caused him to do so. William Nicholls neglected to sprag or secure by timber props the coal he was hewing in the Mt. Nicholas Colliery before holing, and was caught by a fall of coal, from which he received severe injuries, resulting in a broken leg and ribs, also severe contusions on the back and shoulders. Harry Lowe had his leg broken by a fall of earth while working alluvial ground 13 feet deep at New River. Lowe was inexperienced at the open cut work. Some blame is attachable to the management for putting an inexperienced man at the breaking down of the face. Frederick Beard had his leg broken by being struck by a hard lump of cement while working in the level of the open cut, at Pioneer Tin Mine. David Graham and Walter Clay were removing quartz piled against the hanging-wall of a big stope in New Golden Gate Mine; they were warned of the unsoundness of the wall, and told to secure the ground before going too far; this they neglected to do, and were caught, partly by the quartz and partly by the wall-rock. Graham had one of his legs broken. Clay got off with light contusions of the shoulder. William Gough was employed feeding the battery of the Australian Tin Mine, and in playing with another boy, slipped and fell, breaking his arm against the battery horse leg. William Fox, who was overcome by foul air when Thomas lost his life in the Moonlight-cum-Wonder Mine, makes the seventh on the list of serious non-fatal accidents. Percy Green and John McKie each received an injury to the foot by being struck with fragments of sandstone while working in the Nicholas Coal Mine.

Inspection.—All the underground mines in these districts, as also the deep-faced open cut workings, have been visited, and inspected, at regular quarterly intervals; one visit of inspection was also made to the outlying mines of Middlesex and Bell Mount. Safety cages, ropes, and chains, have been tested, and, where found defective, were remedied by being repaired, or replaced, as the case might be.

Explosives.—There is a great want of care in the storing and handling of these. Each mine has its own private magazine of some sort, there being no public magazines in these districts. In most cases the explosives are stored or kept on the surface in a short drive or adit, damp and badly ventilated as a rule.

Ventilation.—There is a reasonable amount of fresh air produced in most of the mines without any appreciable outlay on the part of the owners, natural ventilation being good. There are, however, some of our deep mines and coal mines that cannot be properly ventilated without mechanical appliances, which, in some cases, will mean considerable expense. Owners are, as a rule, slow to incur this additional expense without pressure being brought to bear; but now that the new Act of 1900 has come into force, the Inspector will be better able to enforce compliance with ventilation clauses.

Mine Equipment and Development.

A good deal has been done in this direction during the year, especially so amongst the tin mines.

The Briseis Mines, Limited, has finished over 1000 feet of tunnel through the hard granite, to provide an outlet for the overburden, which will be sluiced off into the Cascade River by this means. This company has also in hand the construction of about 20 miles of head-race, to bring water on to its mine from the Ringarooma River, from a point some miles above its junction with the Maurice. The carrying capacity of this race will be equal to over 100 heads, which would represent the maximum supply during the winter months; one-third of this quantity will probably represent the supply in summer time.

Three lines of syphon-pipes will be required to span gullies at different places. The contract for making these pipes is in the hands of Mephan Ferguson, of the Carlton Foundry, Melbourne. The diameter of the pipes will be 3ft. 6in.; they will be made of steel plates $\frac{3}{16}$ in. in thickness, straight seam rivetted, with spigot and faucet joints. Ferguson is erecting works at Scottsdale for the carrying out of this contract.

The Ringarooma Tin Mine, north of the river at Derby, has just completed a powerful pumping plant, to throw water on to its mine. The power-house is erected on the river bank, some little distance below the Main Road River Bridge. Four large boilers of the Babcock water-tube pattern are in use for generating steam; four direct-acting duplex pumps have been erected; each of these is capable of throwing 6000 gallons of water per hour to a height of 360 feet. The water will be pumped directly through the breaking-down nozzles from the power-house. It is estimated that from 280 to 300 tons of firewood will be consumed per month by this plant when in full work.

Pioneer Tin Mine.—Here, also, new machinery is being erected. For the past year the mine has been worked by an old plant, which, although giving fairly good results, is not powerful enough for working on a large scale. The new plant is erected on a large pontoon, 45 by 40 feet, and comprises two large boilers of the return tubular-marine type, capable of developing 450 horse-power, if required. Vertical engine—coupled compound condensing—high pressure 16in. and low 34in.; cylinders, 30in. stroke, both cylinders steam-jacketed, and fitted with double-piston valves and variable expansive gear for hand adjustment; all moving parts of engine to balance. Driving wheel for rope-gearing, 13 ropes, 1½in. diameter; pump, 15in. diameter gravel pump (centre), 3ft. 8in. diameter, with 3 port runners; the delivery-pipe is 16in. in diameter; both suction and delivery pipes are of lap-welded steel. The equipment also includes a complete electric lighting plant—4 arc and 20 incandescent lamps. The company has also constructed long lines of head-race, to bring water on from the Weld, Frome, and Wyniford rivers. Over £4000 has been expended in pipes alone in connection with this scheme. The result of the past half-year's working with the old plant is considered satisfactory, the yield of tin being equal to 1·5 lbs. per cubic yard of stuff treated. The average depth of the ground being worked is 50 feet, the drift carrying tin, more or less, from the surface down to the bedrock. There is no better equipped or better managed alluvial tin mine on the Coast than the Pioneer.

Lottah.—All the mines here, Anchor, Liberator, Australian and Crystal Hill, are crippled and retarded for want of a good supply of water. The Anchor Company has not yet finished the race to the North George's River. When it is completed, I am afraid the result will not be as satisfactory as could be desired. All the above-mentioned mines have gone far enough to prove the existence of almost unlimited stanniferous rock that can (even at its lowest value of $\frac{3}{8}$ per cent.) be made to pay, if only a sufficient supply of water for crushing-power is to hand. It is to be hoped that the conserving of water on the Wheal-Tasman Flats, near the top of the Tier, the site recently selected by Mr. K. L. Rahbek, Hydraulic Engineer, will be carried out by the Government; in which case, these mines could be supplied with sufficient water-power to work on an extensive scale. It seems a pity, and a great mistake, with tin at £130 per ton in the English market, to see these mines struggling along, and only giving employment to about one hundred men, where there is undeveloped scope for a thousand.

Mount Rex Mine.—The battery, calcining, and concentrating plant is now finished, and will have a trial run before long. This company has done a lot of preparatory and developmental work during the past year. The large and substantially-constructed conserving dam on Egan and Buffalo creeks will give a sufficient supply of water to drive the battery and concentrating machinery. Steam power is to be employed for winding. In working the ore-body in this mine, it was the intention of the owners to continue underhand stoping, with open set-timbers, from the floor of the big chamber downwards. This, in my opinion, would be unsafe, and the mine will now be worked by overhead stoping, on the rill system. By this means large voids will be avoided, and the ground filled in as the stoping proceeds.

Gold Mines.

The following mines, New Pinafore, Moonlight-cum-Wonder, Mangana (Tas.), Gold Reefs, Limited, and New Golden Gate Extended, have each received aid by way of subsidies from the Government, under the Deep Sinking Encouragement Act:—

The New Pinafore expended its vote of £2000 in driving and cross-cutting at the 1200-feet level, but was not successful in cutting payable stone. This is to be regretted, as the vast amount of developmental work done by this company deserved a better reward.

The Moonlight-cum-Wonder, since it obtained Government aid, has sunk its main shaft 150 feet, making the total depth 750 feet from the surface. A good deal of cross-cutting and driving has also been done at the 600-feet level, but without success, so far.

Mangana (Tas.) Gold Reefs Company, since obtaining Government aid, has sunk its shaft 100 feet, making the total depth from the surface 623ft. 6ins. Plats are being cut, and cross-cutting east and west will now be carried out.

The New Golden Gate Extended Company has expended portion of its grant in sinking below the 1000-feet level. Work at this mine is suspended for the present.

Sludge Channels.—The question of declaring the Ringarooma a public sludge channel has been deferred, pending the receipt of a report from Mr. K. L. Rahbek, who is now inspecting the river from Branxholm to the sea, about 60 miles.

INSPECTOR GRIFFIN'S List of Accidents for Twelve Months ending 30th June, 1901.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars
1900.							
13 July	New G. Gate G. M.	Mathinna	Fall of rock	Joseph Mozley	Married	Fatal; chest crushed in	Killed by fall of rock in stopes.
6 Aug.	Liberator T.M.	Lottah	Explosion	John Adams	Single	Severe scalp wounds, &c.	Firing a charge, and did not attempt to leave the spot.
30 Aug.	Mt. Nicholas Colliery	Mt. Nicholas	Fall of rock	Percy Green	Ditto	Injuries to legs	Wedging down roof, when a piece fell and toppled on to his leg.
8 Sept.	Krushka's Alluvial	Alberton	Fall of earth	Harry Lowe	Married	Broken leg	Undermining face, and part came on him.
12 Sept.	Mt. Nicholas Colliery	Mt. Nicholas	Fall of rock	John M'Kie	Single	...	Struck by piece of sandstone, which fell from roof.
17 Sept.	Ditto	Ditto	Fall of coal	Wm. Nicholls	Married	Scalp wound and bruised shoulder	Holing through, and neglected to sprag the top coal, which came down.
20 Sept.	Anchor T.M.	Lottah	Explosion	George Polkey	Single	Hit on head by rock; fatal	Failed to take shelter, and was struck by flying stone.
12 Oct.	Australian T.M	Ditto	Fall in battery-house	Wm. Gough	Ditto	Broken arm	Fell down in battery house
1901.							
14 Mar.	New G. Gate G.M.	Mathinna	Fall of rock	David Graham	Ditto	Broken leg	Moving stacked quartz, some of which fell down and injured the men.
14 Mar.	Ditto	Ditto	Ditto	Walter Clay	Married	Injured shoulder	
19 April	Pioneer T. M. Co.	Bradshaw's Creek	Fall of earth	Fredk. Beard	Single	Broken leg	Struck by a piece of cement dislodged from face.
17 June	Moonlight cum Wonder	Beaconsfield	Foul air	Wm.J. Thomas	Married	Suffocated; fatal	Shaft-sinking; Thomas neglected to take proper precautions to test air before going below, and was overpowered; Fox attempted to rescue Thomas, & also suffered.
17 June	Ditto	Ditto	Ditto	Wm. Fox	Single	Overcome by gas	

Fatal accidents, 3: serious, 7; non-serious, 3—Total, 13.

REPORTS OF THE COMMISSIONERS.

Mr. Commissioner Glover (Launceston) reports:—

In reporting on the mining industry on the Northern mining fields for the last twelve months, I regret that my record must be, as a rule, one of fluctuating prospects and barren results; although there may be a few of better promise. The number of promising discoveries, of the past, which, after a very limited attempt at development, were abandoned, and also others which yielded dividends for a limited period; but, when these ceased, soon exhausted the patience and the purses of the owners, in their still limited attempts at further development, and were similarly abandoned, are still lying in neglect through the insurmountable obstacle to mining in Tasmania—the want of available capital. The same paralysing conditions which operate on the gold-mining interest of these fields is also operative in the iron region at Ilfracombe; and, were it not for the existence of the great and flourishing gold mine at Beaconsfield, the Tasmania, the mining industry of the Beaconsfield and Lefroy districts might well be closed, until adequate outside capital can be obtained. It is, however, some satisfaction to be able to report that the Tasmania Mine at Beaconsfield not only maintains the extent and value of its yield, but, as its development proceeds, exhibits improving prospects. This mine employs 580 men, and for the past twelve months has yielded 33,079 ozs. of retorted gold, value £126,632. Of the three other mining operations worthy of mention on this field, the two long-existing mines known as the Wonder and the Moonlight, the owners of which have for very many years been carrying on their abortive labour, have recently been amalgamated as one mine; and the owners are now, with their united resources, and more effective operations, hopefully striving to, at length, achieve success. This work employs 20 men. The third mine is held by a Victorian company, who are actively working on the west of the Tasmania in the hope of discovering the continuation of the celebrated reef in that direction. There are, also, a few prospecting operations in progress, employing two or three men each. The asbestos enterprise, which, at its inception, some two years ago, by the Australasian Asbestos Company, gave rise to such high expectations, is at present inoperative. The great obstacle to its success was the want of a market for its product, nor is there a sufficient local demand, notwithstanding the pronounced success of the experiments in Melbourne last year, which proved its efficacy as a fire-resisting appliance for wooden structures.

The cloud of depression which has for a length of time overshadowed Lefroy continues, without any reliable promise of its being dispelled. The hopes of those who are interested in the future of Lefroy are now centred in the operations of the New Pinafore Mine, which, with the aid of the grant from the Parliamentary vote for encouragement of deep mining, have been devoted to prospecting at their 1200-feet level; but, up to the present, without success. Some excitement was caused a few months ago by the discovery, by a prospector, of payable quartz in the old workings of an abandoned mine in the neighbourhood of the once-prolific Volunteer reef. The prospector having obtained a lease of the ground, he, with the aid of two youths, his sons, has realised gold to the amount of several hundreds of pounds; but the later prospects do not maintain their earlier promise. Nevertheless, in the ordinary conditions of quartz reefs at Lefroy, the yield may recover, and the old abandoned mine may (like the Volunteer and others on the same field) become a valuable possession, to the limited depth of 300 or 400 feet. The only other mine of any promise at Lefroy is situate on a reef contiguous to the Pinafore, known as the White Pinafore, which gave very valuable prospects a year ago, and is still being vigorously developed. The party of three men who came from Queensland for the purpose, about three years ago, are still realising payable results from chemical treatment of the fine gold in the sand tailings, which had been accumulating for many years in Sludge Creek, from the crushings of many mines a few miles distant. This operation occupies six men, and the yield of gold, as nearly as can be estimated, has been about 300 ounces for the year.

The old surface alluvial gold-field of Lisle continues to occupy the principal labours of about 40 men, who are, for the most part, very limited landholders in the neighbourhood, but who also engage in alluvial gold-digging. This goldfield, however, is about to become the scene of an experiment in dredging on the depressed and humid localities, on the system adopted in New Zealand. Over two years ago, two companies were formed to engage in this enterprise, and they took up a quantity of land for the purpose. One of these at once proceeded to prepare the necessary machinery and appliances, but was, after a time, delayed by the universal impediment to Tasmanian mining enterprise—scarcity of capital. But the company now has all the necessary appliances completed and deposited on the ground, and it is expected that actual dredging operations will commence within about fourteen days.

The neighbouring goldfield of Golconda is confined to quartz prospecting. Within the past few months trial crushings have been made by several prospectors and leaseholders, amounting to about 160 tons, the yield of which averaged half an ounce per ton, which affords sufficient encouragement to perseverance. There are only 14 men engaged on this field.

At Middlesex Plains, Bell Mount, and Upper Forth River, the only mines now in operation are the tin mine known as "Shepherd and Murphy's Claim," which contains also a percentage of bismuth and wolfram, and the Devon Silver, or Galena, Mine. The former employs 12 men, and during the last few months yielded, from 200 tons of quartz, five tons of complex tin ore. The latter mine, during the same period, has yielded 21 tons of galena, valued at £13 per ton. This product has to be conveyed along 67 miles of principally bush road to Railton, 15 miles from the shipping port, and of this 67 miles for 17 miles the ore has to be conveyed on pack-horses, the cost of transport being £5 per ton. It is much to be regretted that the discoveries in this very mineral-bearing region are so few as to preclude the construction of means of transport, without which its development must be the work of generations in the future. At this portion of the Middlesex country a somewhat strong association was formed last year, to engage in hydraulic sluicing for gold. The necessary water had to be conveyed by a race for many miles, and up to within a few months ago, they had accomplished 300 chains of the race, and 30 chains of tail-race. It is expected that sluicing will be in active operation in about a month.

The dredging enterprise on the Whyte River, a few miles from Corinna, on the Pieman, is at length in full operation. The machine raises 100 tons an hour from the river bottom. Although there has not yet been a cleaning-up, imperfect trials have revealed a quantity of coarse gold; and the prospects of the undertaking are said to be most promising; and the first cleaning-up is looked forward to with great interest. The Whyte River will, in all probability, be the scene of several such enterprises.

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

I have the honour to submit my report for the year ending 30th June, 1901, upon the state of mining in the North-Eastern Mining District.

Gold.

There has been much depression in the state of gold-mining in this district during the past year, especially at Mount Victoria and New River, caused principally through the Ringarooma Gold-Mining Company having ceased to carry on mining operations since their battery, with mining and electric plant, was burnt, during the latter part of last year. It is expected that English capital will be found to mine this company's leases, which, if brought about, will cause a revival of mining at this place. There are a few small claims being mined, and one having machinery or a battery erected; on others, prospecting work is being done.

At Warrentinna, the "Bayley's Leases" Mine has been opened up by a drive put in about 300 feet in poor country, and a reef exhibited of payable size. A ten-head battery is now being erected, and it is expected that crushing will be commenced in a few months. There are a few other claims being prospected in this locality, but the want of sufficient capital to test the ground to a good depth retards the progress of this field.

At Waterhouse, prospecting operations have been carried on for some time on the old Southern Cross Claim, but, as yet, nothing has been done towards commencing to work the mine.

During the year ending 30th June last, 935 ozs. gold have been won from quartz, the amount of alluvial gold won for the same period being 295 ozs.; average number of men employed at the former being 37, and at the latter eight.

Tin.

In the vicinity of Ringarooma, there are several miners' claims being worked, which yield satisfactory returns. The old "Nugget" lease, now held by Mr. F. W. Krushka, and which contains tin lodes, is now being mined by him. A ten-head battery has been erected, worked by a 16-horse-power engine, for crushing the lode. Up to the end of June, 300 tons of stone had been crushed. Considering the saving appliances provided for treating the crushed ore, the returns are looked upon as being satisfactory. There is, also, a lease held by him (Mr. Krushka) at Tin Pot Creek, on which he is expending a considerable sum of money in driving a tunnel and other prospecting work in connection with a lode found upon it. So far the prospects are very encouraging.

In the Branxholm locality, the Arba Company has completed the erection of a large sand-pump, or better known as a suction dredge, by which the wash-dirt in the mine is removed or elevated from a low to a high level for treatment; with this there is a hauling plant at work also. The old workings have been unwatered, and the old faces are now being worked, from which it is expected to maintain a steady output of tin ore. There has been, also, a considerable quantity of overburden removed during the past year.

A very large amount of activity has been exhibited on the principal mining claims at Derby in providing mining plant and the construction of necessary preliminary development work. The Briseis Company's water-race from the upper part of the Ringarooma River is now in course of construction. A large number of men are employed on the work, besides three sawmills engaged in cutting timber for flumes, &c., for it, and a foundry has been temporarily established at Scottsdale for the making of pipes for syphons in this race. About 60 men are employed on the mine, but the shortage of water supply has largely retarded the production of tin ore. A new high-level race from the Cascade River has been constructed conjointly by this company with the New Brothers' Home No. 1 Company, which will afford about 100 feet more pressure than the old one, for hydraulic purposes, on their respective mines.

On the Ringarooma Tin Mines, Limited, claim, much solid progress has been made, and careful and skilful management exhibited. This company was floated in Scotland, in July, 1900, with a capital of £50,000, to mine the leases formerly known as the North Brothers' Home and Triangle Companies, which they purchased from the former lessees; with these leases has also been acquired from them their leasehold right to mine 242 acres of the adjoining freehold property of Mr. T. Beswick, which is considered to be intersected by the rich deep lead of alluvial tin ore in continuation through the leases from the former lease of the Krushka Bros. There is, therefore, an immense area of rich tin deposit to be mined on this company's leases. For providing an unfailing water supply for mining operations, a very powerful pumping plant has been erected, consisting of four Babcock and Wilcox water-tube boilers and four pumps of the compound duplex type, each of which pumps is capable of discharging 60,000 gallons per hour, at a pressure equal to a head of 360 feet, the water being taken from the Ringarooma River. The plant started work with one pump recently, and has proved entirely successful. The water is pumped to a nozzle 100 feet above the level of the river, through which it discharges with great force on to the face of the mine. So far, only development work has been done on the mine by the present company; 150,000 cubic yards of basalt overburden has been removed, in about six months, by means, chiefly, of a nozzle supplied by the company's Main Creek race. The former supply will now be used to still further remove the overburden, thus enabling the company to open faces in the richest portions of their mine, when it is expected that an output of five tons per week will eventually be obtained. The prospects of this mine are considered very good.

During several months of the past year but little has been done on the New Brothers' Home No. 1 Company's Mine, but recently mining operations have been resumed with much energy, and 30 men are now employed. The basaltic overburden is being removed by a system called "dry stripping," the stuff being conveyed in a trolly over a tramline, and deposited on a dumping-ground on the lease. There are 200,000 cubic yards to be removed by this method, which will occupy, it is estimated, nine or ten months, to accomplish, after which sluicing operations will be commenced for winning tin ore. It is to be hoped that this system of removing the overburden will prove economical and satisfactory, as it will so much lessen the quantity of material that would otherwise, by hydraulic methods, be discharged into the Ringarooma River. Where dumping-ground is available, lessees should adopt this system, especially during the summer months, or dry seasons, so as to obviate, as far as possible, the blocking of the river by discharging large quantites of stuff into it.

There are a few small claims held in the country along the Cascade River, extending back from Derby several miles, which are producing satisfactory returns of tin ore.

There is a marked improvement in the condition of the town of Derby. Additional accommodation of a better class has been provided by the erection of new buildings for that purpose. New buildings for business establishments, as also cottage residences, have also been constructed, and the place has now a prosperous and progressive appearance.

In the vicinity of Moorina, Frome, and Weld rivers, the development of the mines there is carried on with much industry, and, on the whole, the returns have been satisfactory. A good deal of preparatory work has been done in connection with a few of the large claims, in the way of cutting water-races, &c.

The Moorina Hydraulic Company have in use on their mine a Wilberforce pump, driven by steam power, which pumps the wash-dirt, in an efficient and convenient manner, to a higher elevation for treatment. It appears to do its work remarkably well. Seven men are employed on this claim.

Mining operations on the Pioneer Tin-Mining Company's leases at Bradshaw's Creek are carried on with much energy, under very competent and careful management, and with a considerable amount of success, considering the limited appliances hitherto provided.

The new water supply works from the Frome River have been completed in a substantial and satisfactory manner, after a considerable outlay of capital, and afford a good supply of water to the mine, enabling one large hydraulic elevator to be worked, as also supplying the pumping plant used in elevating the wash-dirt. A new powerful plant is now in course of erection on a very large punt, which rests on the bottom of the mine, but which, by watering the mine to a sufficient depth, can be conveniently moved to such positions as may be required for its use, which will afford sufficient power and capacity to elevate very large quantities of tin-bearing stuff from the lowest depths of deposit to the surface for treatment in an efficient and economical manner. With the present appliances, about ten or twelve tons of tin ore can be won each month; but, when the new machinery is brought into use, it is estimated that there will be an output of thirty tons per month. The ground comprised in the company's leases has been thoroughly prospected with boring-rods, and estimates made of the yield of tin from each cubic yard of stuff. The returns from the portions of ground thus tested, and already mined, have very fully realised the estimates obtained in this way. The tin-bearing ground has been proved to extend in payable quantities over a large area of the leases, and it is estimated that it will take very many years, with full mining operations carried on, before the ground becomes exhausted.

Tin-dredging operations are carried on by the Ringarooma Tin-Dredging Company in the locality of South Mount Cameron. It appears to me that the dredge used is not sufficiently powerful to treat a sufficient quantity of low-grade stuff per hour to produce remunerative returns. However, when the richer portions of the lease are entered upon by the dredge, I have no doubt that the yields will be satisfactory.

There is not anything of any importance to refer to as regards the claims at Wyniford River. Mining operations there are being carried on in a steady and satisfactory manner, and the returns are up to expectations.

In the Mount Cameron and Gladstone localities, the state of mining has been much depressed, largely through the shortage in the supply of water on those claims situate on the southern side of the Ringarooma, and elsewhere, that cannot be supplied by the Mount Cameron Water-race.

The unprecedented dry winter months experienced have retarded mining operations very much. A deep deposit of tin ore has been struck in mining the old "Scotia" claim, which, if proved to form part of a continuous lead, will do much to remove the depression from the locality. A water supply provided on the southern side of the Ringarooma River would enable a considerable area of stanniferous country around the slopes of Mount Cameron, and on towards Ringarooma Port, to be profitably mined, and would give a fresh impetus to mining in this part of the district.

The mineral lands in the vicinity of Mount Horror and Boobyalla River have attracted some attention, and several leases and water-rights have been taken up there, and preparatory work done. I understand that a Wilberforce mining pump and plant is about to be provided by a company to mine the river flats on these leases.

During the year ending 30th June, 683 tons of tin ore have been raised and forwarded from this district, the average number of men employed being about 400 Europeans and 150 Chinese. Considering the very dry periods experienced, with consequent shortage in the supply of water, and also that the large claims, with but one or two exceptions, have not contributed any part of this output, the yield, on the whole, appears to me very satisfactory.

Many miners who held land under miners' rights and miners' claims have abandoned mining such, and accepted remunerative employment on the large claims, and also on the works of construction on the Briseis Company's water-race.

The state of mining in this district appears to be passing from the system of the working of the shallow alluvial deposits, which were mined at but small cost, and which are now becoming exhausted, to the mining of deep ground, and also tin lodes, which require a considerable amount of capital to provide an adequate supply of water, and also machinery, to carry out successful development. Nothing has hitherto been done to ascertain, by boring operations or otherwise, the extent or value of the deep leads of tin ore which, no doubt, intersect the district, in continuation from such deep leads as at the Arba Mine, Brothers' Home, Moorina, Pioneer, and other places; nor has any substantial effort been made to test, at a good depth, the tin lodes found in the Upper Cascade Range country, or other parts of the district, from which it may be reasonably concluded that the alluvial deposits in the lower levels were shed. There is no doubt, apparently, a wide and encouraging field exists here for the legitimate investment of capital in developing its latent resources, and I anticipate that a few years will bring about a marked advance in this direction, and that experience and skill will remove the difficulties yield profitable returns if mined by dredging appliances sufficiently powerful to treat large quantities of stuff, and I have no doubt that, with a little more experience gained in this (to this district) new method of mining, that large areas of land will be worked in the near future. The shortage of water supply has been much felt, especially in connection with mining deep deposits, but this could be largely overcome by the construction of large reservoirs for storage purposes, and for which the country affords an abundant supply of suitable sites, where such could be constructed at a moderate cost. On the whole, taking into consideration the many disadvantages and difficulties experienced, I consider that the state of the mining industry in this district is very satisfactory, and that during the coming twelve months there will be a very substantial increase in the ouput of tin ore from the mines.

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

I have the honour to forward you my Annual Report, ending June, 1901, of the mining industry of the Eastern District.

Tin.

For three years we have had very dry seasons; consequently, the whole of the mines have been short of water most of the year, which, of course, has lessened the output of tin ore. The Anchor, and other companies, have expended large sums of money by the construction of water-races. Several of these are now well forward. The conserving of water in this district is very difficult, and, unless an intake can be had from one of the rivers, the supply is very uncertain. I am certain that, for the last 24 years, we have not had such a dry time.

At the present time, nearly the whole of the working miners are stacking their wash-dirt, waiting for rain. The shortage in the yield of tin ore for the year is simply caused by the want of water throughout the whole of the district.

Gold.

At Mathinna, there are some new finds, which are now being developed; others have stopped work for the want of funds. Still, gold-mining is on the up grade.

At Mangana, and in the vicinity of Fingal, several new finds are being actively prospected, with satisfactory results. Without being sanguine, I am of opinion that Managna will come to the fore before long.

Coal.

This industry is going steadily on, the quality of the coal being about the same at both the mines, and the demand for the coal is, I am informed, satisfactory.

Mr. Commissioner Fowell (Strahan) reports:—

I have the honour to forward to you my Report on the mining industry in the southern portion of the Western Mining District, for the year ending 30th June, 1901.

The depresison felt also in other parts has seriously affected this district, and very little progress has been made in direct mining. The inaccessibility of the majority of the mining properties, and the late inclement season, have also retarded progress.

The mines still working, and which deserve especial mention, are the Jukes Proprietary, Jukes Consols, and the Darwin Proprietary.

The North Mount Lyell Company has completed its railway, and is now pushing forward its works at the smelting site, which is, in every respect, a suitable one. One hundred men are employed in carrying out this work.

At Kelly Basin, both the sawmill and brick works are fully employed, and about 150 men are engaged there.

During the year, a company, named "The Farm Cove Coal Mining Company," has taken up leases for coal, and done a considerable amount of prospecting, with, so far, encouraging results. A hand-boring machine has been used. At 210 feet a seam of coal was passed through about 2ft. 6in. in thickness, and assaying 67 per cent. fixed carbon. A depth of 315 feet has been reached, the bore having passed through sandstone, shale, and, at the lowest depth, fire-clay, also, small seams of coal. To give this property a thorough test, the diamond-drill is required, and the company is prepared to work it, if it could be obtained.

The Birthday Company section, on the Ocean Beach, between Point Hibbs and Cape Sorell, has, during the past year, been prospected vigorously, and with such good results that there is every prospect of a company shortly being floated.

On the southern end of Macquarie Harbour, and on the western shore, asbestos has been discovered. A trial is being made to utilise it for the purpose of manufacturing bricks. Should it prove a success, it will largely benefit the mining interest on the West Coast, as, at the present time, these articles have to be imported from Europe.

In conclusion, I can, with confidence, state that mining on the West Coast is steadily progressing. The mines now at work are self-supporting, and speculation has died out.

Mr. Commissioner Hall (Zeehan) reports:—

Towards the end of the year 1900, the average monthly output of silver-lead ore from the mines had increased very much over the average for the earlier portion of the year; but it fell considerably in the early part of 1901, owing, principally, to one or two of the mining companies having worked out the easily-obtained ore deposits, and not having the capital to systematically explore and develop their mines at a depth from the surface, being compelled, therefore, either to close down their mines, or have recourse to the somewhat unsatisfactory method of letting portions on tribute. These causes, however, will probably have only a temporary effect on the production of the field. The export already shows signs of increase, and I anticipate will soon exceed what it was at the end of 1900. This will result from several mines, which, known for some years, and believed to be payable, are only just now having active mining operations begun to make them productive.

The Western Mine, for some time the most productive on the field, has, since starting, some nine years ago, raised 37,000 tons of ore, containing, by asasy, 3,599,344 ozs. of silver and 19,717 tons of lead, the net value of which, at the mine, was £466,660; £102,000 has been paid in dividends. The output during the twelve months ending 31st March, 1901, was 2892 tons of ore, containing 242,405 ozs. of silver, 1498 tons of lead—a falling-off on the previous year's production. The mine is fully equipped with up-to-date machinery, and employs over 200 men. There has latterly been an improvement in the stopes of the mine, and the output for next year may come up to previous years' productions.

At the Western Consolidated, the principal work done has been the sinking of No. 5 shaft. A small quantity of ore was sent away from the mine, and some taken out was stacked on the surface. About 24 men are employed.

At the Queen Mine a number of tributors are at work. Some of them are doing well. The mine has been on tribute the whole year, an average of about 68 men being employed. During the last half of the year 480 tons of ore have been raised, the net value of which was about £3000.

The Oonah Company ceased work during the year, and has since let portions of the mine on tribute. From the stannite lode regular parcels of ore are being won. Tenders have been invited from miners willing to take the main shaft on tribute, but, so far, without success.

A number of small tribute parties are working on the Queen Extended, some of whom are doing fairly well.

Regular work has gone on at the Montana Mine throughout the year. The total output of ore for the twelve months was 3847 tons, of a gross value of £78,860. The average assay value was—silver, 89·427 ozs. per ton; and lead, 63·734 per cent. per ton—the total silver contents being 344,027 ozs., and lead 245,188 units. The company consists of 80,000 shares, all paid up to £1, and the dividends paid up to date amount to £65,522. The total output of ore from the mine up to the end of June was 19,812 tons. The average number of men employed during the year has been 180. During the year the company has expended on the mine a sum of £35,987, divided as follows:—Wages, £24,415; machinery and plant, £2860; other mining requisites, £9712.

The output of ore from the Mount Zeehan (Tasmania) Mine for the twelve months was 4042 tons, of a gross value of £74,806. Of this, the company won 2653 tons, of the value of £57,938, and tributors won 1389 tons, of the value of £16,868. The company expended during the year the sum of £22,475, distributed as follows:—Wages, £15,122; machinery and plant, £2114; and other mining requisites, £5239. This does not include the expenditure of tributors, of whom there has been an average of about 38 at work during the year. The company has employed an average of about 130 men.

The Silver King Company has re-erected on its mine the machinery and plant formerly on the McKimmie section at Dundas, and again have started work underground at the main shaft. The South King tributors have erected concentrators for treating their seconds. They have taken the Silver Bell section on tribute, and have during the year maintained an enterprising and progressive policy in the exploration and development of their section. The output for the year from the King section was 2243 tons of ore, which was sold locally, and realised £24,468; most of it came from the South King tribute.

Work has been continued during the year at the Colonel North Mine, and small quantities of ore raised and sent away. The concentrators have been overhauled, and put in thorough working order. At a cost of about £500, their capacity has been increased 90 per cent., without any increase in the labour of running. The effect will be to reduce the cost of treatment by about one-half, besides saving a large percentage of mineral that formerly was carried off with the tailings. There are many sections on which small tribute parties are at work. They meet with varying success, and, of course, add to the mineral output of the district; but, except in one or two instances, it seems more than doubtful if the system of their employment is beneficial to mining generally.

A good deal of attention is being paid to the Comstock district. The South Comstock Company has been floated, with a substantial working capital, and work at the mine commenced. Until the Comstock tramway has been constructed, the company will not employ many miners, but the necessary surveys are being done, to ensure the speedy and systematic development of the mine as soon as the tramway nears completion. There are already several hundred tons of ore at grass. The whole of the Comstock district, especially along the route of the Government tramway, is being thoroughly prospected by a number of small parties.

There are welcome signs of a revival of mining in the Dundas district. Many miners are prospecting over the different sections, with promising results, and several tribute parties have had good returns from their claims. The Comet has continued work throughout the year, and has produced in the last nine months 996 tons of ore, which, on being sold to the local smelting company, realised £7238.

The section formerly held by the South Curtin-Davis Company has been taken up again, and is being worked under the name of the Surprise Mine. Encouraging results have been obtained from operations in the old tunnels. The property is under offer for flotation in London. The Hecla-Curtin Mine has also been taken up and explored, and efforts are being made to obtain capital to work it. High returns have been had from a tribute on the Curtin-Davis Mine. A winze has been sunk on the lode for a distance of 25 feet, exposing 2 feet of first-class Fahl ore. A drive on the course of the lode shows it opening out to a width of 3 feet.

The Fahl-Ore Mine has been closed down. During the year ending 31st March last, the company sold about 90 tons of ore, which realised about £400. One parcel of 6 tons 15 cwts. of firsts assayed 158½ ozs. silver and 7·95 per cent. of copper, and realised £105 net.

The Ring Valley Company has been recently floated, with a good working capital, and mining has been resumed on the section.

The Hercules Company has begun to actively develop its mine, and make it productive. During the half-year ending 30th June, 2184 tons of ore were sent away to Dapto Smelting Works, and realised £8341 net. An agreement has been made with the Smelting Company at Dapto, by which 10,000 tons of gossan ore and an equal quantity of sulphide ore are to be supplied to the Smelting Company. Arrangements are being made to erect a drying plant, and, when that is completed, deliveries will probably be made at the rate of 200 or 300 tons weekly. It is likely that an arrangement will be come to between the Hercules Company and the Tasmanian Sulphide Smelting Company for the erection, by the latter, in the vicinity of the mine, of works of the Ellerhausen zinc-lead patented process, in order to treat the large quantities of sulphide ores contained in the mine.

The Mount Reid Company has continued development work at its mine, and has made, throughout the year, regular deliveries of ore to the Tasmanian Smelting Company. On 31st December, the company had broken and stacked at the mine 14,647 tons of ore. The ore won to that date totalled 21,530 tons, of which 6541 had been delivered to the Zeehan Smelters. For the quarter ending 31st March, 1901, 734 tons of ore, containing 290½ ozs. gold, 16,210 ozs. silver, 93 tons of lead, 5¾ tons of copper, and 186 tons of zinc, were delivered to the Tasmanian Smelting Company, the net value of which, at the mine, was £4800.

Scarcely any mining work is being done in the Rosebery district. The Tasmanian Copper Company is still awaiting results of experiments in treatment of its low-grade ores. The Butterfield process is now spoken of most hopefully, and it is not improbable that that treatment will be adopted, and active work begun, at the mine within a short time.

TIN.

The Federation Tin-Mining Company at Heemskirk has continued work through the year. Up to the end of March, 720 tons of lode-stuff had been treated at the company's battery, giving a return of £783. For the last quarter of the year about five tons of tin were exported.

A parcel of five tons of tin ore was sent to Melbourne for treatment from the Renison Bell Mine at Dundas, and resulted satisfactorily. There is a number of miners prospecting for tin on adjacent sections, and also sluicing in the creeks at North Dundas.

With the exception of a few months, while the patented Huntingdon and Heberlein process of roasting sulphide ores was being installed in its works, the Tasmanian Smelting Company has continued smelting during the year. The new process has been very successful, and has very much facilitated the treatment of sulphide ores of the class produced in the district.

Mr. Commissioner GILMORE (Queenstown) reports:—

Lyell Division Western Mining District.—The last year cannot be said to have been altogether a prosperous one for this part of the district, but, though the fact is undeniable, there is no reason for thinking that the depression is permanent, but rather one of those downs which have occasionally been the lot of even the most productive of fields; and the near future will, in all probability, show that there is a copper lining to the cloud. The construction of smelters at Crotty for the North Lyell Company must, of necessity, give an impetus, and they propose, not only smelting ore, but manufacturing copper-plate, wire, explosives, &c., which will of a surety bring a return of prosperity. The Mount Lyell Company, popularly known as "The Big Mine," has, during the past year, purchased the Royal Tharsis property, for the purpose of increasing its reserves of ore-bearing flux. The South Tharsis and Royal Tharsis can easily be worked together, and a quantity of fair-grade ore obtained. Towards the end of 1900, at the No. 5 level, the main body of ore became richer, and this part has been stoped ever since. The most important work going on is the sinking of a main shaft. This work was started simultaneously from Nos. 5 and 7 levels, the distance between the two levels being 142 feet. From No. 5 level, a depth of 100 feet has been attained, leaving about 42 feet to go to get through to No. 7 level. From No. 7 level the process of sinking has not been so rapid, as the country was harder; however, a depth of over 50 feet has been reached. When a depth of 100 feet is reached below No. 7 level, it is intended to open out, and drive for the rich ore-body. Nos. 5, 6, and 7 levels are lighted with electricity. The number of men constantly employed has not been quite as large as last year, but that, under all the circumstances, is not surprising. At the present time, only 17 out of about 40 miners are at work. To the courtesy of the general manager, Mr. Sticht, I am indebted for the following information as regards the amount and value of metal won during the year ending 30th June last:—

Gold, fine.		Silver, fine.	
ozs.	Approximate value.	ozs.	Approximate value.
	£		£
23,446	99,645	630,902	77,441

Copper.	
tons.	Approximate value.
	£
9269	703,900

or a total value of £880,986.

The North Lyell Mine produces about 1300 tons of ore per week, some two-thirds of which is sent to the Mount Lyell Smelters, the balance being shipped to Germany and elsewhere, for treatment. This mine is certainly nearing the dividend-paying stage, which will benefit not only the particular district, but all and sundry. This property contains no less than four bodies of ore, all payable, and all of a more or less high grade. The railway connecting the part of Kelly Basin, or Pillinger, with the mine has now been handed over by the contractors to the company, and made much use of by them for pushing on their works. The carriage of timber used to be a very heavy item, but now it is delivered at Linda by the railway, and then sent on to the mine, by process of the aërial rope-way and tramway. The horse-trucks have been done away with to the Mount Lyell haulage, and heavier rails having been laid, an engine can now run the entire distance. During the past year the company has sent about 25,000 tons to the Mount Lyell Smelters, valued at £123,000, and shipped from Pillinger, 12,000 tons, valued at £135,000.

The Lyell Tharsis Mine has produced for the last six months some 766·6 tons, with an average of 4·63 per cent. copper. Mr. W. H. Vale is now manager of the mine, and his principal work for some time has been to get rid of the overburden caused by the fall last year. It was thought that the good ore had been lost at the 100-feet level of the main shaft, but recent work proves that it continues, and is of very even grade. A diamond-drill has been obtained to further prove the mine at a depth, and this is now being used to bore from the 100-feet level to reach the footwall at a depth of about 200 feet. For many months past the daily output of ore to the smelters has been from 60 to 70 tons, averaging 4·63 per cent. of copper. This mine is self-supporting, which is the next best thing to dividend-paying. The latter is a consummation devoutly to be wished, and by no means impossible. The amount received in payment for the ore for the last six months is about £10,000.

The Mount Lyell Blocks Mine is second mine of the field for the quality of its ore, and has been steadily working and improving during the year; for quantity of output, it stands fourth on the list. For the last six months its output has been 7500 tons, but the average was 8 to 8½ per cent. copper, which speaks volumes for the quality. This mine is undoubtedly one of the best on the field; not to speak of minor developments, it has a fine body of rich ore, and an immense body of gossan, rich in native copper. The main ore-body shows a width of over 90 feet in the bottom. This company recently purchased the winding-plant from the Volunteer Gold Mine, Lefroy. The shaft has been sunk to a depth of 455 feet. A bench has been opened in the huge deposit of gossan clays, which contain native copper. The main ore-body of this mine is probably a continuation of the eastern ore-body of the North Lyell, as that body is close to the boundary of the two mines. The prospects of this mine are certainly bright, and will help to brighten the field.

The Queen River dredging plant near Lynchford is now in full operation, but, so far, the success which the plucky promoters of the undertaking deserve has not attended their efforts. Though every care was taken to select the most suitable place for starting the dredge, the fates were unpropitious, and a hard bar was struck which greatly upset matters. The machinery seems to work well, and gold there is in the river. The directors seem hopeful of ultimate success.

There is a future before the *Mount Lyell Comstock* when the branch railway is run into it to provide an outlet, and the difference of opinion as to route settled. The mine is thoroughly opened up, and some of its ore goes as high as 12 per cent. Benches can be started without removing overburden, and, owing to the steepness of the country, the facilities for mining are very great.

Other mines which have been slowly but surely developed during the past year, are the *Crown Lyell* and *South Mount Lyell*, but both are at present closed down. The *South Lyell* was about to receive Government assistance, and the reason of their shutting down does not seem very clear. The *North Lyell Consolidated* have lately struck a formation which is considered to be a continuation of the Tharsis line of ore. A shaft is being sunk, with the intention of opening out at the 50-feet level.

On the *Western Tharsis* good prospecting work has been continuous during the year, and the energetic manager, Mr. H. Buchanan, has faith in the future of the property, and in the work he has done he has thoroughly prepared for greater things.

The Prince Lyell is at present shut down. The legal management does not appear to be what it should, and the hands of the mine manager, who is a thoroughly capable man, are tied.

The North Crown Lyell has some good ore in the upper level, and is also under the able direction of Mr. T. W. Roberts, of the Prince Lyell.

The Tasman Lyell is now in the hands of a London company, and is under the management of Mr. John Ryan, but the work is mostly of a prospecting character.

The Lyell Reserve, though an immense property, and in the hands of a London company, seems, Micawber-like, to be waiting for something to turn up.

Good things may be expected in the future from the *Great South Lyell*, *North Prince Lyell*, and *Tasman Crown Lyell* Extended. The latter especially, from all appearances, is a coming mine. It is situated near the Comstock Mine, some little time back a solid lode of galena 8 feet thick, assaying 20ozs. of silver and 4·5 per cent. lead per ton.

In conclusion, although the last year has not been too prosperous, and depresison is still felt, nevertheless, indications are such as to afford a more than reasonable hope that, in the near future, the mines, worked in a manner combining prudence and progress, will bring about renewed prosperity.

Mr. Registrar Fidler (Waratah) reports:—

I have the honour to Report on the mining industry in the Waratah division for the past year, as follows:—

The Mount Bischoff Mine still maintains its usual output of 120 tons per month, and has the appearance of continuing to do so for many years. No new developments on the mine.

The West Bischoff has almost completed the erection of machinery, which will consist of a cup mill and Wilfley tables, which will enable the management to maintain a regular output. A new tunnnel has been driven some distance, which will be connected by a rise to No. 4 tunnel. Tramway from the mine to the mill has been thoroughly repaired. Active operations are expected to commence in about a month.

Magnet Silver Mine.—Active work on the mine has been suspended for the present. The energies of the engineer-in-charge are entirely devoted to the pushing on of the construction of the tramline from the Emu Bay Railway, near Waratah, to the mine. Hoppers are being constructed for the reception of ore and the ready filling of trucks. The earthworks on the tramline are completed to about the seventh mile; laying of rails is about to begin.

Godkin Silver Mine.—The Godkin Company is putting in a tunnel at as low a level as possible, for the purpose of opening up the mine, and is saving the cost of pumping machinery.

Confidence Mine.—No work is being done on this property at present. The present holders are negotiating with a Sydney firm, with a view of finding capital for opening up the mine.

Ten-Mile P.A.—A party of five men have this section on tribute, and, besides doing dead-work, have won 30 bags of tin of first-class grade during the last six weeks.

At a mine known as the Discoverer, Messrs. W. R. Bell and L. J. Smith are doing a large amount of prospecting work, with fair prospects of success.

Long Plains.—The sections having been lately surveyed, there is every prospect of work being resumed shortly.

Specimen Reef.—A fair amount of prospecting work has been done on this mine during the past year; at present it is shut down.

Rocky River Mine.—This mine has been idle for some time One of the principal shareholders having visited the mine lately, it is believed that active work will be begun again shortly. The Consolidated Rocky River sections, south of the Rocky River Mine, are being vigorously prospected by Mr. John Templar, with excellent prospects of copper, associated with gold and other minerals.

Whyte River Dredge.—After considerable trouble, the dredge has been floated down to the starting-point. Captain Taylor, who is in charge, has stated that the dredge is working well.

At *Lucy Spur*, Townsend and party are sluicing for gold, with every prospect of success. Operations at Stanley River are suspended for the present.

Mount Farrell.—At the North Mount Farrell and Macintosh Mines, active work has been suspended for the present. Both mines have good prospects, the North Mount Farrell having sent away a large quantity of ore. No work has been done on the tramline to connect this mine with the Emu Bay Railway.

The Murchison Mine is sending away ore of high grade. A large amount of work has been done on this mine by tunnelling and drives.

Tracks have been completed from Waratah to Mount Ramsay, round Parson's Hood, to the Stanley tinfields, also from Waratah to Mount Balfour, which will enable prospectors to get into and examine this little-known country. The district is still progressing, and there is every prospect of it continuing to do so.

DESCRIPTION OF THE ZEEHAN-MONTANA CONCENTRATING PLANT.

By John Craze, *General Manager*.

As a rule, the ores of metalliferous minerals are not found in such a rich state as will permit of the mineral being at once sent to the market. Consequently, it is necessary that some system be adopted to get rid of worthless gangues and country-rocks which form part of the mineral veins, or may become mixed with the rich ores in the mining operations, thus increasing in quality the metallic contents of the ore, and avoiding the cost of freight on worthless rock to smelting furnaces, which are fequently at long distances from the mine.

Active mining operations are at present being carried on at the Zeehan-Montana Mine, of which I have had the honour of being Manager during the past eight years, on nine distinct lodes or veins, varying in size from two inches up to three feet in width. These veins or lodes are being worked simultaneously, at four levels, each level being 100 feet below the one above. The course of the veins varies from 30 degrees east of north to 30 degrees west of north, and in their strike they pass through various classes of country-rock, so that, while in one part the walls of the lodes or veins may be of slate, in another they may be of melaphyre, quartzite, or schist. The gangue of the lodes also changes as frequently as the country-rock. In parts of the mine quartz predominates as a lode gangue, while in another part the lode is composed of slate, with small veins of argentiferous galena intermixed; while again, in other parts, carbonate of iron composes the major part of the lode. Sometimes, veins and branches of pure galena are found in the carbonate of iron lodes, but often the galena found in these lodes is finely disseminated through the gangue or carbonate of iron in such a manner that without some system of reduction or concentration, it would be valueless. Various other minerals, such as zinc-blende and iron pyrites, are found in the lodes, and of the two named, zinc-blende predominates. As the smelting people who are purchasers of our argentiferous galena, have serious objections to zinc in lead-ores, and do not forget to exact heavy premiums from the seller when this mineral is found in the lead-ores, the duty of the mine-owners is to allow as little blende as possible to be sent away with the marketable product.

The system adopted in mining the lodes is practically the same, whether driving a drive or stoping. The country-rock is first mined and disposed of; the lode is then broken down on platforms, under which is spread a coarse canvas or sacking, so that any small particles of ore which may fall through the joints of the platform are recovered on the canvas. The lode-material being broken down, is now hand-picked by the miners, who select the clean galena from the inferior lode-stuff. The clean galena is sent to the surface and conveyed to the shed, and broken into a convenient size, and bagged for export. The remaining portion, which is practically refuse, composed of inferior lode-material, and containing quantities of country-rock which have formed a portion of the lode-filling, and unavoidably become mixed with the lode-material in the mining operations, and cannot, without loss, be separated in the mine, is sent to the surface and conveyed to the concentrating works, where it is concentrated, the principle of which will be explained later on. The reader can very well imagine from the foregoing that the material sent for concentrating is a very fair mixture of mineral and rocks generally. This material is known as second class ore, and is composed of the following:—quartzite, schist, slate, melaphyre, quartz, carbonate of iron, iron pyrites, zinc blende, and argentiferous galena. Each of these contain silver in more or less quantities, as instanced by numerous assays made from time to time. The quartzite gives from 1·30 to 3·2 ozs. silver per ton; slate, when forming the walls of the lode, from 2 to 3 ozs.; carbonate of iron, from 1·5 to 3 ozs.; zinc blende, 4 to 12·5 ozs; while each gives from a trace to 1·5 per cent. lead per ton. From numerous tests made from time to time, I am of opinion that the silver contained in these rocks is not in chemical combination with the lead, or, at least, not in the form of sulphide of lead, and, consequently, the system of concentration adopted is not calculated to recover these units. Our system is purely a silver-lead concentrating plant, so that any silver or lead not in the form of argentiferous galena is actually lost; and any silver or lead that may be associated with any of the rocks is also rejected as tailings, hence, they go to build up the loss sustained by concentration.

The total output of the mine averages about 1500 tons of lode-material per month, and, taking an average of our returns for some years past, one twelfth of this will represent hand-picked ore, while the remaining eleven-twelfths is second class ore, and is subjected to concentration. The first class ore averages about 100 ozs. silver and 63·5 per cent. lead, while the average assay value of the second class ore for the past two years, gives 12·71 ozs. silver and 7·20 per cent. lead per ton; and zinc, 5 per cent. The percentage of silver per unit of lead is here shown as equal to 1·76 in the second class ore, and 1·57 in the hand-picked ore, the difference being probably due to the silver contents of the rocks and zinc. I have shown that one twelfth of the output from the mine is actually marketable, while the remaining eleven-twelfths, assaying 7·20 per cent. lead and 12·71 ozs. silver, is worth, in actual money (taking present price of lead at £12 5*s.* per ton, and silver at 2*s.* 3*d.* per oz.), only £2 6*s.* 2*d.* per ton; and is thus unmarketable, and practically useless. Hence, the necessity of reducing the bulk and increasing the value in order that some revenue may be derived to assist in the profitable working of the mine. However much may be said in favour of smelting low-grade ores of the Zeehan field or in any other field with similar gangues, the fact must not be overlooked that first of all there must be sufficient mineral contents to defray the cost of smelting charges, and reduction for losses in smelting. If the contents of the ore are not sufficient to cover this cost and leave a further margin of profit over mining expenses, it would be useless to subject the ore to the smelting process. It is not the purpose of this paper to state that all ores, either auriferous or argentiferous, require the same process of concentration. On the contrary, the proper method of concentrating depends entirely on the class of ore to be treated. Hence, the system adapted to one class of ore may be entirely unsuited to another. The ores of the Zeehan-Montana Mine are being mined below the oxidised zone, and the particular system of concentration adopted is calculated to deal with the carbonated and rocky formations in which the argentiferous galena is found.

Concentrator.

The concentrating plant is situate about 230 feet from the main hoisting shaft and connected therewith by an overhead tramway, over which the ore is conveyed to an ore-bin attached to the concentrating plant. The capacity of ore-bin is 90 tons, the object being to keep a constant supply of ore for the steady running of the plant. The plant, which was erected in 1897, under the direct supervision of the writer, is erected on what is commonly known as the terrace system, *i.e.*, in benches. The total height from the floor on which the slime appliances are erected to the floor on which the ore enters the building is 40 ft., while the total length of building is 160 feet. The ore, therefore, after entering the building, continues downward through the various stages of breaking, crushing, and sizing, until its final exit as a clean marketable product or valueless tailings. The second and third products of the various jigs,

&c., which require fine crushing before re-treatment, are elevated to fine rolls, and again continue downward through the various systems of classification, finally passing out as clean products or tailings.

Water.

The water necessary for dressing purposes is pumped from the mine and carried direct to a large tank situate near the ore-bin, from which it is conveyed by a complete water service of cast-iron pipes, through the plant to the various machines. After having passed through the mill, it enters a large settling-pit at the lower end of the mill, where it becomes clarified. In the event of the water in the mine becoming less and the supply insufficient for dressing purposes, this water is pumped back and used over again, and in this way an ample supply is maintained. This system, however, has its drawbacks, and we are now constructing a dam situated above the mill, the area of which will be sufficient to allow proper settling and a continuous supply direct.

The ore is fed direct from the ore-bin on to a grizzle or barred screen, which is set at an angle of 50 degrees, and extends from the doors of the ore-bin to the rock-breaker, a distance of 10 feet. This grizzle is constructed of $\frac{3}{8}$ inch by $2\frac{1}{2}$ inches iron bars placed on edge, with distance pieces $\frac{7}{8}$-inch thick, placed between the bars at intervals of 2 feet. These are kept in position by bolts passed through the iron bars and distance pieces, holding together the screen, which forms a grating. The ore passing over this on its way to the rock-breaker becomes divided, the smalls up to $\frac{7}{8}$-inch diameter pass through the grizzle and are caught in a V-shaped shoot lined with $\frac{1}{4}$-inch steel plate, and carried downward, with the assistance of a small stream of water, to No. 1 trommel, while the coarse ore passes on to the rock-breaker.

Rock-breaker.

The rock-breaker is one of May Bros., Gawler, S.A., and is capable of crushing 7 tons per hour. It is set to break to 1-inch diameter. The ore thus broken falls on to a shaking-table, inclining $1\frac{1}{2}$ inches in 3 feet, and fitted with a perforated plate $\frac{7}{8}$-inch diameter. The fine ore passes through these holes into the V-shaped shoot, becomes mixed with the fine ore from the grizzle, and carried on to No. 1 trommel. The coarse ore which does not pass through the perforated plate is deposited on a circular revolving picking table, where any stray pieces of pure galena are picked out and bagged for export, and the purely waste rock discarded, while the second class ore is carried along by the revolving table to a shoot, where the table is automatically relieved of its contents, depositing them in the shoot which conveys the ore to coarse rolls.

Rolls.

These rolls are of the Cornish type, are 24 inches diameter by 14 inches across the face, and made of toughened steel. They are driven by belt and spur-gearing attached to one roll, while the other is driven by the friction of the other roll revolving. They make about eight revolutions per minute, and are adjusted by means of heavy set screws, with steel spiral springs to allow for the expansion of rolls. These rolls are set to crush the ore to 13 m/m. diameter, and the ore, after passing through the rolls, falls into the V-shaped shoot previously mentioned, and becomes mixed with the fine ore from the grizzle and shaking-table before described. It is at this point where all samples are taken of the crude ore being treated, before entering the No. 1 trommel.

Trommels.

A series of five trommels are here erected, each being driven by geared wheels attached to the trommel shafts, deriving their motion from a belt and spur-gearing arranged at the end of the series of trommels. The trommels are covered with steel perforated plates, having holes 13 m/m., 9 m/m., 5 m/m., 3 m/m., and $1\frac{1}{2}$ m/m. respectively. The whole of the ore enters No. 1 trommel, which is situate below the rolls just described, and has holes 13 m/m. diameter; any particles too large to pass through the 13 m/m. holes, are thrown out at the end of trommel, and enter a shoot carrying them to a two-compartment jig. This jig is constructed after the pattern of the Hartz Jig, with side-pockets. The jig sieve has perforated holes, 3 m/m. diameter, and is supported and held down by two cast-iron frames. The bed of ore is about 6 inches deep, and the jig-boxes are kept full of water. The plungers, which are of solid pattern, derive their upward and downward motion from the usual eccentric, and runs at a speed of 90 revolutions per minute, with a 3-inch stroke. By this means, the bed of ore is kept in constant motion. The galena ore, owing to its specific gravity, finds its way to the bottom of the bed and travels forward over the cast-iron frame-work which supports the plates, until it reaches the side-pocket, where it is delivered. A small gate is placed in the open of the pocket, which, by raising or lowering, increases or decreases the value of the product. Any fine particles of ore that may find their way to this jig, pass through the jig-plate, and are drawn off at the bottom of the jig-box. The tailings from this jig pass into an elevator, and are carried back to the coarse rolls, where they become mixed with the other coarse ore from the picking-table, and after passing through the rolls, find their way to the trommels, as before, but being crushed finer, go on to the various jigs set apart for their respective sizes. This jig does excellent work, the assay value of the product being equal to that of first class ore in silver, while the lead increases, viz., 100 ozs. silver and 66·5 per cent. lead.

No. 2 Trommel.

This trommel is built on the same principle as No. 1, but is covered with a steel perforated plate, with 9 m/m. holes. The ore which passes through the 13 m/m. trommel enters No. 2 trommel, and all ore fine enough to pass through the 9 m/m. hole, is carried on to the next trommel, while the ore which is too large is thrown out at the end of the trommel, enters a shoot, and is conveyed to a two-compartment jig (No. 1). This jig makes two products. The first product is clean ore, while the second is somewhat inferior, but both are marketable, and go to the pile. The tailings are discharged into an elevator and carried upward to a set of fine rolls, recrushed, and afterwards treated in jigs on the fine side of the plant, explanation of which will be given below. The product of this jig gives an average assay of 65 per cent.lead and 80·80 ozs. silver, or equal to 1·23 ozs. silver per unit of lead.

No. 3 Trommel.

This trommel is of the same pattern as Nos. 1 and 2, and is situate at the end of trommel No. 2. The perforated plates covering this trommel have holes 5 m/m. diameter. The whole of the mineral which passes through the No. 2 trommel with 9 m/m. holes now enters this trommel, and the fine, up to 5 m/m., passes through the holes, and the coarse, *i.e.*, from 5 m/m. up to 9 m/m., is delivered at the end of the trommel, and carried by a shoot into No. 2 jig. This jig is a three-compartment jig, and is of the same pattern as No. 1 jig, with solid plunger. The first compartment produces clean concentrates, the average assay value of which is 69·50 per cent. lead and 84 ozs. silver, or equal to 1·21 ozs. silver per unit of lead. The second and third products are returned to the fine rolls for recrushing.

No. 4 Trommel.

The steel plates covering this trommel have holes 3 m/m. diameter. The whole of the fine material which passes through No. 3 trommel now enters this trommel, and all material up to 3 m/m. passes through the holes, while the coarse, *i.e.*, from 3 to 5 m/m., is delivered out at the end of trommel and carried to No. 3 jig. The first compartment of this jig yields clean concentrates, the average assay of which is 66·50 per cent. and 84 ozs. silver, or equal to 1·20 ozs. silver per unit of lead. The second and third products of this jig are returned for recrushing.

No. 5 Trommel.

This trommel is covered with a steel plate with holes 1½ m/m. diameter, and is situate at the end of No. 4 trommel. All the material which passes through the 3 m/m. holes, now enters this trommel, and is again subjected to division, so that all fines up to 1½ m/m. pass through the holes, while the coarse, *i.e.*, from 1½ up to 3 m/m.,is delivered out at the end of trommel and conveyed to No. 4 jig. This jig is of the same pattern as Nos. 1, 2, and 3. The first compartment produces clean concentrates, averaging 67·50 per cent. lead and 84·80 ozs. silver, or equal 1·27 ozs. silver per unit of lead. The second and third products from this jig are returned for finer crushing.

Water or Hydraulic Classification.

The ore that passes through the 1½ m/m. trommel now enters a V-shaped classifier, which is built of cast-iron. Clean water is conveyed to the bottom of this classifier by means of a one-inch diameter pipe, attached to the lower end or apex bottom. This water is conveyed under pressure, and regulated by a suitable valve, causing a spray of water to spread upward through the classifier. The water conveying this material from the No. 5 trommel into the classifier carries very fine slimes, together with particles of 1½ m/m., which here become separated, the coarser particles falling to the bottom, and are drawn off, and treated by a three-compartment jig, (No. 5), while the finer slimes are kept up by the upward flow of water and carried on for further treatment. The first compartment of this jig contains clean concentrates, assaying 62 50 per cent. lead and 70·40 ozs. silver, or equal to 1·13 ozs. silver per unit of lead. The second and third products are carried back to the fine rolls for recrushing.

Fine Crushing.

This part of the plant deals exclusively with the tail of No. 1 jig, and the second and third products, of Nos. 2, 3, 4, and 5, jigs, on the main side of plant, just described. The material consists of the heaviest particles of gangue with small pieces of argentiferous galena attached, and also, other minerals, such as zinc blende and pyrites. The clean products of each of the jigs described are practically free from either of the last two-named minerals. The object of the recrushing is to liberate

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the valuable galena from the gangues, which is accomplished by elevating the material to a height of 20 feet above the jig-floor, where it is delivered into a set of Fine Crushing Rolls. These rolls are of the same pattern and size as the coarse rolls previously described, but are driven slightly slower. The material, after passing through the rolls, is conveyed into a trommel, having a perforated plate of 4 m/m. holes, and the material which passes through these holes, enters a second trommel, with 3 m/m. holes. The material, which does not pass through the 4 m/m. holes, is delivered out at the end of that trommel, and conveyed again to the elevator and carried up to the rolls.

No. 2 Trommel.

This trommel has a perforated plate, with 3 m/m. diameter holes. The material which passes through these holes is carried on to No. 3 trommel, while the coarser stuff is delivered out at the end of trommel and into a three-compartment jig. The first product of this jig is put to pile as clean concentrates, while the second and third products are again returned to the fine rolls for re-crushing. Owing to the quantity of pyrites and zinc blende in the material treated on this side of the plant, the product of the No. 1 jig is of lower value than the average of first products. The average assay value of this product is 47·50 per cent. lead and 54·40 ozs. silver per ton, or equal to 1·14 ozs. silver per unit of lead.

No. 3 Trommel.

This trommel has holes 1½ m/m. diameter. The material which does not pass through these holes is delivered out at the end of trommel, and conveyed to a three-compartment jig. The first product is put to pile, and the second and third products are again returned to the fine rolls. The average assay value of first product from this jig is 52·50 per cent. lead and 58·40 ozs. silver per ton, or equal to 1·11 ozs. silver per unit of lead.

Hydraulic Classifier.

The material which passes through the 1½ m/m. trommel, enters an hydraulic classifier, the construction and arrangements of which are similar to the one described. It supplies a three-compartment jig, the products of which are similar to those of the No. 5 jig, before described.

Slimes.

At this point, the pulp-water which has passed through the trommels on both sides of the plant, meets, and is conveyed in one V-shaped shoot to a third hydraulic classifier of the same description, as those previously mentioned. The coarse material is fed into a four-compartment jig, while the fine continues on into an elevator. The first product of this jig is clean, and assays 42·00 per cent. lead and 46·40 ozs. silver per ton, or equal to 1·10 ozs. per unit of lead. The second, third, and fourth products, are conveyed into the same elevator, just described, to a series of settling-boxes or spitzkastens.

Slime Elevator.

The fine slimes rejected by the hydraulic classifier, together with the second, third, and fourth compartments of the fine jigs, and the overflows from all elevators throughout the plant, are conveyed into one common pit. This pit is about 3 ft. deep and 4 ft. by 4 ft., built around on the inside with brick and cement mortar. A double balata-belt elevator is placed in this pit, the buckets being attached to the belting with small bolts. This elevator raises the whole of the slime water to a height of 12 ft., where it is delivered into a shoot and conveyed into the spitzkastens.

Spitzkastens.

These consist of three funnel-shaped boxes or rectangular pyramids, with the base upwards; the first is 3 ft. deep, the second, 4 ft. 6 ins., and the third, 6 ft. The whole of the pulp-water flows into the first, where the coarse sands sink, and are drawn off at the bottom; the next size sinks into the second box, and the very fine, into the third. The first or coarse sands are drawn off at the bottom or apex of the box and fed on to a Wilfley table.

Wilfley Table.

This table is an American invention, but made in the States, N. Guthridge, Limited, 486 Collins-street, Melbourne, being the agents. The table consists of a flat surface 7 ft. wide by 16 ft. long, made of wood, and covered with linoleum, upon which are nailed a series of thin strips of wood which form riffles. These riffles extend nearly the full length of the table on the discharge side, but shorten as the feed corner of table is approached. The pulp is fed on to the table at the side near the end, while the discharge of the tailings is along the opposite side. The clean concentrates are carried forward and delivered at the end, while a second product is made by the moving forward or backward of a small flap situate on the side. This machine has also an elevator attached to the head which is intended to convey the second product again to the head of table for retreatment. This table is given a forward and backward movement by a particular joggle arrangement set at the end, and runs at a speed of from 230 to 240 revolutions per minute. The whole of the pulp is kept in constant agitation, the lighter gangues being carried over the side by a constant supply of water, while the heavier or clean concentrates are carried towards the end by the assistance of the riffles. The size of material fed onto the machine, is about 1 to $1\frac{1}{2}$ m/m., or about the size of battery sand. Experience, however, has taught me that the table will do better work without elevating the second product, consequently, this is not returned to the table direct, but is treated by another machine. The clean concentrates from this machine give an average assay of 51·50 per cent. lead and 57·60 ozs. silver per ton, or equal to 1·11 ozs. silver per unit of lead.

Bartsch Tables.

The pulp from the second and third spitzkastens is drawn off at the bottom or apex, and fed on to two bartsch tables. These tables are circular in form, and are made of cast-iron; are 13 ft. diameter, and conical in form. The pulp is fed into a curved distributor, which spreads the feed over one half of the table at the time, while over the other half a curved spray-pipe is diffusing clean water; with the exception of a vibrating or shaking motion, the table is a fixture. The curved feed-distributor and spray pipe revolve over the surface of the table, the former distributing the pulp, and the later washing it, and finally washing it off into a delivery channel, which also revolves with the feed and water-spray arrangements. The clean product finally flows into the settling-pits, from which it is taken, dried, and bagged for export. These tables are excellent machines for the saving of fine slimes. They are, however, very expensive and slow, one costing £350, and will only treat from 4 to 5 tons in eight hours. The capacity is, therefore, too small to be considered a success on ores having a low-market value. The average assay value of the clean products from these tables, both depositing their product in the same receptacle, is 52·50 per cent. lead and 54·12 ozs. silver, or equal to 1·03 ozs. silver per unit of lead.

Bagging Floor.

The bagging floor is situate at the extreme end of the plant, and is 30 ft. by 60 ft. It is made of concrete, and has a dip of one inch in the foot towards the settling-pits of the bartsch tables. The concentrates are conveyed to the floor from the the various machines, and as the concentrates contain considerable moisture, this is allowed to drain off, the drainage flowing down the incline floor into the settling-pits.

Classification.

Much has been said and written on the matter of efficient classification. The writer's opinion, however, is that no hard and fast lines can be laid down whereby such efficiency can be secured for every class of ore. Efficient classification and sizing of the particles are, however, identical with efficient concentration, and the most accurate results can only be ascertained by experimenting on the particular class of ore to be treated. After long and severe experiments, the sizes and system of classification employed in this particular plant have been found most convenient.

Coarse side of Plant.

No. of Jig.	Size of Ore.	Lead Assay.	Silver Assay.	Silver per unit.
	millimetres.	per cent.	ozs.	ozs.
No. 1	21 to 13	66·50	100·20	1·52
No. 2	13 to 9	65·00	80·80	1·24
No. 3	9 to 5	69·50	84·00	1·21
No. 4	5 to 3	66·50	80·00	1·20
No. 5	3 to 1½	67·50	84·80	1·27
No. 6	1½ to 1	62·50	70·40	1·13
Fine side of Plant.				
No. 1	4 to 2	47·50	54·40	1·14
No. 2	2 to 1½	52·50	54·40	1·03
No. 3	1½ to 1	59·50	58·40	0·98
No. 4	1	42·00	46·40	1·10
Wilfley	1	51·50	57·60	1·11
Bartsch	Fine slimes	52·50	54·12	1·03
Crude ore	...	7·20	12·71	1·76
Coarse tailings	...	1·01	2·8	2·77

The average assay value of concentrates recovered during the last year is 63·22 per cent. lead and 77·69 ozs. silver, or equal to 1·22 ozs. silver per unit of lead. The assays of jigs and slimes given in the above table are the result of samples taken of one day's operations, especially taken for this paper, and must not be taken as averages for any long period. The assay values of second class ore and concentrates, and tailings, are the actual values of twelve months' operations, and on the treatment of 16,500 tons.

The figures given in the above table will be of interest, as they show the gradual decrease in the silver contents per unit of lead, according to the degree of fineness of concentrates. They also point out the advisability of avoiding as far as possible, fine crushing at the outset of concentration, and in recovering the valuable argentiferous galena in as large a state as possible. The result of fine crushing is forcibly shown by the values of products on the fine side of plant, of which a further enrichment in lead would involve greater loss of silver, and would be of no actual benefit as far as value is concerned. The principal object aimed at is to produce the most valuable product with a minimum of loss.

PETROGRAPHICAL REPORT.

Government Geologist's Office,
Launceston, 30th June, 1901.

FIELD and routine work during the past year have not left so much time available for this branch as could be desired. Viewed from the point of view of the practical man, this line of study is apt to be treated as of no real use, though, curiously enough, it is from the miner and prospector that most enquiries have been received as to the names and nature of the rocks associated with our ore-deposits. The splendid work now being done in this department by geological surveys all over the world, and the thousands of pounds which are being spent by civilised nations on petrographical work alone, should convince the most sceptical of its importance.

The establishment of a petrological laboratory is highly desirable, where analyses of all our rocks and soils could be made continually, and our minerals subjected to complete quantitative analysis. Besides the usual equipment for chemical work, this laboratory would be fitted with lathe for rock-slicing and grinding, microscope, photomicrographic camera, goniometer, specific gravity, liquids, and other necessaries for petrographical and mineralogical work. A beginning might be made in a small way. The work would provide constant employment for one man. The Acting Government Geologist of Victoria (Mr. H. Herman) has made a similar suggestion for his State in his report for the past year. The results, when obtained, would be published, and their bearing on Tasmania's geology and our mineral resources would be at once apparent.

During the past twelve months some advance has been made in the elucidation of rocks in the peculiar petrographical province of Port Cygnet. These rocks occur all round the townships of Lovett and Lymington, on the arm of the River Huon known as Port Cygnet. They are associated with permo-carboniferous sandstones, into which they often intrude. Besides intrusives, effusive and plutonic types are found. They are characterised chemically by an excess of soda and potash, and mineralogically by the presence of elæolite and nepheline, haüyne or nosean, sodalite, ægirine, melanite, and other minerals of the alkali rocks. What makes the Port Cygnet group especially interesting to geologists is that it is the only occurrence known in Australasia.

Several of these rocks were described by Mr. W. F. Petterd and myself in 1898, under three divisions, a soda trachyte group, a soda aplite group, a soda syenite group, representing volcanic, dyke, and plutonic rocks. We assigned provisional names to several varieties, names which might be used in the field, and which would not be incongruous with eventual final determinations. From the great variety of types, it was apparent that such determinations would be forthcoming. Considerable caution was exercised in the determinations of elæolite, which we recognised as existing in accessory quantities in some of the syenite. In sending a parcel of Tasmanian rocks to Professor Rosenbusch, he was specially requested to give his opinion on one of these syenites, and, in a letter recently received from him, he determines it as an elæolite syenite. He says:—

"No. 87 is a medium to fine-grained elæolite syenite. It is not at all poor in elæolite, or nepheline, in idiomorphic, somewhat dusty crystals. In hexagonal cross-sections, I observe the interference figure with — sign. Besides orthoclase felspar and elæolite, or nepheline, ægirine augite is abundant, also a peculiar biotite, and melanite garnet, in beautiful crystals (110), often with splendid zonary structure, and in grains as well. The biotite has a plainly oblique extinction, as occurs mostly in the alkali rocks. In addition to the fresh elæolite, or nepheline, there are natrolitic pseudomorphs after sodalite. You would lay me under an obligation if you could send me a few larger specimens. Compared with the numerous elæolite syenites known to me, this Port Cygnet rock has decided characteristics of its own."

The above rock was met with a good deal south of the Regatta Ground, but varieties of similar rocks can be found *in sitû* on the beach at the Regatta Ground itself. There is a good deal of variation in the type, some being coarsely plutonic, while the bulk is medium-grained. The colour is typically yellowish, but ranges to dark grey. A trachytic character is recognisable in the existence here and there of glistening porphyritic crystals of sanidine. Sometimes these pseudophenocrysts have rhomb-shaped sections, and are then most likely anorthoclase. The age of these rocks has not yet been well established. Appearances, so far, indicate that the eruptions belong to the close of the permo-carboniferous. Some distance south of the Regatta Ground is a very striking greenish rock, with parallel layers of glistening tabular crystals of sanidine, well known to collectors in the Island. In the paper mentioned above, this rock was referred to as ægirine trachyte. Professor Rosenbusch writes as follows:—

"No. 83 I would call a tinguaite-porphyry, or, perhaps better, sölvsbergite-porphyry; but I have no objection to your name, although I can scarcely believe the rock was effusive. There are phenocrysts of sanidine, and a strikingly light-coloured ægirine (and ægirine augite), with a : c up to 20° in 010, in a groundmass of felspar and ægirine needles. Staining in the colour-bath shows the groundmass to contain very small quantities of nepheline. The ægirines often contain a kernel of amphibole, with $a : c = 17°$. It is noteworthy that the sanidine phenocrysts often contain ægirine as an inclusion. I also saw melanite twice in the same relation. The rarer elæolite minerals are more plentiful than in No. 84, but I could not determine them with certainty. There is also some titanite present."

In 1899, Mr. D. E. White and Mr. W. A. Macleod described a new variety of garnet, to which they gave the name of Johnstonotite, occurring in a trachytic dyke rock south of the Regatta Ground. This rock, too, has been submitted to Professor Rosenbusch, who writes:—

"No. 84, with the beautiful crystals of garnet (211), I would call a garnetiferous mica-sölvsbergite. Apart from the garnet phenocrysts, the rock is essentially composed of orthoclase felspar laths, and wisps of a peculiar brownish-yellow mica, slightly pleochroic, optically negative, apparently uniaxial; its cross in convergent light does not open out appreciably. This mica takes readily the form of rosettes, which, in one place, have collected into a rectangular aggregate, the outline of which reminds one of the form of amphibole. Besides these, iron ores are present in very small quantity (titaniferous magnetite and some pyrite), and in one place, so far, a colourless mineral in short laths, which, judging from its refraction and double refraction, might possibly be mosandrite; but I have no certain proof of this. At all events, it belongs to the numerous elæolite-syenite minerals of the titano, or zircon, silicates. There is, further, present sporadically, in separate grains, a strongly-refractive, rusty-brown, transparent mineral, which I cannot identify. Between the laths of felspar there is a colourless mineral, the refraction of which is only a little stronger than that of the felspar, and its double refraction is weak. On staining, it is shown to be not nepheline, but albite. Under the glass, I see, in two casts of the garnet left behind on falling out of the rock, that there is a fine violet coating, which may be fluorspar, and that often the garnet was immediately surrounded by pyrite, in which the former left its imprint."

The rock described as häuyne trachyte (magpie), with the biscuit-like felspars, has been further examined. It will be remembered that some doubt was expressed at the time as to the original mineral of the limonite pseudomorphs, the probabilities being in favour of garnet. A fresh slide has placed this reference beyond doubt, for the zonary structure of garnet is plainly evident in a section of one of the pseudomorphs. The other porphyritic pseudomorphs in this rock have been further studied, and I think they may be separated into two classes. viz., pseudomorphs after häuyne and after nepheline. The häuyne ones may be distinguished by their soft grey tint in polarised light, while the nepheline ones give vivid interference colours characteristic of some mica mineral. If this distinction can be sustained, the häuyne rocks of Port Cygnet are fairly rich in nepheline. These coarse porphyries occur at the Mount Mary Mine, and on the Livingstone Hill. The best specimens for häuyne are to be picked up on the hill just north of the Livingstone Mine shaft, between the shaft and the road.

W. H. TWELVETREES,
Government Geologist.

FLEMING'S DEEP FACE, MOORINA T.M.

GEOLOGICAL, &c.

REPORT ON THE MINERAL DISTRICTS OF ZEEHAN AND NEIGHBOURHOOD.

Government Geologist's Office,
Launceston, 27th October, 1900.

SIR,

I HAVE the honour to present my Report of the visit, which, in accordance with your instructions, I paid to the mineral fields of Zeehan and its vicinity in April and May this year. During a part of those months I was absent from that district on a journey to the new mineral ground on Mts. Jukes and Darwin, which will form the subject of a separate report; I was occupied, also, for some time, on departmental business.

The Zeehan and Dundas districts have, within the past ten years, grown from small beginnings to be important and stable contributors to the mineral production of the Colony. This expansion has taken place in the face of great difficulties, some of which are unavoidable, while the others are expected to be remedied or removed as time goes on. It has also proceeded in spite of the continual gloomy forecasts of croakers, who, forgetful of the time needful for underground prospecting and development, the maturing of plans affecting the metallurgical treatment and sale of the ores, investment of capital, improvement of the means of communication, and other considerations involved in the maintenance of a thriving mining field, could only see disaster ahead.

I found the race of croakers not quite extinct, only they had transferred their shattered predictions from the permanent, productive mines of the centre of the Zeehan field to the undeveloped mineral sections of the outlying districts; and when these, too, with the march of events, will, as is certain to happen, be drawn into the zone of productive mines, no other course will remain for croakers than to flee the West Coast, or for ever hereafter hold their peace.

When we see the flat country and low hills close to Zeehan, and consider that the opening up of every mine involves a tremendous outlay for sinking operations, expensive winding shafts, and pumps, &c., and further recollect that only the first class ore can be realised straight away, the seconds, which are the foundation of the health (the bread and butter) of every mine, having to be concentrated in costly dressing mills, it is impossible to stand in Zeehan to-day and look round on the habitations of a population of upwards of 8,000 without recognising in this young and prosperous centre a striking tribute to the solidity of the field.

This imperious necessity for sinking was one of the factors of the mining work at Zeehan which specially attracted my attention. At Dundas and the other fields on the West Coast range the difficulty does not present itself. There the lofty precipitous hills allow mines to be worked cheaply by adits or horizontal tunnels; but at Zeehan such tunnels only give access to the lodes at very shallow depths, and the exploitation of the mines at any reasonable distance from the surface can only be effected by means of shafts. This condition of work is a great tax on young mines unprovided with adequate capital, and it shows the No Liability system at its worst, confronted, as it so often is, by the hopelessness of getting in calls easily evaded by forfeiture. To lay the foundations of complete success in the Zeehan field, first of all ample capital must be assured, and then continuous sinking persevered with. It is of no use to observe false economy and suspend sinking till the shoot of payable ore is exhausted. Sinking should be continued all the time that ore is being raised, and when the time comes, as come it must, that the vein pinches and a blank is met with, the shaft will have either sunk by that time into a productive zone again, or will have rendered search for it a much easier task than if sinking had been discontinued directly the upper ore gave out. Some of the mines on the field (too well known for me to mention names) have had a disastrous experience from this very cause. One or two, the Zeehan-Montana and the Western, are setting an example to the others in resolutely determining to go down below what is called the shallow zone.

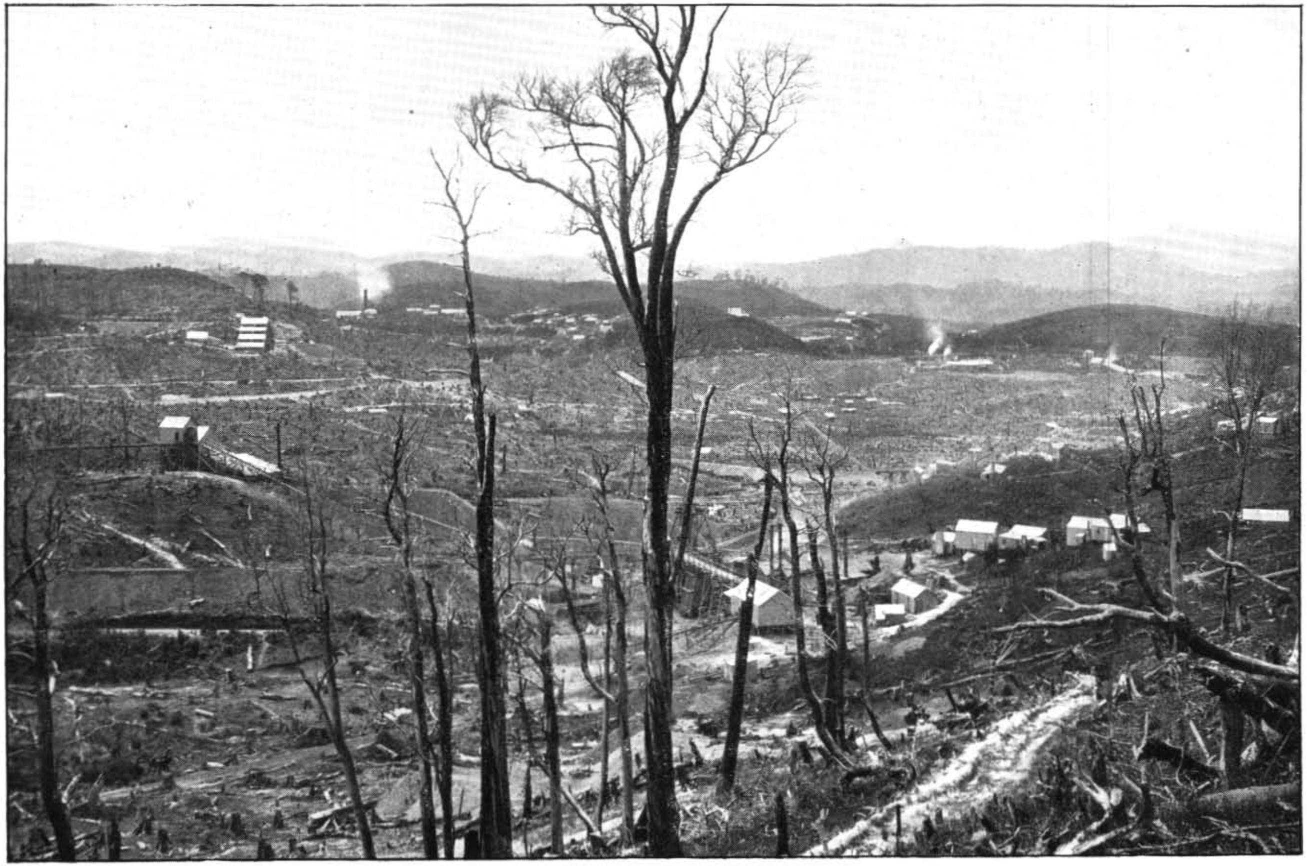
The shafts on the Zeehan mines, as far as I could learn are now at the following depths :—

Western...	600 feet
Oonah	425 feet
Zeehan-Montana	400 feet
Col. North	275 feet
Queen (with winze)	270 feet
King	246 feet
Silver Bell	180 feet
New Mt. Zeehan	140 feet
Fahey's Tribute	100 feet
British Zeehan	93 feet

None of these depths are anything extraordinary, and they are all too insignificant to warrant abandonment in any single case. As a matter of fact, Zeehan has been extremely fortunate in having so much ore concentrated in the lodes of shallow depths, or, to put it more plainly, in having its surface rock worn down by the agents of denudation to a metalliferous horizon in the lodes. The upper edges of the silurian strata have had a good deal removed from them since they were folded by tangential presure and fissured under great piles of superincumbent rock. The upper parts of the Zeehan lodes have disappeared. These may have been either ore-bearing or barren, and the proximity of the present ore shoots to the surface is purely fortuitous. It is not as if surface agencies were responsible for the shallow zone concentrations. It is true there are secondary ore deposits in some of the mines, but the galena which we see in the lodes close to the surface is the same primary sulphide which will be found a thousand feet below. No known physical cause exists to bar the recurrence of similar ore deposits at greater depths. If I am asked to what depth the deposition of ore extends, I would say that is a question which no geologist or miner can answer. In any case we can imagine a depth beyond the reach of practical mining where fissures could not remain open; that is, they could not even be formed at all in molten and plastic rocks, such as may be supposed to exist at immense depths. Physicists have endeavoured to determine such a depth by means of the data at their command, and have variously estimated it at from

16,000 to 33,000 feet. This means that a fissure or lode is not debarred by any physical impossibility from descending to 16,000 feet. I need hardly say that this is a limit which need not be taken into account in mining. Of course, all lodes need not have ascended from these depths. The popular idea is that no lode is good unless it is a true fissure one, and that such lodes extend downwards to the barysphere or central zone of heavy metals. The latter notion belongs to the domain of theory, and deals with a state of things outside the range of observed facts. What has been observed is that lodes followed to great depths have been traceable for long distances on the line of outcrop. We may, therefore, argue the converse. I have not noticed any purely igneous veins in the Zeehan field proper, that is to say, veins in which heavy metals have been deposited by differentiation or concentration in a molten magma. The Zeehan vein fissures, wherever quartz is associated with the ore, must have received their ore by precipitation from solutions. This may have taken place at great depths, though not below the limit mentioned above, for beneath that, water cannot exist as water, and no circulation, consequently no precipitation, can take place. Hence, all ore deposition in quartz must take place above that horizon. It is not too much to assume, further, that some of the waters which had first descended, deposited during their re-ascent the minerals which they carried in solution ; other waters, perhaps, have never seen the surface, but have been expelled direct from the solidifying magma. The derivation of the dissolved minerals is still much debated. The lateral secretion theory has of late years received less support than formerly. The idea is gaining ground that they are derived either from concentrations at extreme depths or from the magma at the base of the more or less consolidated rock. But our knowledge of physical conditions at this depth is elementary.

Most of the Zeehan lodes are true fissure veins, crossing the stratification of the Silurian country ; in other parts of their course they become bedded veins, running between the bedding planes of the sandstones or slates. Sometimes they are contact lodes, having "white country" (melaphyre) on one side and sandstone or slate



ZEEHAN MINES.

on the other. A very frequent feature is the absence of walls or any parting between vein and country. The absence of a defined wall is commented on unfavourably by many mining men, and it used to be considered a more detrimental sign than it is now-a-day. More extended observation has shown the fallacy of the reasoning which underlies the old opinion. If the rock is at all fractured, as is mostly the case, the presence of walls means simply that the dislocation has been considerable. An insignificant degree of displacement may not result in the formation of walls, but may still be accompanied by the formation of veins.

The sets of lodes at Zeehan form a complex series, branching and anastomosing in a network fashion, so that any particular lode cannot be followed far along a course having any definite bearing. Still, in the apparent confusion caused by the different branches and junctions, it is possible to roughly determine the bearings and trend of the main systems as east of north, west of north, and north and south. Thus, the King line of lode on the east of the field is a north and south line. It may be taken as represented by the main lode on the Silver King section and four west lodes on the same property. The continuation of the main lode south passes through Fahey's tribute, and further south to the main shaft on the Zeehan Bell, and extends still further south to the shafts on the Sunrise section. The four west lodes bear slightly east of north and west of south, and, if prolonged, would come into the Tasmanian Smelting Company's section, some of them in the immediate vicinity of the works. All this line of lode south of Zeehan requires prospecting, as there is every reason to believe that the lode-fissures extend a good way into this country. The country rock appears favourable, and I should not be surprised if future exploratory work at this end of the town resulted in an important extension of the Zeehan mining field in this direction. A drawback belonging to the southern end of the line is an impoverishment of the silver contents of the ore, compared with the northern and central mines of the field. Whether this is dependent upon the proximity of the limestone is not easy to say, and, as long as exploratory work is so incomplete, it would not be safe to say that the limestone has anything to do with it. All we know about the influence of limestone on galena deposits is that it is rather favourable than otherwise, and the rock is usually esteemed as a precipitating agent. The silver contents of galena are often so variable in one and the same mine, that the low grade observed in the few places opened upon ought not to act as a deterrent from work. The Zeehan-Montana Despatch lode appears to belong to the western set of the King system.

There is another set of lodes which bears S.E. from the Oonah, through the Silver Queen, east of Balstrup's, through Montagu, Watts, and M'Auliffe and Austral, down to the smelters, where it would unite with the King system.

The general run of the lodes from the Western, Zeehan-Montana, and Oonah properties, through the Mount Zeehan (Tasmania), is, on the whole, N.E. and S.W. towards the manganese hill; and the Western blocks also show a set of lodes running in a south-easterly direction, but I cannot satisfactorily identify the prolongation of these. In this part of the field there is such a network of minor veins that the general bearing can only be given vaguely. Some of the westerly veins on the Silver Queen would bear S.W. into the Mount Zeehan (Tas.) property, into the east part of Colonel North, and into the Nubeena, further south.

The outside lodes to the west of Zeehan, in the Comstock district, have no uniform bearing. The Comstock and Boss W. lodes bear west of north, the Comstock west lode east of N., Montgomery's lode due N., while the two lodes on the Tasmanian Land Exploration Company's property run north-east. The two lodes on the Britannia bear N.W.; the lode on Stonehenge has a similar bearing: on Britannia Extended, west of N. The Silver Stream lodes have a bearing east of N. It will readily be seen that the lodes in this district cannot be classed according to bearing, as there appears to be no system or regularity in their directions.

The lodes in the whole Zeehan area traverse sandstones, quartzites, slates, limestones, and the so-called "white rock," = melaphyre, an ancient basalt, often vesicular in character, sometimes hard and solid, sometimes soft and tuffaceous. This series of rocks, from their lithological features, were long ago recognised as Silurian, and, on the evidence of fossils found in the limestone and determined by Mr. R. Etheridge, jun., are referred by him to the upper portion of the middle division of that system. The melaphyre, which at one time excited considerable curiosity, is, undoubtedly, of the same geological age. It is seen, especially in the Oonah and Montana mines, interbedded with the sedimentary strata in contemporaneous sheets, and has, evidently, been emitted in more than one flow. I have been told that it has been also noticed as decidedly intrusive, but I was not able to verify this. There is, however, nothing improbable in dyke-like masses being thrust into adjoining strata at the same time that the lavas and tuffs were projected from the volcanic vents, only I have not seen any proof of it. The rock strikes N.W. with the stratified rocks across the British Zeehan, Silver Queen, Silver Queen Extended, Oonah, Zeehan-Montana, and Western. It is seen while ascending to the saddle of hill on road to the Sylvester mine, six or seven chains E. of the old Sylvester workings. Here the rock is white and vesicular, but decomposes to a yellow clay. It is clearly bedded, and dips N.E., the same as the sedimentary rocks of the field. The prevalent idea, till recently, was that when the lodes are in this rock their silver contents are augmented, but beyond that it is favourable country for ore; I cannot find adequate evidence to establish this. Certainly, I found the No. 4 lode in the Montana wholly in this melaphyre in one place, and thinning out just before coming to the black slate; and the melaphyre is not intrusive there, for it underlies the slate conformably. But this is not the kind of evidence which would specifically prove enrichment. At the same time an enrichment may really take place, and it would be interesting to collect the facts bearing on the point thoroughly and systematically, and settle the question once for all. I commend this to students at Zeehan.

One of the most interesting problems connected with the mining geology of Zeehan is the source of the lode contents. Have they proceeded from the serpentine (gabbro) or the granite magma? Zeehan is bounded on the west by a belt of serpentine and gabbro, about a mile broad, from east to west. It crosses the road to Trial Harbour about a quarter of a mile west of the South Comstock, and continues west as far as the Agnew huts, where the bare granite country comes in. The margin of the timber is the margin of the basic area. The serpentine is nowhere very pure. West of M'Ivor's cottage the rock does not appear to be serpentinised at all. A little past the cottage the road passes over fresh coarse gabbro, and thence the rock has apparently been influenced by the intrusion of the great granite mass of the Heemskirk range. The serpentine country a few miles east of Zeehan is that in the Dundas district. Some of the rock betwen the Comstock and M'Ivor's is serpentinised gabbro; and a specimen which I took from the contact near the South Comstock (unfortunately mislaid) appeared to me also to have been gabbro. I was unable, on this visit, to find any rock on that side of Zeehan which could be identified as purely pyroxenic. The serpentine of the Dundas district is a purer form; and some of it might be utilised for small ornaments. There is no demand in the Colony for serpentine rock, and it is, consequently, valueless, at present; but a limited demand might be created by making and exhibiting a few ornaments. In selecting blocks for cutting and polishing care should be taken to avoid varieties which contain grains of the chromic iron, which is a natural and frequent ingredient of serpentine.

From the above we may assume that since the Silurian strata of Zeehan were laid down, the consolidation and intrusion of an immense mass of basic rock, now serpentine, took place on each side of the field; and the question is, whether it is not continuous in depth below the township. The serpentine on the west creeps a little nearer to the town, on the Colonel North property; and I have seen talcose or serpentinous matter in the planes of the slates on the New Mount Zeehan ground, quite close to the centre of the town. The comparatively small proportion of quartz and the correspondingly abundant carbonate of iron, which form the gangue of the lodes, seem to point to some influence being exerted by the serpentine; but this is still compatible with a reference of the lodes to the later formation of granite beneath the field. The nearest granite is that of Mount Agnew, four or five miles to the west, which is demonstrably later than the serpentine, the latter being hardened at its contact. This is seen quite plainly, where the flinty serpentine occurs on H. D. Marsh's section, E. of Mount Agnew, and near Trial Harbour, where the granite abuts on the hardened hackly sepentine rock. That the granite has influenced the Zeehan country is evident from the stannite found in the No. 1 tribute Silver Queen and the lode of that mineral now being worked in the Oonah mine. This mineral can only have come from a granitic source, and the same source is the parent of the dyke or intrusion of spherulitic felsite uncovered in the swamp between the Montana and Western mines. This latter rock has for some years furnished specimens to collectors and was thought to be an isolated boulder, but while I was in Zeehan this time Mr. George Waller, of the Zeehan School of Mines, put a pick into the ground and exposed the bedrock, which, for a few feet in width, was found to consist of the same spherulitic rock in a rather decomposed state. As far as uncovered it appeared in the trench to be bounded on the north side by quartzite and decayed clayey sandstone, and on the south side by decomposed melaphyre. The work done on it was not sufficient to establish its bearing with certainty, but it seemed to be trending a little to the north of west. We tried to trace it into the hills to the west, but failed to pick it up again. It seems to pass a good way north of the Oonah mine. This felsite is as unmistakable a sign of the proximity of granite as the Oonah stannite lode is, and as far as these two occurrences are concerned, a granitic source is unquestionable. The further question arises, whether the stannite lode, apart from its stannite, presents any features distinguishable from other lodes on the field, or anything, in fact, to indicate that it belongs to a different lode system from the ordinary silver-lead lodes. If the galena lodes are connected with a serpentine or, rather, basic source, then the stannite lode, of granitic birth, is a later stranger in the field, and this might account for its unique occurrence. The alternative is to suppose that when the consolidation of the granite magma took place in a serpentine area, the Zeehan lodes, as a whole, were formed in connection with this intrusion. This is, perhaps, the most probable, but there is room here for a series of careful observations which would throw light upon a doubtful point. Although both serpentine and granite were probably Post-silurian (Devonian ?), it must be remembered that there is a chronological difference, the granite being the later of the two, as far as can be judged from observations made hitherto

The general trend of the Silurian sedimentary strata is west of north and east of south, and the dip N.E., though in the southern part of the field the latter is westerly. Those lodes which are running west of north often happen to coincide with the bedding planes of the sandstones and slates, but this is merely accidental, for they soon pass across these divisional lines as they descend. The angles at which these strata are inclined from the horizon are from 60° to 70°. This inclination must not be looked upon as due to local tilting by adjacent eruptive rock. The high angles of dip of Silurian strata is nearly universal throughout the Colony; this alone forbids our attributing it to any purely local cause. It may be explained by rock folding on an immense scale. The peculiar flat valley bottoms round Zeehan margined by abruptly rising hills are no doubt the products of marine erosion. They are not filled with river deposits, but have been well sluiced by the sea in Tertiary times, as we see the bed-rock everywhere. Around Zeehan itself I did not see any remnants of Permo-carboniferous or Mesozoic strata, and it would therefore seem probable that these Zeehan country rocks have been exposed to the agencies of sub-aërial denudation from the Devonian period to the present day : a little further south on the Zeehan-Strahan line Permo-carboniferous sandstones and mudstones rest upon the Silurian rocks, which there have been protected from waste and destruction. The nearest Mesozoic rock is that on the summit of Mount Dundas, occupied by the familiar dolerite (diabase) of the Tiers. The upper parts of the lodes at Zeehan, consequently, have been within the range of surface waters for a very long time, sufficient to account for the gossan outcrops and for some of the rich concentrations of secondary silver ores occasionally met with, but I cannot admit that the general productiveness of the shallow zone is in any way due to re-precipitation. The sulphides mined in the upper levels of the mines are primary ores, and the shallow zone has only a specious appearance of being the richer because productive lodes alone have been worked in that zone.

On this visit time did not permit of my doing more than visit the principal mines on the field. I did not examine the mines for the purposes of detailed description, but for observing their general state of development, and noting any facts in mining geology which might have a bearing upon the nature and prospects of the field at large. At the north end I visited the

Western Mine,

Mr. C. F. Heathcote, Manager :—This important company leases 420 acres, and is working vigorously. The prospects of the mine, thanks to its careful administration, are generally better than they were some time ago. During its career, which dates from 1888, it has raised 34,108 tons of silver-lead ore, of a net value at the mine of £427,550. For the half-year ending 31st March last 1303 tons ore were sold, as against 1939 tons the preceding six months. A good deal of the falling-off was owing to insufficient pumping power, the three bottom levels, Nos. 7, 8, and 9, being under water. A new pumping engine was started just before I left Zeehan. The levels opened from main shaft are—No. 1, at 45 feet ; No. 2, 110 feet; No. 3, 170 feet; No. 4, 230 feet ; No. 5, 290 feet ; No. 6, 360 feet ; No. 7, 430 feet ; No. 8, 500 feet ; No. 9, 600 feet. It has been decided to carry the shaft down a further 200 feet, and it is to be hoped that this sinking policy will be continued. The mine has seven miles of drives and crosscuts.

In the No. 6 level at the rise from No. 7, at a depth of 360 feet, I saw a good bunch of ore, banded with carbonate of iron, lode dipping E. The stope over the back was poor in the north end, 20 feet above level, but ore is known to be overhead as well as ahead. The lode improves going south and overhead. No real walls are visible, but spurs of galena run out into the slate at an angle of 45°. The end of level is 40 feet from the south boundary, and the drive has been barren for the last 15 feet. The stope overhead will be pushed up to this, and then stopped.

In the N. drive from No. 5 level E. crosscut the end shows dressing ore. It is intended to rise on the boundary up to No. 2, 180 feet, where there is good ore underfoot. The melaphyre goes a good stretch in this crosscut and junctions with the slate on each side. In this mine the best stopes are associated with melaphyre, but, on the other hand, there are stopes where there is no white rock anywhere near. The south end is poor; the lode here is in slate, with a little filling—a very flat lode, with no good walls, but carrying a little ore. The crosscourse slide seems to come in here. The drive N. 30° W., on slide from No. 5, 4 E. north (Jackson's drive), and the slide here, contain ore. It was driven through a short distance, and holed through to another drive, but the ore-bunch gave out. The average width of the slide is the same as that of the lode, viz., 2 ft. 6 ins. This main slide runs through the mine right down to No. 5, with a bearing of N. 25° W., while the main lode (No. 1 E. lode) bears N.E. In the crosscut E. for Simson's lode, the end looks as if ore were not far away.

Besides the main lode, there is a set of lodes bearing N.W., and another N. and S.; and, as all these sets intersect one another, the result is a complex system of veins, giving rise to a mine which requires very judicious management to yield satisfactory results.

During the past half-year 15,179 tons of stuff have been broken in the gross from this part of the mine, and over 4000 square yards of lode stoped away. The half-year's work has proved the following:—

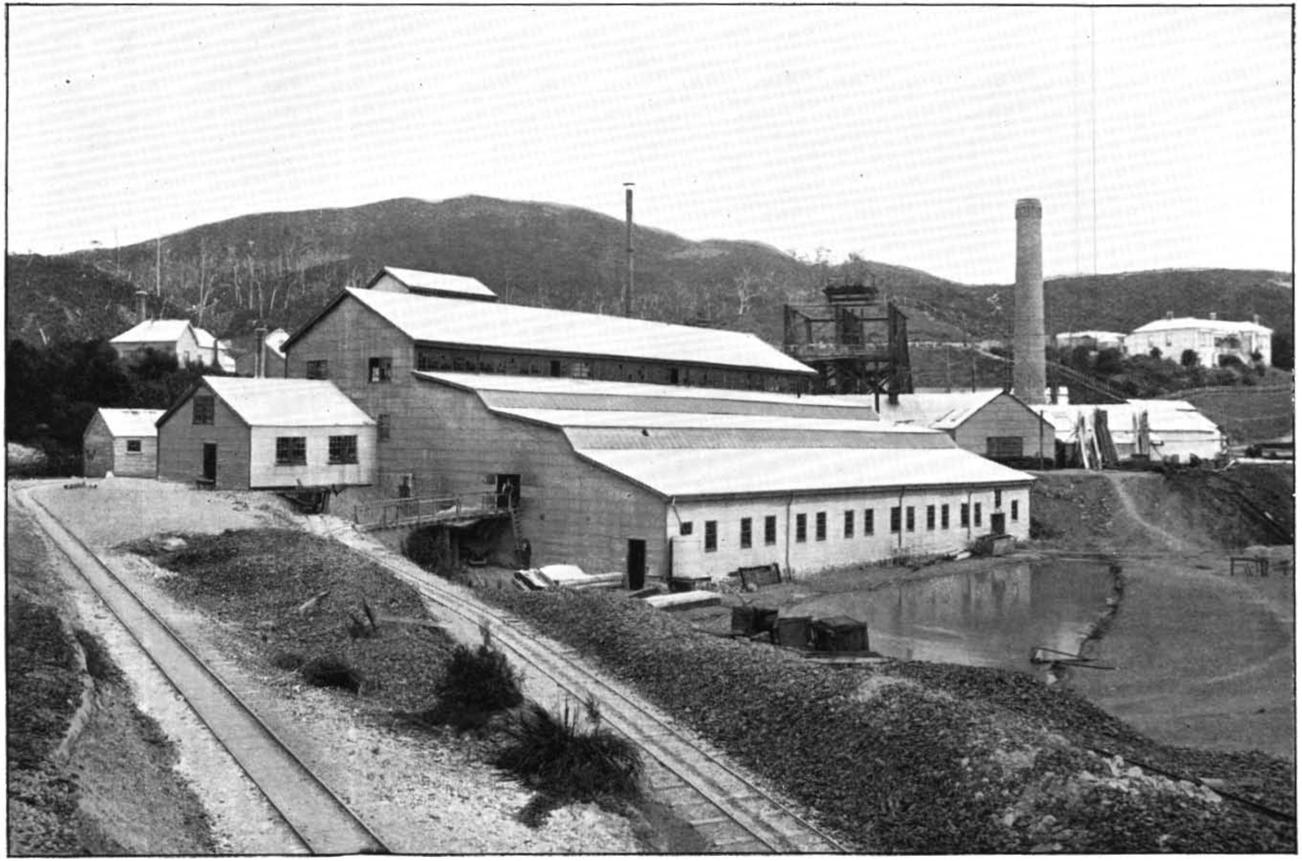
No. 2 *Level.*—5 W. lode found, so far, to be of no value, but payable ore 40 feet long in the S. extension of a W. lode, and E. branch of 1 E.S. payable for a length of 100 feet.

No. 3 *Level.*—3 W. and 4 W. proved to exist at this level.

No. 4 *Level.*—Discovery of 2 W.N. lode, and 40 feet length of good ore proved.

No. 5 *Level.*—7 E. lode proved within boundary. 4 E.N., 35 feet of payable ground found.

No. 6 *Level.*—Stoping towards boundary, as mentioned above.



WESTERN MINE.

No. 7 *Level.*—6 1.E.S. and 7 E.S. proved to be different branches of main lode at 360 feet depth south of shaft, and both contain payable ore at this depth.

A good deal of important work is contemplated the next half-year. In a mine with so many miles of underground drives I could not visit every place, but Mr. Heathcote was good enough to explain to me some of the items of the programme. Among others, these were :—

(1.) 2 *crosscut W.* to be extended into virgin country to the west.

(2.) *Level* 3.—To explore round 1 W.N., 3 W.S., and 4 W.S., to get ore going down from No. 2.

(3.) *Level* 4 E.S.—To find E. branch, and get ore below No. 3.

(4.) *Level* 5.—Crosscut E.—Boundary rise to No. 2 level, to explore No. 7 E. lode.

(5.) *Level* 5.—4 E N. Exploration below Simson's workings.

(6.) *Level* 5.—1 W.N. crosscut: to get under 4. 2. W.N.

(7.) *Level* 7.—Exploration of parallel lode 1.E.S.

(8.) *Level* 9.—Crosscut W. Below No. 4 there has been no crosscut W.

(9.) *Levels* 7, 8, *and* 9.—1.E.S. will be carried on.

Exploration and development may still be said to be in arrear, but prospects have considerably improved of late. It is true that at the main shaft no large body of ore is being worked, with the exception of 6. 1.E.S., but there is every probability of good bodies being available shortly in 7. 1.E.S. and 8. 1.E.S. 9. 1.E.S. will also be carried on.

Simson's shaft is situate 820 feet a little W. of N. from the main shaft, and the workings in connection with it have added considerably to the value of the mine. These workings were started in April, 1895, and have disclosed a mass of interlacing and branching veins of galena, forming a kind of magnified open-meshed stockwork. This part of the mine shows the importance of not allowing exploration work to fall behind. It is not so very long ago that the workings were viewed rather doubtfully. The ore has been principally obtained by starting some very unpromising places, and now Mr. Heathcote tells me he estimates he has 7000 tons in sight, and, altogether, a probability of 20,000 tons of ore existing above No. 2 level. No. 1 level has been opened at 70 feet, and No. 2 at 170 feet, and the continuation of No. 5 level from the main part of the mine will come in under Simson's shaft at 260 feet. In the network of veins it is difficult to recognise any main lodes: there are lode lines bearing N.W., N.E., and N., all connected by meshed veins, generally without walls, being simply fractures of the country filled with ore. The ore is highly argentiferous, having a ratio of 2 ozs. silver to the unit of lead, and this value is maintained from top to bottom. In fact, through the whole mine there is very little variation in the above ratio, nor is the primary ore richer or poorer in the upper levels than in the lower ones.

Some 273 hands were employed at the time of my visit. As is well known, the mill is equipped with the Lührig concentrating plant. A very complete statistical analysis of the Western Company's accounts up to September, 1897, by Mr. Aug. Simson, is published in the Transactions of the Australian Inst. Mining Engineers for 1898, vol. v. The published accounts of the company state that during the past half year 1 ton of concentrates were obtained from 11·964 tons ore, an improvement on the previous six months, when 1 ton was returned from 12·91 tons ore.

The management of the mine is not free from difficulty, owing to the extensive workings and the irregular and branching nature of the ore-shoots. Exploration work must absolutely be kept up. Even an additional 200 feet of sinking will not mean the attainment of any great depth, and there is little doubt but that this important company will persevere in a policy of testing the lodes down to a serious depth. The new pumping engine will take a shaft down to 1500 feet, and with its present careful management the mine will do fairly well. Its future is dependent upon the result of work at a greater depth than has been attained hitherto. The numerous fractures, which are now being worked for their ore fillings, may be expected to improve into more important fissures in depth in the zone below where they began to split.

Zeehan-Montana Mine.

Manager: Mr. T. Craze. This company is an English one, and started work in 1893 on property S.E. and adjoining the Western Mine blocks, and has since taken additional ground from the Silver Crown and the Silver Queen, bringing its holding up to upwards of 300 acres. It is working on nine lodes, mostly running N.W.-S E. and N.-S. The No. 8 lode would seem to be the same as the No. 2 main lode of the Western Mine. The No. 6 N. and S. lode breaks up into junctioning veins—it junctions with No. 8, at both the north and south boundaries, but has been struck again further north in the long crosscut of the Crown.

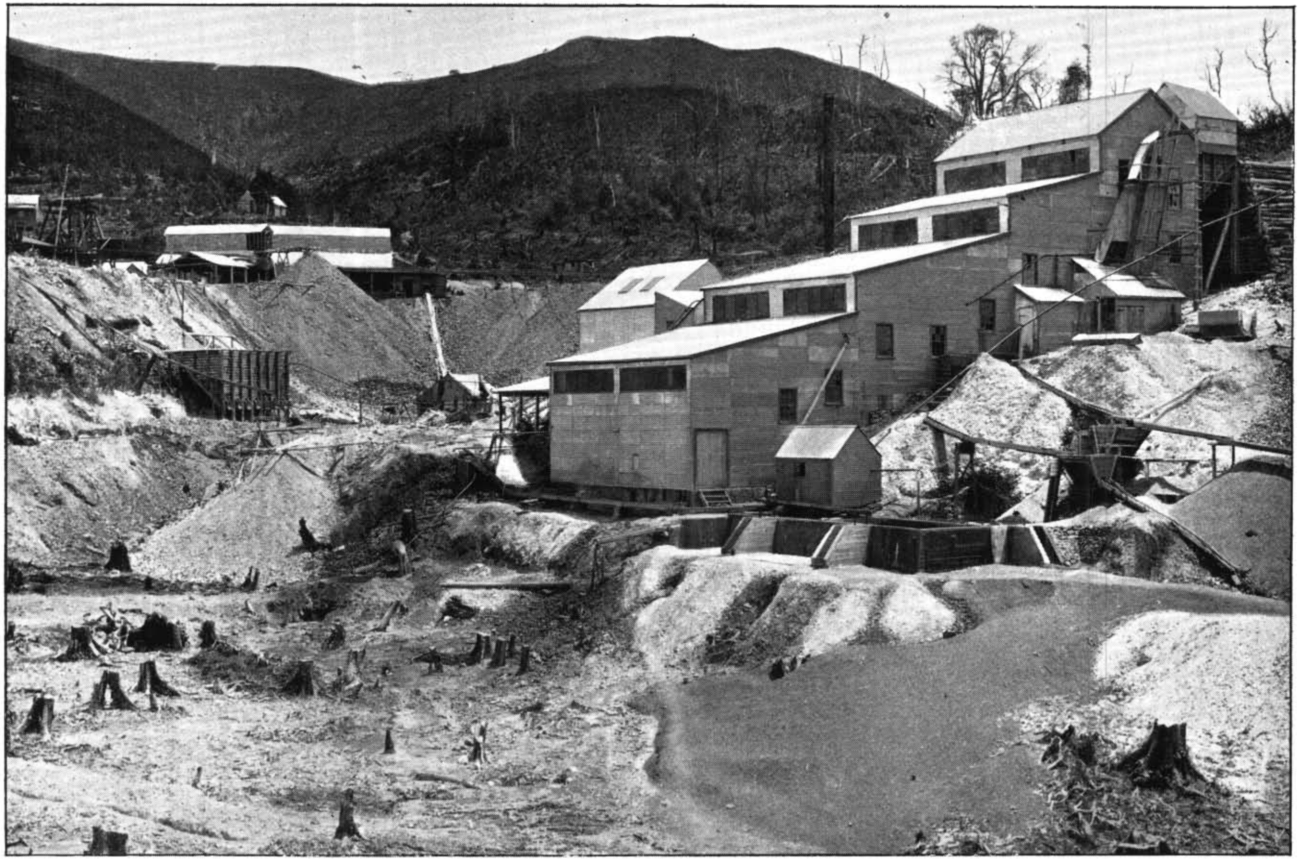
The main shaft is down 400 feet, and 4 levels opened, viz.—No. 1 at 112 feet; No. 2 at 194 feet; No. 3 at 294 feet; and when I was there the shaft had just got down to the 400 feet, but the bottom level was not then opened.

No. 6 is the chief lode of the mine, and is the principal contributor to the output. It runs right through the section N. and S., and underlies E. The central part of its length is unproductive, but the richest end is the north end: however, south of the cross-course the lode becomes payable, and opens out, then, to six feet in width. The central country is slate, but in the north part of the lode the hanging-wall is quartzite, and the footwall black slate. In the N. end of stopes, over back of No. 2 level, the lode thins, and seems to die out in the melaphyre just before coming to the black slate. I may mention the stopes get shorter going towards surface. I noticed the melaphyre underlying the slates, and dipping E. No. 4 lode in No. 3 level N. is wholly in melaphyre, and is carrying excellent ore. This band of melaphyre runs N. and S., and is 350 feet wide. It goes back to the main shaft, the north side of which is slate country. The south drive has been driven up to the slate. The crosscut W. from this level (No. 3) is wholly in slate, dipping E., with bands of hard metamorphic slate or sandstone. The N. drive on No. 6 lode from above crosscut has a slate hanging-wall, and foot-wall of metamorphic slate or sandstone. I saw 5 feet of first-class ore with soft carbonate of iron in the end. There has now been a fine shoot of payable ore for 450 feet in length.

The mine has a fine hoisting and pumping plant for sinking to 1000 feet, and is equipped with rock-drills and electric-lighting appliances. There is a good concentrating mill, with Bartsch and Wilfley tables. About 65 tons of ore are sent away weekly, averaging about $1\frac{1}{2}$ ozs. silver per unit of lead. From Mr. Craze's statement, it appears that the main workings measure about four miles, that 61,600 tons of lode-stuff have been raised during seven years working, and, as £60,000 have been paid in dividends, the shareholders have received nearly £1 per ton of stuff raised. I will add, that not only has this mine been working at a profit, but it has set a brilliant example to the whole field, for the owners have committed themselves to a policy of deep sinking, which others would do well to follow. Mr. acting-manager Mayne courteously showed me over the mine.

Oonah Mine.

Con. Hy. Curtain, Manager. Work was begun in 1888, and the present company formed in 1890. The property comprises 255 acres, adjacent to and S.W. of the Western mine sections. It is an important mine on the field, and has been a good producer of silver-lead ore in the past, at one time producing up to 1800 tons in the year, though of late the output has sadly fallen off. The mine still employs 50 hands and 36 tributors. The last half-year 297 tons silver-lead ore were sold by company and tributors, worth between £15 and £16 per ton, besides 72 tons stannite, at £21 per ton. The main lode has a bearing W. of north, and underlies E. The deepest level is No. 6, 424 ft. from surface; above this are are No. 5, at 322 ft.; No. 4, at 250 ft.; No. 3, at 163 ft.; No. 2, at 137 ft. Most of the galena ground has been stoped away right up to surface, and the bottom workings, it must be conceded, are poor. It is possible, however, that parallel lodes may add to the output, and, in any case, the No. 6 level ought not to be stopped. There is a new lode under the magazine parallel to the



OONAH MINE.

main lode, 212 ft. to the S.W., and carrying from one inch to three inches of galena. This is now being driven upon, and the programme is to cut it also from No. 6. In the south workings on the main lode there is some rich gossan, with silver chloride and native silver. This is being stoped. Some of it has assayed up to 420 ozs. silver. The crosscut here is in slate and melaphyre, the latter plainly conformable with the slate, which is not perceptibly indurated by it, either above or below. Mr. Curtain told me he had also seen places where the melaphyre is intrusive. This is not impossible, for modern basalts behave in the same way. The Oonah shaft is the second deepest on the field, but, after all, is really no depth at all. Though a vast amount of driving can still be done on the company's leases, no permanence can be assured to the mine without further sinking, and the mistake made is not to have kept that work going continuously. A crosscut (No. 6) 160 ft., has been driven E. in white country, but the lode track, where cut, was insignificant: driving south on it was just started, but the downward extension of the ore-shoot is not expected just yet. The payable lode-stuff over the back of No. 5 level seems to have been stoped away. Between Nos. 3 and 5 levels the main lode has split, and encloses a horse of country which attains its widest diameter at the horizon of No. 4. Between Nos. 4 and 3 stoping is still going on. No. 3 level W. was being driven, the face in pyrites and slate being of an encouraging nature for ore; besides which, it was just about where it ought to cut the stannite lode at a depth of 163 feet from surface. The lode in the crosscut behind the end has since shown some very clean and fairly argentiferous galena, with nearly 2 ozs. silver to each unit of lead. In June this year the stannite was cut in the eastern crosscut, 40 ft. below the old workings. When cut, it assayed 80 ozs. silver per ton. The mine is situated in a central position on the Zeehan lode system, did very well at the beginning of its career, has a lot of maiden ground, possesses a unique lode of stannite, for which they have been getting £21 per ton, but must be carried down to a greater depth if it is to lead to anything beyond a struggling existence upon explorations at present levels.

The stannite lode, which came to the front at the end of 1897, besides being a mineralogical curiosity, is a valuable asset of the mine ; in fact, it is not too much to say that it has, practically, saved the company from the ill effects of shallow mining. It was being mined at the time of my visit by two tributes, on the south section on two parallel veins. Allison's tunnel crosscut, called the No. 1 lower stannite tunnel, has its entrance in slate, striking N.W. and dipping N.E., and the drive W. is on a lode 6 feet wide, in slate country. The lode-channel carries a vein of stannite 3 inches to 1 foot, fairly continuous, the best being on the footwall. Behind the end a slide had thrown out the vein from the footwall, and now the vein, a 6-inch one, is on the hanging wall, which is graphitic slate. In the face, dark slate carries streaks of quartz and pyrites. This drive is 115 feet long. Returning to the tunnel, a few feet further in, is a broad drive S., in pyrites and stannite. At first the stannite is 18 inches wide, but then goes off west in 2-inch veins. In the N. drive, about 70 feet, there are two inches of good stannite on the hanging wall, and at 36 feet above the end exceptional assays of 305 ozs. silver per ton have been obtained. The tunnel has been extended 60 feet beyond this, and cut a small pyritic vein.

A surface drive 89 feet, has opened stoping ground N. and S. of the winze. Across the creek, to the N., is the north surface adit, the end of which is about 46 feet above the north end of drive below. A quartz and stannite vein is on the W. side inside entrance, and a small rich vein crosses the level at Curtain's winze, 36 feet ahead of the lower drive N. The uppermost surface adit shows stannite, copper, and galena.

The No. 3 level is about to come below the stannite workings, and there is every reason to believe that the veins of this mineral are persistent in depth. The metal has already been struck in the No. 3 workings, and, if the development turns out to be satisfactory, the Oonah Mine will get a substantial lift. The lower levels of the mine will enable the stannite lode to be attacked in depth, and it will infallibly be met with at those levels. This is a very encouraging feature of the mine. There seems to be a good deal of variability in the contents of the ore, but up to the date of my visit the average value realised had been £21 per ton. The tin is not paid for: according to assays, the ore contains about 14 per cent. tin, 29 per cent. copper, and from 107 to 140 ozs. silver. When I was there, the ore obtained was bulking 14 per cent. tin, and a maximum of 264 ozs. silver, but the silver contents have not been maintained. The per cent. copper is the same as that of European stannites, but the tin per cent. is only half that of normal stannite; the silver, too, is a decided novelty. The ore contains, also, bismuth, antimony, and is mixed with galena and iron pyrites. In Cornwall, stannite occurs in granite, associated with cassiterite. It is stated to be lost in dressing*. In his elements of metallurgy (p. 470), Phillips says—"This mineral does not occur in sufficient quantities to admit of being metallurgically treated, and must be regarded as essentially a mixture of various isomorphous sulphides." A notice of stannite as found on the Silver Queen in Clarke's tribute lode, associated with pyrites and galena, assayed by Mr. J. G. S. Stitt, and containing 90 ozs. silver per ton, appears in Proc. Royal Society Tasmania, 1895, p xx. (W. F. Petterd). The following are assays of stannite published by Dana and Phillips:—

	S.	Sn.	Cu.	Fe.	Zn.
Wheal Rock	29·64	25·55	29·39	12·44	1·77
St Michael's Mt..	29·46	26·85	29·18	6·73	7·26
Cornwall	27·94	22·04	27·77	12·75	3·62
Cornwall	29·68	23·42	29·50	13·55	3·85
Zinnwald	29·05	25·65	29·38	6·24	9·68
Klaproth	30·50	26·50	30·00	12·00	—
Kudernatsch	29·64	25·55	29·39	12·44	—
Oonah Mine	?	14·00	29·00	?	—

I went over various workings on cupriferous and galena lodes on the Oonah properties, but I need not particularise. Nothing is being done at Bradshaw's copper workings, but there is room for exploration. All that appears requisite is a slight increase in the copper percentage. Though the work, on the whole, has had somewhat disappointing results, and the outlook, as things are going on now, is none too encouraging, it was quite evident to me that the Oonah has the makings of a good mine: but it requires adequate capital and a more enterprising policy.

* Phillips. Ore Deposits. 1896 ed., page 218.

The dressing floors are fitted with a Lührig plant. It is a pity it cannot be kept running continuously. Fifty hands were employed at this mine and 36 tributors.

I am indebted to Mr. Con. Curtain for accompanying me to the several surface shows and other features of the property in bad weather.

Mount Zeehan (Tasmania) Mine.

This company, better known as the British Zeehan, is working on the Silver Queen Extended, Balstrup, and Silver Spray sections. I had no time to go through the mine this time, but I know the property. The Argent is one of its sections, and at one time returned a good deal of ore, but water grew difficult. The principal work has been carried on lately on the Queen Extended block, but a fine discovery of rich antimonial silver-lead ore, some of it assaying over 2000 ozs. per ton, and the bulk of it worth £30, has been recently made on one of the two 80-acre Silver Spray sections. This rich ore is Jamesonite, a sulphide of antimony and lead, as shown by the following analysis made by Mr. W. F. Ward, Government Analyst :—

Lead............	40 per cent.
Antimony	29 per cent.
Sulphur	18 per cent.

After several years' perseverence the company seems to be on the eve of prosperity : its output is on the increase, and the increased values also are not wholly due to the present higher market rates. In 1898 the output was between 500 and 600 tons silver-lead ore, worth about £16 per ton ; in 1899 between 1100 and 1200 tons, worth about £19 per ton ; and this year the new rich ore will make itself felt in the Returns. It is disappointing to notice that work has been carried on mainly by tribute, a very unsatisfactory plan. Although it has kept the concern alive, these large properties have not been developed to anything like the extent they should have been. There has been far too much shallow mining indulged in, and it is only within the last year that preparations have been made for deeper sinking. It is to be hoped that the better times which appear to be coming will induce the owners to embark on a more vigorous policy. They have an excellent manager in Mr. Vincent. On theoretical grounds I have formed a high opinion of the value of the Balstrup section south of and adjoining the Argent block, and I believe that that ground will eventually be proved to be valuable, for it seems to contain the junction of two separate converging sets of mineral-filled fractures coming in from N.E. and N.W. respectively.

Colonel North Mine.

J. H. Houghton, Manager. This company, besides its mines, has four miles of tramway connecting with Zeehan. Its property is a large one, over 600 acres, at the S.W. end of the lode systems coming through from the Montana, Queen, and British Zeehan sections. It is near the edge of the Zeehan Basin, and on the margin of the serpentine area. The ratio of silver to lead in the ore is fair, though not high, averaging from 1 to 1½ ozs. silver to the unit of lead. From the Grubb's Mine £32,000 worth of ore is stated to have been raised in the past, and that lode is not the only one on the property. The main shaft is down to 275 feet, 4 levels having been driven on the lode, viz.—Intermediate, at a depth of 80 feet; No. 1, at 130 feet; No. 2, at 200 feet; No. 3, at 273 feet. The old stopes go right up to surface, representing a block of lode about 270 feet high × 200 feet in length. The ore-shoot, or body, which, above No. 2, seemed to be vertical, lengthens out between Nos. 2 and 3 in a southerly direction, and from this fact the ore is considered to pitch south as it goes down. At the northern end of the mine there was very good ore in the upper levels, but as the lode descended it grew poorer, and split down to the 130-feet level. No. 2 level, I found, was not being driven N., as the ore stopped with the stope in that direction. It ought to be driven S., however, for there is a probability of it coming into another shoot of ore, which has been struck in the bottom level; and if No. 2 becomes ore-bearing, it will be necessary to resume driving the south end of No. 1. The bottom level was being driven S. on a 6-foot lode carrying a foot of solid milling ore, when I was underground. The ore is rather finer-grained than the produce of the old stopes, and its assay value is lower. Its appearance, though it is fairly well mixed with blende, is very encouraging. The lode is a fissure one, bearing N. 47° E. In the upper levels its underlay is westerly (contrary to the general rule at Zeehan, except at the King), but there are indications of the E. dip being recovered in depth. The N. drive at the bottom level is on a lode containing much blende. The gangue is carbonate of iron, and the country-rock, melaphyre. It is intended to rise and crosscut behind this end—a very good plan.

It is interesting to notice that Mr. Stitt has determined rutile in a vein on the Colonel North old ground. This would seem to indicate some connection with granite.

The concentrating works are equipped with May's plant, 3 jigs, 3 Frue-vanners, concentrators, and a few Frue-vanners for slimes. Outside some 300 tons second-class ore were stacked as reserve. Fourteen men were working underground. Less blende and more galena would be a desideratum in the ore, and some of the galena is rather poor in silver; but the mine is in ground well worth prospecting, and offering good chances of success. There is every reason to believe that judicious progressive work will bring this property into a prosperous condition.

The four miles of railway from Zeehan offer, along a line through Kenney's, Omant's, Anderson's, and Quiggan's sections, the means of extension into the Comstock district. Access could also be given to the Comstock, especially to the southern portion of the field, by running an extension from the Colonel North tram to the end of the old Tasmanian tram on Carson's section. The Colonel North Company has advantages in the possession of its tramway which it would do well not to sleep upon.

New Mount Zeehan.

This company has 120 acres at Zeehan, and has, unfortunately, spent nearly £14,000 on its mine, with no result worth speaking of. The deepest level is only 124 feet from surface, the main shaft being 140 feet deep. The mine could never be expected to live at this trifling depth. Another factor in its failure is the small amount of driving upon the lodes. Crosscutting has been carried on to a large extent, but crosscutting is not of much use if the lodes, when intersected, are not fol-followed up by drives. These two causes have combined to bring the mine to its present deplorable state. Work has now been suspended and the mine let on tribute. Eleven parties of tributors are working on different parts of the property, but they do not seem to be very successful so far, and I do not anticipate that they will do the company any real good. There are enough surface shows on the property to tempt them, as there appears to be a network of lodes all over the flat, but of very variable size and quality.

From the main shaft, at a depth of 60 feet, a level has been driven 700 feet on the lode, and another at 124 feet, the lode running a little E. of N., and the ore-shoots pitching S., as they do in all lodes on the property. The 124-feet level, S. on main lode, goes towards Smith's tribute, has been driven 1040 feet, and is within 500 feet of the boundary. A little ore was found in an underlay winze to 40 feet, but nothing payable in the main level. At the surface good ore occurs in Murphy's lode, down to 40 feet behind the end of main level south. A few crosscuts are wanted in this drive. I understand shortness of funds has prevented these being driven.

On Nos. 3 and 4 lodes W. there are short drives, which had some high-grade ore 10 inches to 1 foot, much faulted. The lode here requires developing.

A 100-feet extension of crosscut would connect Nos. 2 and 3 shafts, and drain the latter to 70 feet. This shaft is, however, small, and of no use for deep work.

No. 1 lode, W. level from main crosscut, has been driven without results, though the lode is good enough at surface. A west arm, probably the same as the No. 1 lode coming S. W from N. E., crosses with a short shoot of ore from surface down to 60 feet.

There are nine lodes crossing Main-street, bearing W. of N., with angle diminishing going N. These lodes are nearly vertical, with a slight easterly underlay. When Main-street was constructed, and sundry excavations made for buildings, I believe galena was found in all these lodes. All the land in Main-street has been resumed by the Government, and this resumption has, doubtless, been injurious to the company.

I had a look at some of the tribute works. On Section 559 No. 2 tunnel was being driven E. to crosscut supposed lodes in the hill, below where galena was found while digging posts for houses. The tunnel was 123 feet in, and the end 70 or 80 feet from surface. A wide formation of black pyritic pug had been met with, but no galena, except a little near the entrance, and 18 inches of ore which came up in the sole. It is clear that this drive is not deep enough. The country passed through was soft and clayey. Some chocolate-coloured slate or grit, with serpentinous veins, was intersected: in the end a white, lumpy, crystalline sandstone. The main E. crosscut end is 100 feet N. of the pug formation in the tunnel, and will cut it, if continued. There is every sign of the pug being the upper part of a lode, and I look upon the tunnel as being below the mere surface-shoots of ore, and not low enough for a second shoot.

No. 1 tunnel, near Smith's section, is 200 feet from the boundary, and passes through the same black pug formation as in No. 2. A lode 2 feet wide has been cut in it, and a second drive has the same lode on the footwall. It was followed a little distance, but was only a small vein. The black pug, probably, represents Currie's lode in Smith's section. The length of this tunnel is 206 feet, and the end is 100 feet below surface. It is being driven towards the crown of the hill, below which it will be 150 feet. It ought shortly to intersect another lode seen at surface. There are some rather interesting soft carbonaceous seams in the slates in the tunnel end.

If the company begins serious work again there are three aims which it ought to keep in view, viz.:—

1. To continue crosscut from the 70-feet level and connect No. 2 shaft with No. 3 at the Gaiety. Only a hundred feet of crosscutting are required to connect; of course, the lodes intersected in the crosscut would have to be driven upon. If the main crosscut were then continued beyond No. 3 shaft up to the boundary, it would cut four more lodes in the eastern part of the property. Another shaft would,

however, have to be sunk for continued work ; the Gaiety one is only suitable for an air shaft.

2. To resume sinking the main shaft, which is only down to a trifling depth.
3. To arrange an amalgamation with Smith's, which ought not to be difficult, as that section is rather small to float by itself.

To No. 1 I may add that if permanent developments occur in the eastern part of the property another main shaft will be absolutely necessary, as the distance from the present engine shaft will be too great.

The disappointing results, so far, tend to discourage continuance of the work at present depths. Despite the money which has been spent, the mine has not been opened up with a view to the future, and, from all appearances, resumption of work here practically means the starting of a new mine. There is nothing, however, in the nature of the country or lodes to forbid the hope that ore may make again in depth.

South King (Fahey's Tribute).

This thriving tribute is on the south section of the Silver King property, and has been lately an important contributor to the production of the field. Between Fahey's and the railway there is a western line of gossan outcropping across the mine tram track. A crosscut from Fahey's ought to cut it. It is a soft gossan, originating yellow ferruginous water, and no work has been done on it yet. The country is a light fissile sandstone, and the outcrop ought to be tried, for it has a promising look.

The main shaft is now down to nearly 200 feet, and a No. 3 level will be driven from the bottom. At 100 feet a crosscut was driven E., cutting the main lode at a short distance in. The crosscut was then extended to cut a rich little lode known as the Sunrise, but the water proved too heavy, and driving had to be discontinued till sinking is resumed. The lode in this mine averages from 3 to 4 feet wide, and, unlike the lodes in the other parts of the field, underlies W. The country-rock is sandstone. An underlay winze had just been started on

4 feet of solid ore, but had to be stopped at 8 feet on account of water. When the main shaft is sunk further this winze will be drained and work resumed. Going south, the lode widens to 6 feet, and attains a maximum width in stope of 18 feet. In the gossan, in the upper parts of the mine, patches of copper ore are found. Further on there is blank ground for nearly 60 feet; two exploratory crosscuts have been driven, but without success. For 30 feet behind the end of level there are stopes overhead. The N. level has been driven 293 feet, the last 30 feet of which have been blank. The remainder has been on a lode from 2 feet 6 inches to 4 feet 6 inches wide, bearing slightly W. of N., dipping 1 in 5, and carrying dressing ore with carbonate of iron gangue. When the lode is flattest, it has been found best for ore. The ratio of silver to lead has varied from a little under to a little over 1 oz. silver to each unit of lead. The last stope was 90 feet from the crosscut. The lode does not seem to have any proper walls; they are walls behind walls; but such as they are, they are exceptionally good, showing graphitic slate and pug. In the end there is no hanging-wall visible, but the lode track hugs the footwall on which pug and soft carbonate of iron are lying. The rest of the face is lode-slate streaked with carbonate of iron and galena. A crosscut E. has been driven behind the end for 22 feet, but without intersecting anything. The lode in this mine is widest at 30 feet from surface, but the best body of ore is at 50 feet. The stopes are 130 feet in length. Second class ore was being treated in handjigs, but the intention is to erect a concentrating plant. 170 hands were employed. For some time the tributors were unfortunate with this mine, but it is pleasing to see that their perseverance has been rewarded. Their success will not be without effect on neighbouring ventures.

On the boundary between the South King and Zeehan-Bell there is a shaft which goes down to the 116-feet level of the Bell, and some 30 feet lower still. It was formerly worked by tributors, and I understand that a sub-tribute from the King did pretty well here. Both the South King and Bell mines are connected with this shaft, and now the Bell Company ought to sink to strike ore at a deeper level, as the ore pitches south, though close to the shaft it would appear to narrow out funnel-shaped in depth.

North of Fahey's, just south and E. of the railway line, a small shaft was being started by Mr. Fahey on a gossan outcrop on the main line of lode. This gossan carries galena, and it is quite likely that there may be a shoot of ore here.

Zeehan-Bell Mine.

From the old tribute shaft, in the northern part of this property, some argentiferous gossan and low-grade galena were obtained, not very high in silver. This was on the main lode, which was picked up further south, and stoped out to surface for a long distance. The zinc contents are said to increase going south. Two levels have been opened out in this mine: an upper one at 116 feet, a lower one at 180 feet, besides the upper adit. The bottom level is being driven, but nothing done in main faces until both levels are connected. The lode in bottom level carries 2 feet mixed ore in short erratic shoots. No ore in the face and no stopes in back of level. This level is 270 feet long from crosscut. A little stoping has been done over back of adit. A winze is going down from the 116-feet level to connect with rise from the 180-feet. The face of the 116-feet has holed to the level from the South King workings. The work in the winze and rise was all that was going on at the time of my visit. 13 hands were employed. The lode has been traced and worked at surface for 300 feet south and as far north as the South King boundary. The claim has been idle a couple of years, but seven months ago was re-started.

There are no concentrating works attached to the mine, as the company intends first to sell its ore as raised, and wishes to assure itself of a better grade before committing itself to that expenditure. The ratio of silver in the ore from this mine is low, being $\frac{1}{2}$oz. to a unit of lead, and this is the return from ore in the bottom drive. There is a good deal of low-grade ore in the upper part of the mine awaiting concentration; in fact, most of the ore requires to be dressed. If a small dressing plant had been put up here, Fahey's ore would have been secured, but it is now almost too late.

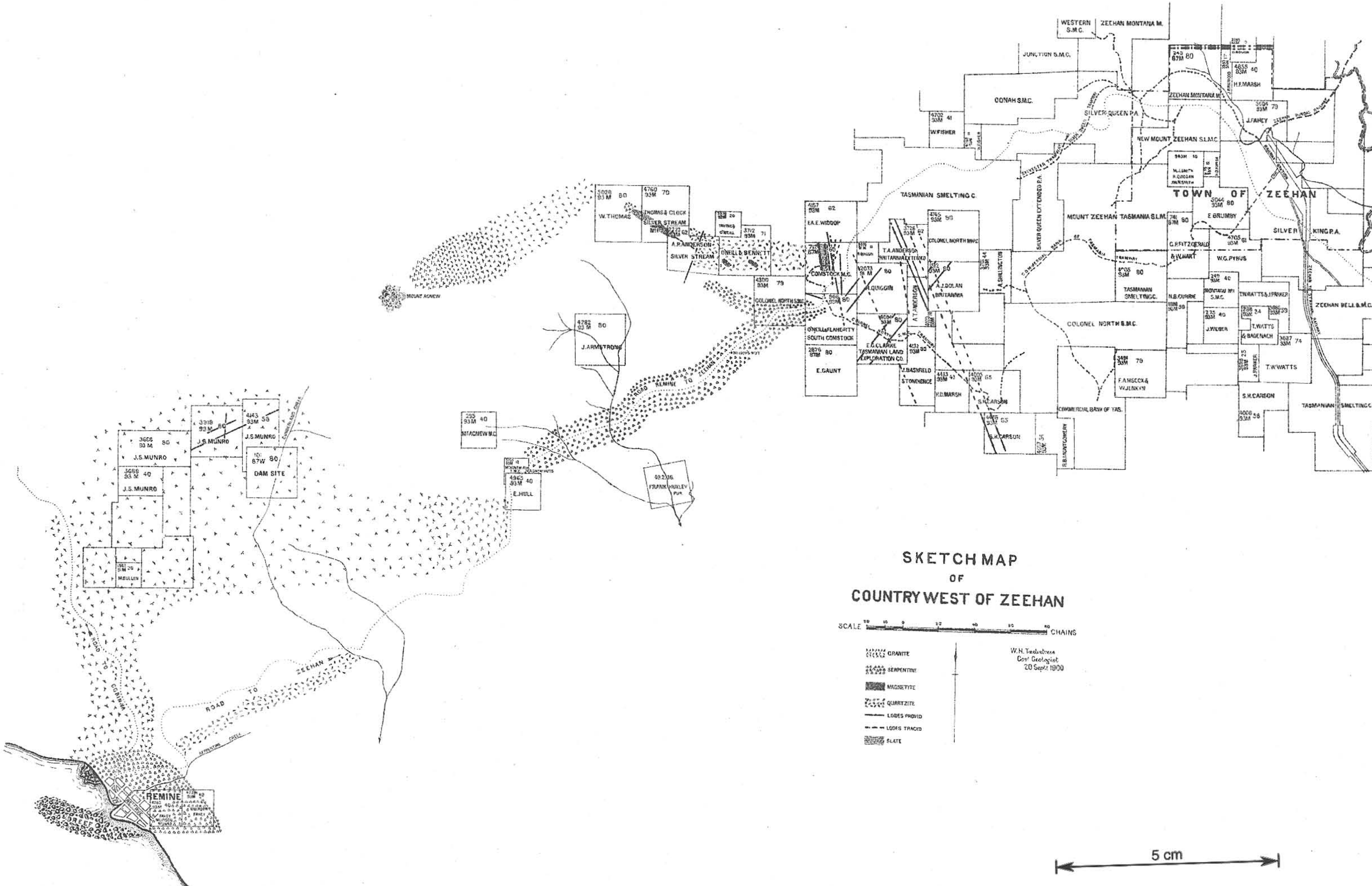
I noticed the ore is associated with a fair amount of zinc blende. The ore close to the King boundary has been stoped away to surface, and the prospects of the mine, as a whole, are not encouraging between the 115 and 180 feet levels. A fair trial would be to carry exploration to a greater depth. A long crosscut from the shaft would cut the western gossan lode, and that would be a legitimate piece of work; but the present company does not seem to be very energetic in its venture.

Western Consolidated Mine.

This was formerly the Western Extended, in part. It comprises 350 acres, adjoining the Western Mine property on the N. and N.W. The old Western Extended did work on some lodes running E. and W. of N., and sank a main shaft 160 feet. The new company is being formed to take over these blocks as well as those formerly held by the May Queen and others. A lode has been found running E. of south, which is claimed to be identical with the main lode of the Western Mine. Whether it is so, will have to be ascertained by following it to the boundary, for the lodes of the Western are so irregular in bearing and behaviour, that the mere correspondence in strike of a lode on an adjacent section is insufficient for identification. The published assays of the ore are very variable, the lowest silver ratio being about $\frac{8}{10}$ oz. to the unit of lead, and the highest, over 3 ozs. to the unit, but, I should think, the latter must be secondary ores. The country is slate and sandstone, outside the favourable melaphyre country, and deserves prospecting. It will be gratifying if the owners can show that the Western is not the termination of the field, but that the Zeehan lodes extend further north. As an effort to prospect and extend the length of the ore-bearing belt beyond its present known limit, the venture is worthy of encouragement.

The Comstock District.

About four miles west of Zeehan the country, consisting of Silurian slates, sandstone, and limestone, with an extension of the melaphyre lava, is seamed with a series of zincey silver-lead lodes, which, though unconnected


SKETCH MAP
OF
COUNTRY WEST OF ZEEHAN
SCALE
CHAINS
GRANITE
SERPENTINE
MAGNETITE
QUARTZITE
LODES PROVID
LODES TRACED
SLATE
W.H. Twelvetrees
Govt Geologist
20 Sept 1900
TOWN OF ZEEHAN
TASMANIAN SMELTING C.
MOUNT ZEEHAN TASMANIA S.L.M.
COLONEL NORTH S.M.C.
SILVER KING P.A.
ZEEHAN BELL S.M.C.
CONAH S.M.C.
JUNCTION S.M.C.
WESTERN S.M.C.
ZEEHAN MONTANA M.
NEW MOUNT ZEEHAN S.L.M.C.
SILVER QUEEN P.A.
COMSTOCK M.C.
SOUTH COMSTOCK
TASMANIAN LAND EXPLORATION CO.
SILVER STREAM
DAM SITE
MOUNT AGNEW
ROAD REMINE TO ZEEHAN
ROAD TO ZEEHAN
REMINE

5 cm

with the Zeehan lodes, are probably of the same age, and originate from the same source. They have no constant bearing, but cross each other in sets in different directions. Perhaps, however, the most frequent bearings are west of north and east of north; but it is altogether premature to say which of these sets are the most important. I am inclined, however, to believe that, like the lodes on the Zeehan field, those running W. of north will be found the principal ones. The country rocks mostly bear N.E., and the lodes intersect them after the nature of fissure-veins. On only one property (North Tasmania) has a shaft been sunk as deep as 190 feet; all the other shafts are 100 feet and under, so that we really do not know what the lodes are like at any reasonable depth. Some of them have gossan outcrops, the poverty of which may be attributed to the leaching out of the primary minerals, to be found again in a secondary form at the ground-water level. Most, however, show unchanged sulphide in their outcrop, and from this we may infer that no great leaching has taken place. From the favourable appearance of the outcrops, and the solid, defined character of the lodes as seen not far below surface, it may be assumed that their behaviour in depth will be found satisfactory. Certainly, there is nothing in their aspect to warrant the absurd notions that they are only surface phenomena. As channels for ore deposition they are as well defined as any on the Zeehan field proper, and from this point of view I should judge them to be even superior, for their is no symptom yet of the vein branching and interlacing, which is characteristic of so many of the Zeehan lodes. They are a good deal nearer to the Heemskirk granite range than the Zeehan veins are, and many of them are close to the contact of the serpentine with the Silurian country. The serpentine contact crosses the Trial Harbour road a little W. of the South Comstock, and runs N.W. through the Colonel North West and Silver Stream to H. D. Marsh's west section, where it has been raised by the great granite mass which is now developed as Mount Agnew. It continues in a S.E. direction to the west of the old Tasmanian tramway; but I found serpentine also further E., on the Britannia section. This contact country is in the highest degree favourable for the deposition of ore in lodes, and the district may be considered favoured in that respect. I should think it very likely that the serpentine intrusions shattered, or at least shook, the country-rock, inducing the formation of lines of weakness, which were taken advantage of by the succeeding granite magma acting as the mineralisator.

The Comstock district has been practically abandoned for several years, desultory and tribute work only being now proceeded with at a few of the old mines. Numerous sections were taken up about 12 years ago, and great expectations formed of the field. Its failure to fulfil the hopes entertained may be ascribed to a combination of causes, which I enumerate as follow :—

1. The preponderance of zinc blende in the vein stuff.
2. The comparatively low silver contents of the galena.
3. The insufficiency of subscribed capital for working the mines.
4. The difficulty and cost of transport.

These drawbacks discouraged adventurers, and, finally, led to the stoppage of work. The attention of the public was then drawn away to the newly-discovered silverfields at Dundas, and the Comstock area fell into a state of neglect, from which it has never recovered.

If we examine the causes of disappointment we shall find that some are remediable, while the others may, under the altered state of things now prevailing, operate far less prejudicially than they did in the eighties.

Though zinc is an unwelcome companion of galena, it is by no means such a drawback as it used to be. The rise in its market value and improvements in separation methods have increased the chances of the Comstock mines. The clean blende ore can be sold at a profit direct, either to the smelting works at Zeehan or to local buyers for European smelters : and where the blende is associated with galena not too intimately (*i.e.* not chemically) and without too much iron pyrites, there is no insuperable difficulty in separating it by dressing. Some of the zinc blende occurs very clean, scarcely needing hand-picking, and yielding 50 per cent. zinc.

A sample of dense zinc blende which I took from the South Comstock Mine has been assayed by Mr. W. F. Ward, Government Analyst, and contained—

Zinc............	48·70 per cent.
Lead	1·12 „
Iron............	9·80 „
Manganese...	1·60 „
Silica	6·48 „
Gold	trace.
Silver	16 dwts. 8 grs.

An analysis of solid zinc ore from the same mine by Mr. J. G. A. Stitt yielded the following results :—

Zinc............	52·47 per cent.
Iron............	10·50 „
Manganese...	3·62 „
Sulphur.......	32·95 „
Silica, &c.	·46 „
	100·00 „
Gold	4 dwts. 14 grs.
Silver	1 oz. 15 dwts. 22 grs.

Assays of South Comstock zinc ore by Mr. Hill, the assayer at the Hercules Mine, have given the following :—

	Per cent.	Per cent.
Zinc	50·80	51.80
Iron	10·40	18·20
Manganese......	0·50	—
Lead	0·54	—
Silver............	3·20	1·90
Insoluble	9·15	2·80

The iron is evidently approaching a quantity which may prove troublesome. For a zinc ore assaying 43 per cent. Zn. miners can obtain about 20*s*. a ton at the mine, and 4*s*. for every excess unit. Bulk parcels of 48 per cent. have been sold at 35*s*. a ton ; other consignments down to 32*s*. Consequently, there is an important difference between now and a dozen years ago, in that there is a market now at Zeehan for the blende ores, while then there was none, and the zinc was an absolutely useless commodity. It need not be anticipated, however, that the blende will remain the sole or dominant mineral in the lodes. Blende and galena are natural associates, and when one dies out the other often appears. This change is not dependent upon depth, but may take place at any time. I think, however, it is likely, seeing the great development of blende there is in the lodes of the district, that the galena will always be found to be accompanied by blende more or less, even when the former predominates. There is, however, nothing in this to discourage exploitation. On the contrary, the presence of zinc in such quantity is satisfactory in the meantime, as furnishing some return for capital pending the discovery of galena zones in the lodes.

The silver contents of the ore constituted a second factor in the cessation of work, but these are not intrinsically low. The average contents of 287 tons of ore from the Comstock Mine I find to be 63 ozs. silver to 52 per cent. lead per ton. This is a little below the average of the Zeehan ore, and, with former conditions of work, may have tended to discourage early investors. In some mines on this field the silver contents fall below 1 oz. to the unit of lead, but at the present time they do not offer an invincible difficulty. Thus the two drawbacks abovementioned are no longer so formidable as they appeared at one time. As for the remaining ones, they may be remedied absolutely.

The great mistake was made of supposing that a small oulay would bring quick and important returns; and there is danger of this mistake being repeated. Most of these mines require shafts, pumping and hoisting appliances, &c., and to attempt to begin work at them again without being prepared with ample capital will only lead to disaster and bring the field into bad repute. Small prospecting companies cannot hope to achieve anything worth doing, and it would be well if only such companies resume operations here as are ready with a well-considered programme and have the funds for carrying it out.

Comstock Mine.

This mine is close to the main road to Trial Harbour, about 5 miles from Zeehan railway station. From Zeehan the track along the Silver Queen swamp is taken over decayed melaphyre and slate country. The hills appear to be sandstone. At the junction of the Oonah and town trams we see melaphyre, and again going up the hill at Queen No. 2, where it is vesicular. The melaphyre here has yielded rich kaolin and carbonate ores. It decomposes to a characteristic yellow clay, which clothes the spur up to the Sylvester saddle, 360 feet above the Queen bridge. On the saddle, in the roadside cutting, the white rock is well bedded, striking N. 20° W., and dipping N.E. at a chain south of the north boundary of the Sylvester 33-acre section. The country along the road S.W. of the saddle is obscured by surface soil, but the melaphyre possibly extends to the old Sylvester Mine, where the ore is very pyritous. The upper zone in this mine yielded fair secondary ores, chlorides, and phosphates, and the galena obtained was equal in silver contents to that of the Zeehan mines.

The Comstock Mine itself is on Section 712-87M, and was opened in the early part of 1888, on a strong lode, bearing N. 15° W., and dipping N.E. Following the lode up from the south, a surface trench exposes it in limestone as 5 feet wide, with seams of galena, pyrites, and dark, ferriferous zinc blende. This dark blende tarnishes an indigo blue, and the iron pyrites, on exposure, assume a coppery hue. Going north, the lode appears to split. North of the small reservoir it continues strong, with good ore underfoot. Up to here it has been stoped down to 19 feet: there is a nice seam of metal in the N. end of this cut. A small shaft which is between the dam and poppet-head yielded two or three tons of blende last year. In the part of the section north of the central 10-acre block there is a 30 or 40 feet shaft, just S. of the main shaft, which latter has been sunk to 100 feet. From this shaft, 8 chains N. of the open stope, two levels have been driven N. and S., one at 45 feet, and a bottom one at 100 feet. The lode, when struck in a 43-feet E. crosscut, was found to be a blende one, 4 feet in width. A good shoot of galena and blende ore, 100 feet in length, has been stoped away from the shallow level to surface, going south. The mullock-heap has been picked over since, and, it is said, has yielded some good blende, assaying over 50 per cent. zinc. The Comstock lode throughout its length contains galena and blende in varying proportions, the latter often very abundantly. From the open stopes to the northern boundary, the lode, with blende, can be traced through the section. Ten chains east of this another strong lode, of similar character, though poorer in lead and silver, has been traced for a length of five chains, and will most likely be found to traverse the property. From the company's records, I notice that 300 tons of silver-lead ore realised £4000, or £13 per ton, which, for the ore of this field, and in those days, was a satisfactory return. As far as I can learn, about 600 tons of ore was the total output. This should encourage perseverance in further developing the property, which has several good points, and the proprietors should not rest satisfied until they have explored the lode at serious depths. This lode, which goes strong into the South Comstock section, is a powerful and continuous one along its strike, and has every indication of persistence in depth. To more fully prospect it, a long crosscut tunnel has been driven nearly 700 feet on an easement from the South Comstock, and is about to be extended as far as the lode.

South Comstock Mine.

This is on the 80-acre section, situate immediately to the south of the Comstock. The lessees, Messrs. G. O'Neill and W. Flaherty, have let the mine on tribute, and it is at present the only mine on the field forwarding regular parcels of ore to Zeehan. The main workings are just inside the north boundary, where there is an open cut with a face 58 feet high, exposing a lode at least 13 feet wide, which consists, at this point, of zinc blende and other lode-matter. The full width of lode is not laid bare. In the floor of the face a shaft has been sunk, first for 40 feet vertical from surface, then on the underlie to a depth equivalent to a further 40 feet vertical. A short drive, 20 feet, has been put in south from the bottom of shaft, and from this drive a little good galena ore has been won. The drive, however, resembles a burrow more than anything else. This is the deepest part of the mine, and the zinc blende here is, perhaps, the purest. The underlay (E.) is becoming much flatter in descending. Both galena and blende co-existing at this depth is rather favourable for galena prospects as mining works go down. O'Neill's tunnel has been driven at 18 feet below the shaft collar for 114 feet along the lode, which consists mainly of nodular blende and pyrites. At the end of the tunnel a crosscut has been driven diagonally S.E. across the lode for 66 feet without absolutely reaching the hanging-wall. The ore exposed is chiefly zinc blende, in irregular lumps and patches, the poor lodestuff between the solid patches of ore being soft iron oxide and pyrites. At the end of the crosscut a winze has been sunk 15 feet, and in the bottom of this the zinc ore seems more solid. The long tunnel from the S. side of the hill is 97 feet vertical below the level of these works, and will provide a useful test of this lode at some depth. A little galena is won from time to time, and hand-picked at the mine, and realises from £6 to £10 per ton at the mine. Sales have been made at £6 13s., £8, and £10. A sample from the N. drive, assayed by the Government Analyst, returned 84 per cent. lead (by wet method), and 114 ozs. 6 dwts. 16 grs. silver. I have very little doubt that the proportion of galena will sooner or later increase. If the mine, in the meantime, can be kept going with the proceeds of the zinc blende, of which it has a large quantity easily available, it will inevitably, in the course of time, come into the galena-bearing zone of the lode. The lode has not yet been blocked out sufficiently to allow of any safe calculation of the quantity of zinc ore in sight or readily accessible. The quantity of soft, worthless lode-matter is considerable, I should say at least 50 per cent., and any unforeseen increase in this will upset the estimate, but I think it would be safe to say that there are from 6,000 to 8,000 tons zinc blende above the level of the deepest works. This blende ore averages from 40 per cent. to 48 per cent. zinc.

A small drive is being put in N. on the lode from the crosscut behind the end, and the soft gossan of the crosscut has given place to solid blende ore the last six feet. Some galena has also been won from this drive; good clean ore alternating with blende, and apparently going underfoot. With the present means of transport, I do not think that the ore can be mined and delivered in Zeehan under 30s. per ton, but improved communication ought to reduce this cost by 5s. per ton, which, in such a low-grade ore, means a great deal. It has been claimed that the blende averages 4 dwts. in gold contents, but my sample, assayed by the Government Analyst, contained only a trace of the precious metal, and 16 dwts. 8 grs. silver. I am told that continental buyers offer £4 per ton in Antwerp, with an extra allowance for any gold contents, but as the ore would cost nearly that sum by the time it was placed on the European market, there seems to be no particular advantage in disposing of the output in this way.

If the blende ore could be sent to Zeehan for 3s. or 4s. per ton this mine would be a legitimate venture, especially if amalgamated with its neighbour, the Comstock; and I think a fair proportion of silver-lead ore could also be got out without much difficulty or delay. The silver contents of the galena being a little higher than in some of the other mines of the Comstock district, is an advantage. But the proprietors, to ensure success and make a good mine of it, ought to amalgamate with the Comstock and provide ample capital for systematic work. Small associations with insufficient means will neither benefit the adventurers nor do justice to the mines.

Besides the main lode which traverses both the Comstock and South Comstock properties, the latter section carries a nearly parallel east lode bearing N. 45° W., a N. and S. lode (Montgomery's) and two lodes running N.E., viz., the Stockyard lode N. 30° E., and the Boss lode N. 32° E. The Stockyard lode has an old collapsed shaft, and carries the usual zincy galena ore. Some nine tons which were sent away are reported to have had good silver contents. In order to test the nature of the gossanous material from some of these lodes I took samples from the South Comstock upper tunnel and the Stockyard lode, which have been assayed by Mr. W. F. Ward (the Government Analyst) as under:—

S. Comstock: soft gossan. Gold trace, Silver, 1oz. 17dwts. 13grs.
Stockyard lode: gossan. Gold, 1dwt. 15grs., Silver, 2ozs. 9 dwts.

The lower adit referred to above, if pushed far enough, would drain all these lodes, and give access to them at a moderate depth. The South Comstock main lode is concealed southwards by the overburden on the hill; but what is supposed to be its continuation has been driven on N. below the old Tasmanian tramway. Some blende and galena were found in a small seam in similar slate country to that on the N. side of the hill. A little native copper, too, is present in the ore.

Macdonald's Tribute.

I should have mentioned above that, on the Comstock property, E. of the main road, an open cast excavation is being worked on tribute, on a large galena lode bearing N. 20° W. and dipping N.E. An old shaft is situate just E. of the workings, and has cut the lode at 35 feet. The ore is poor in silver, but rich in blende. The lode has been trenched along its course northwards, and several tons of blende ore sold from it, carrying 45 per cent. to 47 per cent. zinc. This is parallel with the Boss lode on the adjoining section. A little concentrating ore can be picked out of the waste heaps which I saw, but the galena is associated with a good deal of pyrites and blende, and I do not think mining will pay unless there is easy tram communication with Zeehan. But, even with rich ore, this tribute would never pay with the present unsystematic way of working. The tributor intends sinking, and cutting the lode lower down, but at no great depth, and shallow mining will neither prove nor sustain the mine. A few yards south of this, just before coming to the *Comstock Hotel*, an outcrop of iron pyrites, blende with a little galena, courses N. 20° W. through slate country.

North Comstock.

Section 1546-93M, 62 acres. This was taken up in 1888, and about £1200 spent in shallow and surface prospecting, which was continued without results, as far as silver-lead ore was concerned; and work was abandoned in 1892. I walked over the property, and examined the work which had been carried on, with a view of picking up the main lode coming into the section from the Comstock.

Half a chain north of the south boundary, a small adit has been driven N. 80° W., but it is altogether too far to the west of the main lode, though, if continued, it would intersect one of the lodes coming from the south. It has been driven 45 feet in dark slate country, containing a little pyrites. The upper, or third adit, about 550 feet above the South Comstock, has been driven N. 80° W., across slate, and has intersected a small vein carrying galena. This vein runs with the stratification of the country, and was the object aimed at in starting the adit, but, seeing its unsatisfactory nature, the tunnel was pushed on to cut any lode which might possibly be ahead, as loose pieces of galena have been found in the creek, higher up. An intermediate tunnel has been driven N.E. for a couple of chains (including the approach) to cut the Comstock lode. After this, it forks; the westerly drive following a soft gossanous lode, which crosses the tunnel W. of north. The lode carries a 1-inch seam of galena. The gangue is quartzose, and the ore is not associated with so much blende as usual. The end is not more than 18 feet below the surface, and no additional backs can be got by continuing the drive. The only possible policy is to sink, but the country is wet, and it would be advisable to wait till it is drained by the companies on the Comstock sections, lower down. By extending the eastern fork a zinciferous lode, which crops out in the creek, would be met with, but no great increase of backs could be got. The outcrop does not expose the lode sufficiently to see its width, but, from all appearances, this is most likely the Comstock lode, or a branch of it, for I am rather inclined to think that the main Comstock lode splits up into branches as it goes north. The wet country and the rather heavy scrub make prospecting on this section difficult. What ought to be done first of all is to expose the lodes coming in from the south all along their course from the boundary, and see exactly what there is to aim at. At present, some uncertainty exists as to what the lodes which have been cut really are, and whether the exploratory works are in the best positions.

Out on the button-grass country, within two chains of the N. boundary, a N. and S. lode, with a westerly dip, goes into the hill N. Its width is 14 inches to 16 inches, and it runs in sandstone and quartzite country, apparently, conformably in direction with the stratification. It is seamed with quartz sprinkled with a little galena, and impregnated with iron pyrites. Good backs are available, and can be increased to the extent of about 40 feet by going lower down into the button-grass swamp. The hill is a high grassy ridge running across the northern part of the section. The direction of the lode bears down the hill into the plain a little E. of a shaft which has been sunk in the swamp at the base of the hill. This shaft, 20 feet deep, is in gossany matter, sprinkled with pyrites and a little galena, but in different country, viz., slaty. The lode here can only be explored by sinking. From what I have said, it is evident that none of these lodes have been sufficiently tested.

Boss Section.

This comprises 80 acres (2073-87M), in the name of R. Quiggin, east of and adjoining the Comstock and South Comstock sections. A good deal of prospecting has been carried on, but no depth has been attained. The main lode enters the section from the N.E. angle of the South Comstock property, and bears N. 32 E., across the Boss section, with an outcrop about 20 chains in length. Just inside the boundary, from the Comstock, a trench exposes the strong pyritic lode, which, about 50 feet further N.E., is shown again in a long trench and a short crosscut drive, where it consists of dense iron pyrites, and crosses fissile black sandstone country. Still further N.E. are some open workings on the same lode, where the iron pyrites carry blende and some nice-looking galena. Some of the latter is reported to have assayed 105 ozs. silver, and to have been sold at £15 per ton. The lode contains a good deal of blende, which looks well enough where it is not mixed with the iron pyrites. Very little backs are obtainable, and this necessitates sinking. Further N.E. the lode was driven on, and 30 tons of ore were sent to the Argent mill. Five tons of ore were won in simply cutting through the lode 16 feet, which crosses the level diagonally, and was composed of pyrites and blende, with bars of galena. After driving 70 feet a sink was begun, but discontinued at only three feet below the level, owing to water. A shaft from surface has gone down to a depth of 28 feet. The lode is in yellow clay, and, together with the country strata, dips W. It is a strong lode, with a solid outcrop, 19 feet wide, of iron pyrites, and work has been abandoned without giving it fair play. To leave off at this trifling depth from grass is only playing at mining. No backs are to be had, and further adit-driving is, in my opinion, useless.

There is another lode on the section, the west lode, which is shown in a strong iron gossan outcrop, bearing N. 30° W., dipping N.E., and, in direction, passes out of the block at the N.W. corner. Some iron pyrites is visible in this outcrop, and the gangue is quartz. It is seen on a small hill on the rather flat button-grass plain, 100 feet above the *Comstock Hotel.* The country falls away on the east of this to the plain at the base of Mt. Zeehan. A crosscut tunnel into the hill from the W. would test the lode not far from surface; but, as not more than 30 feet of backs are obtainable, the result of the crosscut would be indecisive. The great drawback of the lodes on this section is, that sinking is an imperative necessity, and this will involve heavy preliminary and standing expenditure. Down the hill, near the east boundary, is the eastern lode, bearing west of north and running through slates with a westerly dip. This lode is two feet wide, and carries blende and iron pyrites, with some galena. It has been surface-trenched some six or seven feet deep, and lower down the hill an adit is being driven just inside the E. boundary, to come under the surface outcrop of blende ore at a depth of about 40 feet. It has been driven about 200 feet, and now seems to be about vertically underneath the outcrop, but will have to go in further still, as the lode underlies west. The men, however, have been taken back from the face 100 feet to drive on a galena vein intersected by the adit. A seam of galena 1½ inches thick, in curly disturbed country, veined with quartz and impregnated with iron pyrites, appears in a south drive just started, and requires following. In the opposite drive, where the ore continued for six feet in, the country is now barren. Further in an inch vein of galena was risen on for six feet over back of tunnel, but died out in very broken country. The stratification all through the adit is irregular, and heads of rock are constant. I do not think the main lode has been reached yet; the galena which has been met with so far appears only to be associated with flat seams of quartz, and not to represent any real lode. Further to the north-west on this part of the section there is another lode carrying small veins of galena. And again, towards the south and just inside the east boundary line, is a shaft sunk on a lode or vein running west of north in fissile sandstone and slate. A tunnel is being driven from the boundary to cut this, but has not yet connected with the shaft. I picked over some fair-looking galena on the small pile of stuff at mouth of shaft, but my impression is that this part of the property is seamed with small veins rather than fissured by any definite lode-channels, and, on the whole, the deposits of ore are likely to be irregular.

Clarke's Section.

This is an 80-acre block, No. 4094-93M., in the name of E. G. Clarke, formerly Tasmanian Land Exploration Company, and is situate south of the Boss. The Boss west lode passes into it, and it has, further, two lodes of its own traversing the section from the S.W. corner to the N.E. About 400 feet west of the west boundary the old main shaft is sunk 100 feet, and bottom levels are said to have been driven N. and S. for 275 feet, the south level in ore which has been stoped out to surface. The ore – a high grade galena-blende—is said to be the best on the field. A parallel lode—the Laura lode—has been worked with fair results. Several prospecting shafts have been put down, and trenches cut into these lodes, but I am told that work practically ceased six years ago. The hoisting plant is reported to have been inadequate; at any rate, after considerable expenditure on shafts, the company suspended operations. I could not get underground, and can form no proper opinion of the mining prospects, but the lodes which traverse the property deserve a better fate than their present neglected state. The country-rock is conglomerate and sandstone.

Stonehenge.

Section No. 4132-93M., 80 acres, is south-east of the preceding. Three lodes bearing west of north, traverse this property. The westerly lode passes N. into Clarke's, and the two others N. to the Susannite. The principal lode has been sunk on, and 60 or 70 feet driven upon it. The ore is galena blende, but I was unable to learn anything about the results obtained. The section seems to have been completely abandoned, without much work being done on it.

E. Gaunt's Section.

No. 2876-87M., 80 acres. This is situate south of the South Comstock, and is favourably placed for the extension into the section of the lodes from the South Comstock and those from Clarke's section. Nothing has been done to prove these yet, but if work is resumed at this group of mines, the section ought to be thoroughly prospected.

Carson's Sections.

No. 4005-93M, 65 acres, and No. 4476-93M, 65 acres, situate a little to the E. of Stonehenge, have two lodes bearing W. of N., which pass northwards into the North Tasmanian section. The lode in the western part of No. 4005 is tapped by an adit driven N.E. There is fair milling ore, but it would never pay for the cost of transport into Zeehan. If the adit were continued further, it would cut the western lode. The backs here are low, not more than 40 feet. The lode is of a good size, but the work done is only on the top of it. At the south boundary of 4005, the old Tasmanian main shaft and tunnel are situate, near the east end of the Tasmanian tramway. The slates strike N.E. and dip S.E. The lode is a large blende-pyrites one, associated with quartz; and the ore used to be treated in a concentrating mill, which was afterwards sold to the Comet Company. The large 3-compartment shaft has its poppet legs damaged by fire, probably bush fires, as it is in a line with a belt of burnt timber. The low silver ratio of the ore, and the want of communication with Zeehan, are great drawbacks.

North Tasmanian.

These blocks appear now on the chart in the name of A. E. Shillington. They comprise 182 acres, viz., No. 3699-93M, 73 acres; No. 3700-93M, 65 acres;

No. 3701-93M, 44 acres. Two nearly parallel lodes enter the section from Carson's, on the south, and course N.W. through the S.W. corner of the middle section, continuing thence into the Britannia property. A main shaft has been sunk in the south section. The depth attained is said to have been 190 feet, and levels opened out on a good-sized lode, which has been stoped out, I believe, to surface on a good run of galena-blende ore. The underground workings are now inaccessible. The lode bears N. 20° W. and dips N.E. The ore has a solid healthy appearance in the specimens which I picked up at surface, but would have to be dressed. The silver ratio averages a little under 1 ounce to the unit of lead. Mr. J. G. A. Stitt, of Zeehan, reports numerous assays of the ores as sold to the Queensland Smelting Company, viz. :—

Kaolin and Gossan ore,	328	ozs.	Silver,	39 %	Lead
"	87	"	"	7 %	"
"	76	"	"	13 %	"
Galena, first quality	75	"	"	76 %	"
" "	70	"	"	74 %	"
" "	67	"	"	71 %	"
" "	65	"	"	73 %	"
" second quality	54	"	"	61 %	"
" "	49	"	"	52 %	"
" "	44	"	"	66 %	"

But a sample of galena picked north of shaft assayed 124 ozs. silver, 79 per cent. lead. On the other hand, a good deal of the ore is stated to contain only a little over half an ounce of silver to the unit of lead.

We have slates and sandstones on this property on the E., while to the W. igneous rock occurs, which I was not able to identify on the spot ; but there is some sort of a contact which has probably influenced the lodes favourably. £5000 or £6000 worth of ore is reported to have been won from the mine during the company's and subsequent tributors' time. I am told that the pumping plant, which was removed when work was stopped, was inadequate for managing the water at the depth reached.

About 200 feet W. of the main lode is another one, coursing N., 10° W. Both lodes dip N.E., but the western one is flatter, and there is hardly any doubt that it will junction with the E. one in depth. The former ought to be cut in depth by a crosscut W. from the bottom level on the E. lode, and this should be done by any one who takes up this property.

An adit has been driven W. 200 feet on the middle section with the view of cutting these lodes, but I believe it will have to be extended a little further before intersecting. This is a piece of work which requires proceeding with, as the lodes can be easily followed north with moderate backs, though none too good. Deepening the shaft will expose the lode at a more satisfactory depth ; and, given better communication with Zeehan and the necessary capital, this property, with the higher price of lead, possesses encouraging prospects. Its position is within a mile S.W. of the Colonel North railway, besides which the old line of the Tasmanian tram passes through the section at the S.W. corner. It is a pity to see a legitimate prospecting property like this lying idle.

Britannia Section.

No. 1512-93M., 80 acres, A. J. Dolan. This is bounded on the S. by the preceding, and on the N.W. and W. by the Susannite property. It can be easily reached by a track about 30 chains long from Grubb's tram (Col. North railway), on the British Mt. Zeehan property. Shillington's tram, branching off from Grubb's, is along the line marked out by the Colonel North Company for tram extension to the Comstock. Several lodes are known to exist on the section, but the most important ones are the two parallel lines of lodes coming in from the south, and traversing the Britannia section in a N.W. direction, and passing out of it near its N.W. corner ; and the two T.L.E. parallel lodes, which cross the N.W. corner in a N.E. direction. The latter are the principal ones. The western lode has a strong outcrop traceable for 7 chains, and the eastern lode for 14 chains. On the eastern T.L.E. lode a small prospecting shaft was sunk 12 feet about eleven years ago, upon the discovery of galena in the creek. A bucketfull of blende and iron pyrites was got up, but the water proved too heavy, and nothing further was done, except at surface. A trench a few yards S.W. of this shaft shows a lode about 6 inches wide, said to be widening under foot, which consists of blende and pyrites, with a little fine-grained galena. It carries some soft pug on the hanging-wall. The country-rock is slate, striking N.W. and dipping N.E., while the lode cuts through it with a bearing of N., 10° E., and a dip to the S.E. About 700 feet S. of the north boundary line a small shaft has been put down some 20 or 30 feet on a blende and pyrites lode containing a little galena, and a further shaft of about the same depth was sunk on some highly argentiferous galena. The No. 4 adit has been driven N.E. through slate, and cutting the E. lode at about 140 feet in an E. crosscut, in which the lode is about 10 feet wide, 6 feet of which is a solid lode of zinc blende and iron pyrites, carrying galena. The remaining 4 feet are composed of soft pug, pyritous and zincy matter. The ratio of silver obtained is 1½ ozs. to the unit of lead ; a little copper is also said to be present in the ore. Altogether, it is an ugly mixture. A little further on in the crosscut is a small seam of galena about 8 feet beyond the lode-wall. The lode has been tested at surface 50 feet ahead of this, but the depth in the crosscut is trifling, only 25 feet below grass. Further south, about 500 feet from south boundary, two adits have been driven at right angles to each other, No. 1 going north, No. 2 going west, or a little north of west. The No. 1 adit has been extended through slate country 102 feet, and under a strong gossan outcrop. At 70 feet a quartz lode was cut, 2 feet wide between walls, carrying 4 inches of galena, clean, and with no blende. This ore assayed a little over 1 oz. silver to the unit of lead. The vein bears N.E., consequently, parallel with the E. lode, which is ahead of the adit. From the indications at surface I think the adit will shortly enter serpentine country. At the contact line, possibly, some ore-channel may be met with. This adit is a low one, and should be continued through the section, for it will cut all lodes belonging to both systems, and enable the ground to be satisfactorily proved. The country between the lodes is veined considerably. Of the two systems the T.L.E. is the more important, and the work has been done principally on those lodes. The Tasmanian lodes are represented by lines which require to be traced by systematic trenching.

The No. 2 adit has also been driven 102 feet at right angles to No. 1; nothing has been cut in it so far, and it has some distance to go before intersecting the E. lode. The line of one of the Tasmanian lodes crosses it at or near the entrance, but though both these lodes, if continuous, would pass through the section, they cannot be identified till the trenching just mentioned has been carried out. In the N.W. corner of the block, No. 3 adit has been driven north-west for about 170 feet, with the object of intersecting the west T.L.E. lode, under a strong outcrop which crosses that corner to the S. boundary of the Britannia Extended. About 30 feet from approach, and 18 feet from surface, a 6-feet band of pyritiferous and iron gossan crosses the tunnel, and has been passed through. The present end of tunnel cannot be far from the lode, which is underlaying to meet it. Close to the face there is a vein of quartz, and water is flowing freely. The tunnel is in pink and yellow clay, the decomposition product of slate, and the face is now about 40 feet vertical below surface.

Besides these main lodes there are other features which deserve attention. In the eastern part of the property there are large and wide gossan outcrops; and E. of the east lode a small seam of galena was cut in a trench, and a shaft sunk 21 feet, with a crosscut extended from the bottom to cut the lode, which, 1-foot wide, dipped out of the shaft at 15 feet. The lode is a galena-pyrites one: the bottom of the shaft is in curly slate, with quartz and a little pyrites; the crosscut has not been driven far enough to reach the lode.

There are other prospecting works on the property, some of which I did not see; others, I need not particularise. The section is conveniently situated with regard to the Grubb (Col. North) railway, via Shillington's line, only one section intervening, and the indications of mineral at so many points warrant an expectation that more vigorous progressive work would result in satisfactory developments. As the E. lode underlies west and the W. lode east, they will probably unite in depth, and one of the aims of those in charge of future work should be to explore them at the junction.

Britannia Extended.

This block, N.E. of the Boss and N.W. of the Britannia sections, is better known as the Susannite, owing to the occurrence of highly argentiferous mimetite (arseniate and chloride of lead), which at first was conjectured to be susannite, a variety of leadhillite (sulphato-carbonate of lead). The barrel-shaped crystals of this yellowish resinous-looking mineral have been identified as campylite by Mr. W. F. Petterd, and this identification has been confirmed by an analysis made by Mr. W. A. Macleod, B.A., B.Sc. During the investigations a question arose whether the mineral might not be what Dana calls pseudo-campylite, a pyromorphite which assumes rounded forms resembling campylite. It appears that the boundary is vague between mimetite and that variety of pyromorphite in which arsenic takes the place of phosphorus. The increase of arsenic causes pyromorphite to pass into mimetite, and when the barrel form is present there is scarcely a doubt as to it being campylite. In the present instance, we may consider the mineral as true campylite, *i.e.*, an arsenical pyromorphite or mimetite, which crystallises in barrel-shaped crystals. It is associated with other crystals having the mammillary and acicular habits of pyromorphite and mimetite. I notice the lodes marked on local plans of this section are called mimetite lodes. This rich secondary ore is characteristic of the upper part of the lode, and is mixed with soft decomposed pyrites down to the tunnel level, which is not more than 35 feet befow surface. The pyritous lode bulks 1½ ozs. silver to the unit of lead, and the other lode in drive 1 oz. to the unit. A tribute party of four are working, but had not effected any sales when I was there. They had a small pile of ore outside tunnel, which they claimed had given assay returns up to 116 ozs. silver and 7 per cent. lead.

This ore will infallibly change to lead sulphide in depth. The west drive on this property has been driven 200 feet. It intersects a strong pyrite-galena lode 16 feet to 18 feet wide, with rather low silver contents, under 1 oz. to the unit. There is no blende with this ore, and on any other field such a lode would not be left unexplored. But nothing much can be done with the property by small tribute parties. The lodes invite thorough testing in depth.

Silver Stream District.

This must be considered with the Comstock field, of which it forms the western part. It comprises the sections lying immediately west of the Comstock and North Comstock. Geologically, it shows more pronounced signs of the proximity of the serpentine than the generality of the Comstock mines. The succession of strata going E. to W. from the Comstock Mine to the base of Mount Agnew would be—1 limestone, 2 quartzite, 3 sandstone, 4 black slate, 5 quartzite, 6 serpentine, 7 granite: the serpentine intrusive into the sedimentary strata, and the granite subsequent to all others. It would require considerable time to go over all the surrounding country and trace the geological boundary lines, but by walking westwards, I thought I could fix the granite contact somewhere in the swampy flat on W. Thomas's section, No. 5028-93M. The serpentine is seen along the Trial Harbour Road, in contact with the sedimentary rocks a little to the west of the South Comstock Mine, and also on the Colonel North West Section, so that it is evident that the mineral deposits of the Silver Stream district are situate near the serpentine contact lines, and have probably been indirectly influenced by the rock. There is, however, no necessity to refer them directly to anything but the granite period, notwithstanding the presence of minerals commonly found in serpentine country, *e.g.*, brucite (?), magnetite, clinochlore, &c.

Proceeding westward from the Comstock section, we enter a 39-acre block, 970-93M, where the country is quartzite, covered with button-grass. On the top of the hill is a seam of gossan, which transgresses the country strata with a bearing of N. 10° E. It goes down vertically from 2 feet to 12 inches wide, and with a fair wall on the E. side. This is about 230 feet above the Comstock. Passing further west to

O'Neill and Bennett's Section,

71 acres, No. 3712-93M, the quartzite country continues, and on the top of the hill is a deep cut through a

strong iron and quartz outcrop 4 feet wide, and bearing N. 25° W. On the N. side 250 to 300 feet of driving would give a couple of hundred feet of backs. The gossan carries no metal, but where exposed looks a very likely capping for a lode. About 250 feet further west a shallow cutting exposes another iron outcrop, about 3 feet wide. A few hundred feet of backs could be got here from the east. I believe these outcrops cover silver-lead lodes, and an attempt ought to be made to get below them. Since these notes were penned I have heard that one of these lodes has been recently cut at 120 feet below surface, and that a ton of galena has been sold from it, netting £10.

The hill here falls off towards the sea, and an extensive view is obtained of the timbered serpentine country to the S.W. In the southern part of the section there is a bold projecting outcrop of magnetic iron ore, which can be traced for about 7 or 8 chains south down to the blind creek in gully, 60 feet deep; but further west additional backs could be obtained by driving a crosscut tunnel. At the southern end the outcrop is not so dense, but more gossanous. Going N.W. and across gully, about 150 feet further west, is another iron outcrop, where gold prospecting has been carried on. While the quartzite country is bare, the iron outcrop is covered by a narrow belt of timber, evidently denoting a more favourable soil for forest growth. The magnetic iron seems to be surrounded by quartzite country, and thus to partake of the nature of a lode, but I am very doubtful as to its occupying an independent fissure, or to its having any other connection than with the neighbouring serpentine, which may also be beneath it. The question ought to be set at rest by prospecting below it and along its walls, where the deposition of ore is most likely to have taken place.

Silver Stream,

Section 2223-93M, 62 acres, A. P. Anderson, is due west of O'Neill and Bennett's property. Work on a lode, bearing east of north, was started ten or eleven years ago, and has been carried on in a desultory way, the mine falling into the hands of tributors, and meeting with the usual fate. A shaft has been sunk 50 feet down to No. 1 level, and thence continued 27 feet by a winze to the lower adit. Payable ore was stoped out above No. 1 level, and No. 2 level has been driven 600 feet, but for a length of 500 feet it was not more than 30 feet from surface, and only an additional 45 feet were gained in the last hundred feet of the drive. The lode is wide in places, but averages three or four feet. From what I learned, upwards of 200 tons ore had been sold, but low in silver contents. The silver ratio is reported not to have exceeded half an ounce to the unit of lead. The ore-band has been as much as five or six feet wide in this lode, and it will doubtless recur in depth, but nothing can be done without the necessary capital for sinking and draining. The Silver Stream lode is the principal one known in this part of the field, and has been left alone far too long. When the district is brought into communication with Zeehan there will be some chance of a vigorous development of the property. A few chains south of the shaft the eastern fringe of the serpentine country is met with, but at the mine itself I saw nothing but quartzite and dark clay-slate.

Three or four chains north of the south boundary, a tunnel about a chain long has been driven S 10° E., in what appeared to be serpentine. It passes through what was described to me as the copper formation, which is a band of decomposed serpentine carrying a little copper pyrites. The trend of the serpentine is N.W. By continuing this crosscut the galena lode would be intersected. The copper pyrites band is none too encouraging; the ore is sparsely disseminated and does not seem to fill a fissure. From what I noticed in this journey, the serpentine in various parts of the field appears to contain disseminations of copper ore, but there are no known copper lodes, and it is very doubtful whether the magnetite outcrops pass into copper pyrites in depth. The margins of the magnetic iron masses are the most likely places for copper ore.

Silver Stream, No. 1.

No. 4760-93M, 70 acres, Thomas and Glock. This is a property N.W. and adjoining the Silver Stream. Its characteristic feature is a large outcrop of magnetic iron, several chains wide, forming the top of a N.W.—S.E. timbered ridge, which passes through the section. This iron belt passes into the adjoining section on the west, and 3 or 4 chains into the Silver Stream on the south-east. O'Neill's magnetic iron outcrop on the 71-acre section is supposed to be its continuation, and though that blow seems a little north of the line of strike, it undoubtedly has some connection with the occurrence. The big deposit of magnetite is a most interesting geological phenomenon, besides claiming attention from a mining point of view. It is desirable to attack it at a reasonable depth and determine whether it caps a pyritic lode. The surface indications show that in its more solid portions it is a mass of dense magnetic iron ore without any symptoms of a sulphidic lode beneath it. The view which a prospector habitually and naturally takes of oxidised outcrops is that they graduate downwards into unaltered sulphides: and such a view encourages him to aim at getting down into the supposed sulphidic zone. He is fortified by his success in sinking on lode cappings in sedimentary or acid eruptive rocks. But there is grave doubt whether the same thing always holds good in gabbro and serpentine country. In these latter rocks concentrations of iron oxide are assumed to take place during the crystallisation and differentiation of the magma, and are thus distinct phenomena from those connected with the formation of lodes. A cut in the gossany clay and iron towards the north end of the ridge shows an earth which certainly looks like the decomposition product of an igneous rock, which might have been serpentine or a contact rock. It contains small glistening talc-like flakes, somewhat resembling decomposed enstatite, but which are probably clinochlore, a mineral of the chlorite group, often associated with serpentine and its contacts. In this part of the blow the iron is not dense and solid. Still, it would be improper to look upon the iron as a simple cap, for it runs down to creek level. I do not see why it should not continue to descend to any imaginable depth with earthy or stony portions, according to the more or less perfect concentration of the iron in the original magma. This concentration appears to have proceeded in a

N.W.-S.E. line, and, as a whole, to have been connected with the contact either of granite with serpentine, or of the latter with the sedimentary rocks against which it impinges all along this line. It is quite possible that some copper ore concentrations may occur in connection with it, though no decided signs are noticeable. The most likely positions for ore of any kind would not be below it in depth, but on its flanks. I believe a local association is driving from the adjoining section to get well into the iron formation. If this tunnel is continued far enough, we shall know more about the body of ore than we do now. As an ore of iron, this large blow may at some future time impart value to the property.

Wm. Thomas's Section.

No. 5028-93M, 80 acres. This was formerly held by the Tasmanian Silver Prospecting Company, and subsequently by H. D. Marsh. The magnetite on the preceding section runs into this, and is evidently close to the granite contact. A little further W. is quartz-tourmaline rock, and then the granite of Mt. Agnew. The intervening country on this section appears to be sandstone and quartzite, together with a dark metamorphosed rock, which microscopical examination shows to be indurated serpentine. Some blende and pyrites from M'Clochlin's shaft show that a lode of some kind has been struck. The mica-like mineral in large plates, slightly greenish, and with greasy lustre, seen on the heap at mouth of shaft, is clinochlore, and the ore deposit would appear to be a contact one. Clinochlore is a secondary mineral, and this is just the position in which it is likely to occur. The phenomenal silver assays said to have been obtained from here are in accordance with this view. Unless the shaft is unwatered, no opinion can be formed as to the prospects of mining here. No good shoot of galena has been met with : the ground is low and swampy, and all work would have to be done by means of sinking.

I have now passed in review most of the properties on the Comstock field. My remarks will have shown that the district is favoured with several strong blende-galena lodes, serious work on which has been neglected for several years, owing to circumstances already alluded to. In consequence of the blende ores now being marketable, and with the higher price which has been ruling for lead and silver for some time past, it appears to me quite practicable for some of these abandoned mines to be profitably worked, if only there is the means of cheap transport to Zeehan. The Trial Harbour road does not give this facility, and the Colonel North railway stops a good way short of the south end of the field.

Communication by tram, either by one route or another, seems to be the only remedy for this unfortunate isolation, and the knowledge that it is to be applied will, without a doubt, revive interest in the dormant sections. Of course, a line running out to the field will not have full traffic immediately, but I anticipate it would at once secure a fair quantity of ore from the Comstock and South Comstock mines, besides which it would convey stores to these and other mines restarting.

The field can be approached in two ways. First, there is the Queen Extended route to the Comstock and South Comstock mines. These mines are five miles from the Zeehan railway station. There is a tram-line for about half the distance, and the extension of this for a further $2\frac{1}{2}$ miles would take it as far as the Comstock. This is the route favoured by those interested in the Comstock group, as being the shortest and most direct one to the mines at their end of the field. The drawback to it is that it will have to climb the hill from the present Queen extended tram. The Trial Harbour road ascends 350 feet from the Queen bridge, and then descends 150 feet to the mine, and the tram-line could not avoid at least 250 feet of this ascent. A survey, however, would show whether a convenient line could not be found. Of course, as the Comstock mines will be the chief immediate customers of the tram, their position has to be kept in view. Another thing to be considered is that if the Comstock is to be on the main line, which will be ultimately extended to Heemskirk, then the most direct route should be taken, and the companies in the other parts of the field left to connect with it by horse-tram. It would be desirable to see whether the Queen Extended route could not be taken up to the Britannia, Susannite, Boss, and so on, to the Comstock. It would thus serve most of the mines which are now working.

The other way of opening up the field is by making use of the Colonel North railway (Grubb's tram), which could be extended to the Comstock in two ways, viz., (1) by a direct route of 1½ miles from a point on the existing line due west across Shillington's, Britannia, and along the north boundary of the Boss; or (2) by about a mile of new tramway connecting with the old Tasmanian tram, which communicates with the Comstock by a two-mile track. This route is the more circuitous, but each route passes through sections which are likely to be taken in hand again, and work resumed on the lodes which traverse them.

Taking the (1) Colonel North route, that company has already surveyed it from the saddle of its own line on the Spray Hill, on Section 195-87M. It crosses Shillington's section from E. to W. into the Britannia, where prospecting is going on upon lodes which I have described. It then continues westward into the Britannia Extended or Susannite ground, where exploratory work is being conducted; and thence along the north boundary of R. Quiggin's Boss section, the lodes on which require more attention than they are receiving at present. From here it enters the Comstock section, leaving the Sylvester mine close at hand to the N., and would be continued to the South Comstock immediately to the south. The mines along the old Tasmanian tramway would then connect with the new railway at the South Comstock.

The Colonel North Company has an alternative route (2), filling up the existing gap between its line on section 1584-91M., and the end of the Tasmanian line on Carson's section, 4005-93M., whence the tram rails would be laid along the line of the old tram road to the Comstock. It would serve the Tasmanian sections, and ultimately reach the Comstock, but would leave the Britannia blocks to the N.

I think the real choice will be found to lie between what I may call the west branch (1) from the Colonel North and the Queen extended line. In favour of the former, it is alleged that the Colonel North railway has already climbed the hill, while the Queen Extended would have to find a way up, and that it is the shortest due west route from the Zeehan railway station. In support of the Queen route, it is contended that it is a natural line of extension of the town tram, and would best serve the mines in the northern part of the field. Whichever of the two routes be adopted, it will have the effect of making work possible on sections which have long been condemned to enforced idleness.

It must not be expected that a large traffic will attend on the line all at once. Capital has been unfairly diverted from the district, and it will take some time to secure its return. There will, however, be an immediate return from the South Comstock, and probably from the Comstock Mine; and others certainly will follow. The district will in time supply the Zeehan mines with a fair quantity of timber, and the smelting works with flux, all of which will be carried by the proposed line. Mine-owners will be able to get stores and machinery to the field economically and with ease. I anticipate confidently that the line will be instrumental in assuring a reasonable measure of prosperity to mines which are now either languishing or abandoned. What I chiefly fear, is that sections will be taken in hand by small prospecting associations, who, with insufficient capital, cannot carry out the work systematically and thoroughly, and who, after a short trial, and the exhaustion of their funds, will put their properties again on tribute, and, sooner or later, throw them up, having securely fastened upon them a thoroughly bad name. What is wanted, I repeat, is for companies well provided with capital to begin serious work, with the determination to see it through; and I have no doubt that perseverance on those lines would be rewarded. Hitherto the lodes have been too far from Zeehan to pay for ore transport, and perhaps too near to be floated into important companies. If they had been more distant and less accessible they might have had a better chance of attracting capital. The worst detractors of the field cannot deny that it abounds with mineral. Most of this cannot be realised profitably under present conditions of transport. The zinc blende, which is so prevalent, was worthless in former days, but is now a marketable product, and, with cheap transport and smelters near at hand, can be turned into hard cash. This ore, and the argentiferous galena found on so many sections, supply good reasons why the field should not be allowed to remain in its present undeveloped state. If treated properly, it may be expected that in the future this district will become an important adjunct to the Zeehan system of mines.

I do not know that the serpentine country to the south-west has been properly explored for lodes, but, geologically, it is quite as favourable a matrix for silver-lead lodes in this Colony as the Silurian strata are, and it would not be at all surprising if prospecting resulted in uncovering some important lodes between the Comstock and Trial Harbour. The most likely zones in that country would be on the contact line between the gabbro and granite, where the granite begins near the Agnew, and again further west near the coast line, where the granite joins the serpentine. These contact boundaries furnish lines of weakness, along which, under the stimulus of intrusive rock magma, deposition of ore is apt to take place.

If eventually the tin ground at Heemskirk is proved to be valuable, and this is quite possible, then the country west of Zeehan will assume additional importance. Be this as it may, Zeehan, surrounded by country which invites the prospector and investor, must remain for generations an attractive mining centre.

Trial Harbour and Mt. Heemskirk.

I combined a visit to Trial Harbour with my journey to Heemskirk. On the main road, about half a mile west from the South Comstock, a small cut has been made into the serpentine, on a 15-inch quartz vein, which carries a little auriferous pyrites. This is 5 or 6 chains north of the south boundary of the Col. North W. sections. It is in a good position for working, if it can be proved to be of any value, having excellent backs above and below road. The rock along the road is imperfectly serpentinised, and fresh gabbro is seen just beyond M'Ivor's cottage in the road cutting on the left. A little iron and copper pyrites can be detected in it, but there are no safe indications of anything payable. The gabbro seems inclined to become amphibolitic along this road, indicating its proximity to granite About ¾-mile further on, a large iron gossan outcrop crosses the road, but no trial of it appears to have been made. The Heemskirk granite invades the gabbro country near the Agnew Creek. This latter rock is the bluish granular stone seen on the road, and used as road metal. It merges gradually further E. into a more typical gabbro of coarser texture. The granite of Heemskirk in its fresh and unaltered state is a handsome rock, consisting of pink orthoclase felspar, abundant dark mica, and quartz. Where it is tin-bearing there is a development of white mica, a fact suggestive of the secondary nature of this mineral. In places, the granite is converted into greisen, or a quartz-lithic-mica rock. The tourmaline of the stanniferous granite is very abundant, and ranks among the finest in the Colony. Fine cabinet specimens are freely obtained.

Bourke's Alluvial.

I looked at these tin workings, which are on the Agnew creek, just at the change from the gabbro country to the granite. About 3 feet of wash rests on the coarse bed-rock granite. This drift is full of large stones of granite and quartz-tourmaline rock. Mr. Bourke had been sluicing here for eleven months, and had found the ground very patchy, but had struck a rich spot just before my visit. Here, and at the Big Orient, there were 5 men at work.

The Heemskirk granite country covers the area between the Agnew and Orient creeks, and on the plateau S.W. of the latter creek we have schistose quartzites, bearing N. 30° W., and dipping N.E. At the creek above Trial Harbour these are replaced by somewhat indurated serpentine, which, at the harbour, forms the high bank fringing the ocean shore. About 28 chains N. of the harbour granite comes in, and the serpentine shows signs of contact metamorphism.

Trial Harbour Nickel.

About half a mile south of the harbour, on the hill facing the ocean, a shallow shaft, 180 feet above sea-level, has been sunk in soft serpentine, which contains some impregnations of sulphidic nickel ore and a little zaratite.

Outside the shaft are five bags of ore and a barrowful of green nickel-stained serpentine, but I could not see any sulphide ore in the stones on the heap. A very good specimen was shown me at Smith's, at the harbour. This shaft seems to be following an irony vein running N.W. Thirty feet below the shaft collar a drive has been extended 26 feet from approach, with the view of intersecting the nickeliferous vein. For the last 12 feet the drive bears N. 80° W., in massive, but somewhat decomposed serpentine, with iron ore seams and white patches of magnesite (the carbonate of magnesia). The drive was suspended when I visited it, but it ought to be continued to the shaft, and the behaviour of the nickel vein ascertained. At present, all that can be said is that there is undoubtedly a concentration of nickel ore in the serpentine here, but whether it will be found to develop into anything payable is problematical. To the east of the shaft is a wide iron gossan, which no doubt covers a ferruginous belt of the serpentine, but it is improbable that it is the capping of any lode. These lodeless gossans are characteristic of serpentine country, and have often led to fruitless work. They do not mark the course of any fissure, but represent a magmatic concentration of iron in the cooling rock-mass. On the north side of the hill a long tunnel has been driven S. into the serpentine, 150 feet above sea-level, towards the surface gossanous outcrop. I followed the adit some 50 or 60 feet as far as the water would allow me. There are no indications of productive lodes in this serpentine, but, theoretically, contact ore-deposits ought to occur along the common boundary of serpentine and granite, and they may possibly yet be found.

The granite country to the north is a plain of marine denudation, rising gently towards the Heemskirk range, furrowed with gullies and strewn with water-worn granite boulders, and exposing round bosses of the same rock. Everywhere solid granite underlies the soil a few feet below the surface.

Montagu Mine.

This abandoned claim is situate at the foot of South Heemskirk and between the Cumberland Mine and the main road from Zeehan. Mr. Matthew Bullen resides on the property, and showed me round, giving me sundry information. I saw in his house a splendid nugget of tin ore found in the Montagu Creek, and evidently brought down from some lode on Heemskirk. An old main shaft is situate above the creek. This was sunk 120 feet, a well of 120 feet left, and a drive put in at 100 feet for the creek. An E. and W. lode was cut and driven upon for 12 feet. Where cut the lode is said to have been 10 feet wide, but very poor, consisting of hard quartz-tourmaline rock. It was very irregular, cutting out into barren rock, and no further work was done when the funds ran out. I believe a few tons of tin ore were obtained. The main lode is intersected by a N. and S. one in the Montagu Creek, and at the intersection the latter is two feet wide ; it is said to open out to 3 feet 6 inches at 40 feet down a prospecting shaft sunk in the creek. Two other prospecting shafts have been sunk between this and the main shaft. About 20 feet to the west, lower down the creek, are two or three small parallel veins, but not stanniferous at outcrop. Altogether there are over a dozen lodes and veins of tourmaline, which cut through the line of the N. and S. lode in this creek. The latter lode is tin-bearing at surface where the others intersect, which is just what might be expected. As usual, the veins do not shift at the junctions.

The Montagu main lode can be traced at surface for quite a quarter of a mile along its course E. In this direction a prospecting shaft sunk on it discloses about a foot of tourmaline quartz rock in decomposed granite. Further up the hill the lode is crossed by another from the north. The most easterly shaft is 20 feet deep, and in this Mr. Bullen cut the lode 2 feet 2 inches wide, carrying fair ore. A peculiar feature in this lode is that in its western part the tin ore is grey and brown, while east of the split it changes to a sharply crystallized black ore.

The present position of the claim is that two or three tons of tin ore per year can be got from the stone at surface single-handed by simply hand-crushing and dollying, and there is evidently a good deal of tin in the surrounding country. Whether a resumption of active work would result in success is difficult to say. The necessity for sinking is a drawback, and the bunchy nature of the ore is another damaging factor; still, the lode has not had a fair trial.

Federation Tin Mine.

Formerly the New West Cumberland, comprising 256 acres leased to J. S. Munro, viz., No. 3689-93M, 40 acres; No. 4143-93M, 56 acres; Nos. 3688 and 3919-93M, 160 acres. This mine, on the south end of Mount Heemskirk, is 3 miles from Trial Habour, and 12 miles by road from Zeehan. It has been recently taken over by new owners, who intend testing its value in a systematic way. They have put the battery in order, which is now equipped with 20 head of stamps, a Frey's stone-breaker, 3 classifiers, 8 Frue vanners (4 with corrugated belts, and 4 with plain ones), convex slime-table, 2 Pelton wheels (one to drive the vanners, the other the battery). The water is brought through a 7-inch column at 250 feet of pressure, and with an additional head of 200 feet above that, making altogether 450 feet of pressure available. A race has been cut 1¼ miles from the dam to the intake. The supply is abundant—more water, it is said, running away in the height of summer than would be required for 40 head of stamps. The old battery site was lower down the creek, a hundred feet lower than the new mill. The property has been practically idle for five years; and the old proprietors gave it up altogether the year before last. From what I can learn, the association of iron with the tin ore, on Section 3688, baffled the dressers, who were not up to table work. They also had a large percentage loss in dressing the bismuth found with some of their ore. This applies to the old portion of the property, which the present owners have no intention of working. An inclined self-acting tramway for 20 chains, the top of which is 450 feet vertical above the mill, connects with a ground horse tram-line, which comes round the hill from the East Cumberland section.

The old workings at the top of the self-actor consist of two adit levels, one 70 feet above the other. The upper adit has been driven 400 feet, at first on a body of tin ore taken out in an open face at entrance: most of it is said to have been a bag to the ton of stuff. A few vertical tourmaline veins also gave a little tin. The ore pinched out to a small vein of quartz, and the drive was driven through dry tourmaline granite, containing at one point a shoot of bismuth ore, which was stoped out by the old company. This adit finally cuts through what is called the iron-stone lode, 4 feet wide, from which, I was told, some bismuth had also been taken. It is really a cross-lode of ferruginous tourmaline rock, the iron oxide being derived from the tourmaline: the iron varieties of tourmaline assay, according to Dana, as much as 14 per cent. Fe O. The lower adit does not appear to have met with any success.

On the top of the hill, on the eastern section (No. 3688), are two long outcrops, which merit a more particular description. The one courses N. 50° E., and is the lode now called No. 1, upon which work is about to be principally carried on. The other, No. 2 lode, is a very long outcrop of hard tourmaline-quartz, running N. 62° E. In an easterly direction it courses through the Cumberland section proper, the long section, and has been worked at the east end. On the top of the hill, about 150 feet of granite forms the country between these two nearly parallel lodes.

On the No. 1, or block lode, a small prospecting shaft (Munro's shaft) has been sunk 27 feet, where the lode may be taken as being about a chain wide. The lode-matter is dense black stellate tourmaline, containing cavities which probably were once occupied by quartz. From this shaft, in the old times, lodestuff, which was sledged down to the battery, is said to have returned 3 per cent. tin ore. Mr. Stitt's assay of a bulk sample from the bottom of the shaft yielded 5 per cent. tin ore; Mr. Latta's assay of 14 lbs. from this shaft was 1·37 per cent. metallic tin. A sample taken on my visit right across the face averaged 4 per cent. tin ore. The shaft cuts across the lode, which is here of great width and promise. It has a 4-feet band of soft decomposed quartz-tourmaline running down it, and flanked at the east end with reddish micaceous-looking iron oxide. This point is, at present, a very important part of the mine, as it is not only, so far, the deepest accessible place, but the lode-matter is more stanniferous than in the drive lower down, where it is associated with the harder country-rock. The aim of the owners, I conceive, should be to attack the lode wherever it is of a soft ferruginous nature, for that portion will be found to be the richer in tin. Why it should be is not so easy to explain. It may be due to simply mechanical liberation of the tin ore from its associated tourmaline on the decomposition of the latter, together with the rock of which it formed part, and, as the decomposition product occupies a smaller space than the original rock, the tin ore may be regarded as a natural concentrate; or it may be that the rock was really richer in tin at these places, and the oxidation of the iron in the tourmaline is in some way connected with the unstable nature of the rock itself, where saturated with the fluoric solutions or vapours. In either of these two cases, the oxidised irony lode-matter is the indication of tin ore, and its most favourable matrix. A face, therefore, below this shaft, where, according to assays, there appears to be payable tin, and, provided the bulk returns can be kept up to 1 per cent., or even a little under, the venture should, with careful management and the existing facilities for economical extraction and treatment, be fairly satisfactory.

A little lower down the hill a blind drive has been cut some 12 feet into the lode, composed of black decomposed tourmaline quartz-rock. A dish prospect, on my visit, gave 3·47 per cent. tin ore, but an assay by Mr. Latta returned 1·62 per cent. metallic tin. Close by is the upper drive across the same lode, cutting across it for 40 feet. At 40 feet in, the further wall is struck, but for the last few feet the lode carries hardly any tin, so that 30 feet may be put down as the ore-bearing part. But this is scarcely the full width, as the approach is in lode, and the latter extends several feet further down the hill. There are portions of hard, poor rock in the lode exposed by this drive, and to this I attribute the poor return obtained from a bulk sample which I took of the lode and rock all along the drive. The Government Analyst reports a yield of 0·20 per cent. tin. On the other hand, Mr. Stitt took an average sample from along the roof of drive, and obtained from it 1 per cent. tin oxide. The N.E. drive from this adit has been extended 30 feet along the hanging-wall of lode in poor rock. The country here and there is soft and kaolinised, and seems to be outside the tin-bearing, gossany part of the lode. The S.W. drive, 47 feet, is also in massive country outside the proper tin-bearing part of the lode. Bunches of gossan, kaolin, and tourmaline form a soft, clinkery lode, best seen on the footwall side of the drive. These drives have not served any useful purpose beyond defining the boundary of the lode. Some of the lodestuff from the end of the S.W. drive was assayed by Mr. Stitt, and returned 2 per cent. tin ore. The adit has been continued into the hill for half a chain beyond these drives in a decomposed rock, which can be identified as white mica granite. By continuing it another couple of chains the tourmaline lode of the long section ought to be reached, and with no great difficulty, for the granite country is soft for the most part, the kaolin and iron being easy ground for driving. It is intended to begin a face on this lode a little further down the hill, below Munro's shaft. Mr. Sale, of Zeehan, assayed the concentrate from a dish prospect from the face exposure, which yielded 3·96 ozs. metallic tin per dish. A sample of the lode-rock assayed 2·06 per cent. metallic tin. A lower tunnel has been driven from the horizontal tramway, lower down the hill, on the N. side, for a distance of 210 feet, originally directed straight towards Munro's shaft (150 feet below it), but was afterwards bent round eastwards to come beneath the upper adit. The country is granite all the way in. The horizontal tramway starts from the mouth of this tunnel, and goes right round the hill to the hoppers.

This line of lode going S.W., not many yards from Munro's shaft, crosses another quartz-tourmaline lode, running N. and S., or a little E. of N. The way in which it crosses this at the top of the hill is instructive. It neither displaces it, nor is heaved by it, but crosses without any deviation. This is a frequent feature of tin lodes, and shows that the line of lode is a line of jointing which existed before the introduction of the tin. It is well known that extensive jointing, apart from metalliferous lodes, is a constant characteristic of granite country. A cut or two on the west side of the apex of the hill leaves no doubt but that the lode has really passed through the hill. Two shafts have been sunk about 30 feet deep on the N. and S. lode, or cross-lode, as it may be called, and on the N. side of the hill a small underlay shaft or adit has been driven on its course a short distance. Here the lode is about 4 feet wide, consisting of black quartz-tourmaline rock, bounded by a greyer variety of the same rock on either side. The shaft just above it to the S. is at the top of the hill, between 800 and 900 feet above the battery, and is sunk on the same lode, which is banded with a hard rib of bluish and greenish tourmaline rock, about 20 inches wide, with about a couple of feet of softer decomposed tourmaline rock. Some assays of the hard rib-rock by the Hamburg Metal Compauy returned over 25 per cent. metallic tin; and a recent assay by Mr. J. G. A. Stitt yielded 28·5 per cent. tin oxide. A sample from this shaft, according to an assay conducted by the Government Analyst, contained 12·2 per cent. metallic tin. The lode may, consequently, be expected to vary a good deal in its tin contents, but the returns obtained obviously suggest the advisability of further trial, which can be made inexpensively by adit from the north side of the hill. Another shaft has been sunk on the same tourmaline course, some 40 feet further S. The rock here contains some arsenopyrite, which is the origin of a characteristic yellow colour.

No. 2 lode runs right through Sections 3919 and 4143 to the Cumberland Creek, but has not been traced east of the latter section. It has a long, wide outcrop of quartz-tourmaline rock traversing the granite, and forming the backbone of the hill. The tourmaline on the Cumberland section proper (the long section) becomes greenish in tint going east, and at the eastern end of the outcrop is quite pea-green, like the similar rock at Mt. Bischoff, which used to be called chlorite. At that end is an old inclined shaft descending to the adit below on a lode composed of quartz-tourmaline, with white mica, the quartz being stained with some fluorine. The quartz-tourmaline-felspar pug yielded a little tin in the old times. Some work has been done in an open face above No. 1 adit, and ground stoped below that adit from a pass going down to No. 2, but tin has not been found in payable quantities. On Section 3919 a long tunnel was driven by the old company from the south, but was suspended before it was far enough in to come under the outcrop aimed at.

In the alluvial of creek to the E. of the upper hopper, on Section 3688, half a ton of black tin ore has been won. The ore is not waterworn, but sharply crystalline, and the wash or soil containing it bends away from the creek northwards. The creek itself runs up from the valley N. 60° E., and has about 2 feet of alluvial, decreasing to 18 inches, soil up the hill. The mineral is evidently lode tin from a vein not far away. It is a fine-quality ore, and the hillside should be prospected to ascertain which lode it came from.

Near the top of the inclined tramway, I saw a few old trenches and shafts exposing tourmaline lodes, some of which had yielded a little tin ore in the old days. Not very much systematic work has been done on the property, and outside the No. 1 lode nothing really good has resulted from prospecting. After my examination, the opinion which I have formed is that the ground is eminently favourble for tin ore, but the lodes are likely to be rich only locally. If parts of the lodes in which ore-concentrations exist can be picked up by prospecting, they will help the production, but these zones are very irregular, and of small extent, as far as disclosed by past work. The mainstay of the mine will be found in the No. 1 lode, and there is a fair chance of a payable output being derived from it. The venture upon which this enterprising syndicate is now embarked will be watched with interest by all who wish well to Heemskirk tin-mining.

About 18 men are employed at this mine, and perhaps 40 or 50 altogether on the Heemskirk range. Alluvial has been worked on Packer's Creek, below the Cumberland, and about 15 tons of tin ore were won. The alluvial consisted of 2 feet of wash under 7 feet of stripping. The reason why much alluvial is not found between here and the coast-line is that the sea at no distant date covered the country up to the range and well-sluiced the bedrock. Though tin-bearing alluvium will continue to be worked here and there, and will perhaps give fair returns to small parties of men, yet Heemskirk must depend for its permanence upon the lodes which certainly exist, and which in places contain good deposits of ore.

Heemskirk, as a tin field, has for a long time altogether lost favour, owing to its abandonment after a little underground work, and the consequent collapse of possibly extravagant hopes. The lodes have been condemned as capricious, but in doing this the nature of tin deposits, which are often only impregnations from joints, is not sufficiently taken into account. As far as I could see, the Heemskirk lodes have nothing unusual about them, and I have no doubt that their richer portions, when discovered, will answer expectations. The present price of tin has led to a revival of interest in the field, and if any measure of success attends the efforts now being inaugurated, it will lead to a more thorough trial of the lodes than they have yet received.

Renison Bell Tin Mine.

This property comprises five sections—181 acres in the North Dundas district, viz., Sections No. 165-93M, 40 acres; No. 166-93M, 16 acres; No. 2534-87M, 40 acres; No. 2606-87M, 40 acres; No. 2536-87M, 45 acres. It is reached by taking the train from Zeehan to the 5-mile station, whence a four-mile walk along either the Emu Bay line or the Owen Meredith tram leads to the mine. The mine is 2 miles 56 chains along the railway line from the centre of Tunnel Hill. From the 5-mile the Emu Bay line first passes N.E. through the old M'Kimmie Silver and Nickel Mining Company's sections, and further north through the Madame Melba flat, where a few men are still washing gold. The country-rock is a decomposed serpentine, which a little further north graduates into its parent rock, gabbro or bronzitite. On the track over the tunnel is the junction between the serpentine country and the Silurian slates. The railway thence runs along the strike of the slates, and the contact with the serpentine is exposed at intervals to within about three-quarters of a mile of the Renison Bell Mine, when it is replaced by sandstones and slates. On entering the S.W. angle of the 45-acre section, we first become aware of the proximity of tin country, for the railway track has just uncovered a band of tourmaline-quartz-porphyry, a white granular porphyry with needles of black tourmaline scattered sparingly through its groundmass. The rock is, however, without tin. Another outcrop of similar rock occurs nearly 1000 feet higher up to the S.E., on both sides of the boundary between Renison Bell section (165) and Sligo's section (1146). It is there a few chains wide, and is bounded by slate on the east side. The two exposures are parallel, and as one is only 10 chains east of the other, they may be parts of one and the same intrusion, though they cannot be connected, so far.

The Renison Bell Mine is in a very undeveloped state, and this renders any useful expression of opinion at present very difficult. Some work has been carried out down at the Argent River, on the northern section of the property, No. 2536, and the lodes have been trenched up the hill on that section: driving is proceeding at the Big Blow on Section 2534, but merely on a scale sufficient to avoid forfeiture.

The main, or No. 1, lode courses S.E. through the hill from the Argent River, on Section 2536. On the S. bank of the river it is exposed in an open face, about 20 feet wide, where it is of a soft gossanous and pyritic nature. A tunnel has been driven in slate S.E. along the western side of the lode for 100 feet. A crosscut N.E. from this tunnel only cut a soft pyritic vein, which, when followed a few feet, died out into flinty country. As this crosscut was a failure, a second one was put in at end of tunnel, and 200 feet from entrance. This has been driven 60 feet, and has cut into the lode, which is here dolomite and arsenical and iron pyrites, but has not yielded any tin. After cutting into the dolomite, the crosscut makes a useless bend, being driven too much to the south. It has passed through about 30 feet of dolomitic stone. Several assays have been made of the pyritic lodestuff in this crosscut. The indications show that we have a true tin lode, although in this part of it the tin ore is absent.

Government Analyst's Assay :—

Gold	Minute trace.
Silver....................	4 dwts. 21 grs.

Queensland Smelting Company's Assays :—

Gold	1 dwt. 12 grs.
Silver	11 dwts. 2 grs.
Copper..................	0·75 per cent.
Lead	0·20 per cent.
Gold	15 grs.
Silver.....................	11 oz. 5 dwts. 9 grs.
Lead.......................	0·75 per cent.
Bismuth	Present

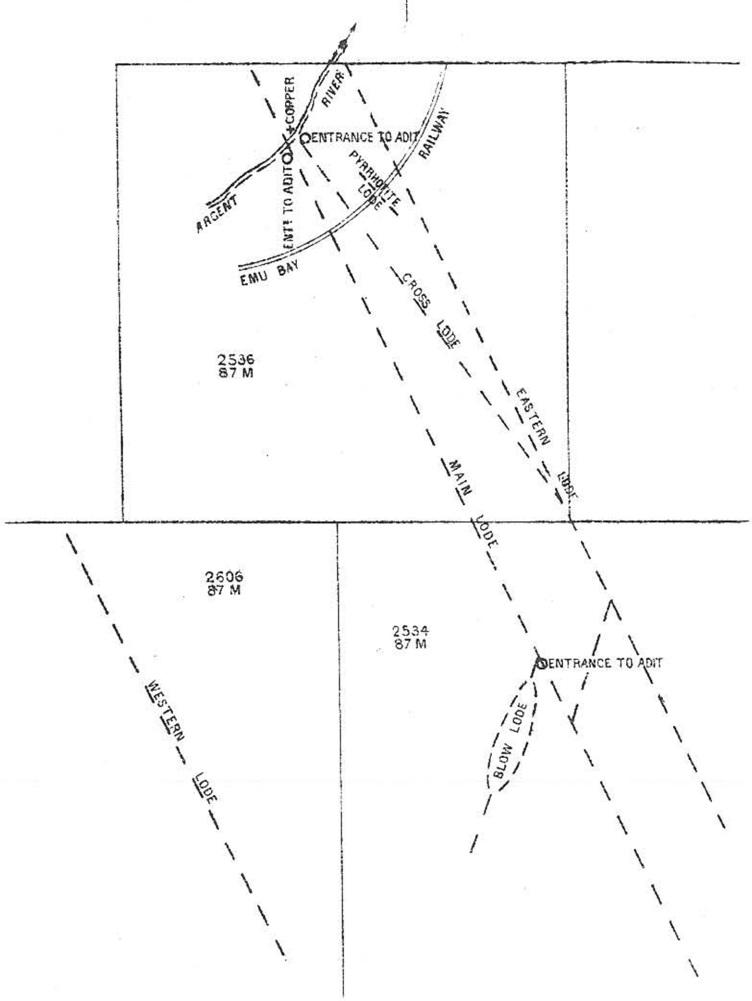
And the Government Analyst's assay of soft lode-matter 40 feet in from mouth of tunnel returned :—

Gold	20 grs.
Silver	2 ozs. 4 dwts. 2 grs.

The open gossan face on this lode, at the river, is evidently rich in tin, as may readily be seen by dish prospects. The Government Analyst's published assays of what are stated as bulk samples taken from this face give 9 per cent. metallic tin. As we have just seen, however, the lode does not maintain this richness when cut within the hill. It is a pity the drive was not carried along part of the lode, instead of outside it in the slate country, as it would have proved it more thoroughly. I have been told that bulk assays of even 10 per cent. tin have been made from the open face, and I can well credit it ; but such contents seem confined to the soft gossanous material, and are, I believe, due to the oxidation of the pyrites releasing the tin ore, and permitting the natural, mechanical concentration of the latter, which, in this way, enriches patches of the gossan far above the average of the lode as a whole. If this is correct, we need not always look for a rich lode below a rich gossan. Still, there is rich solid tinstone distributed irregularly in the lodes on this property, and it can only be got at by systematic development work. The open face cannot be worked purely hydraulically, as too much of it will require crushing. The site for machinery will have to be lower down the river, E. of mine. The river drops about 100 feet in a mile, and about that length of race and fluming would give a good fall to the battery. It is, however, quite premature to consider the machinery question yet. The present tunnel is not high enough above the river

5 cm

SKETCH OF LODES
RENISON BELL MINE



for a good tip, and too low for a future battery. Some connection with surface further east will have to be aimed at, so as to give the needful height above river.

What is called the cross-lode joins the main lode at the open face, on the river bank, and has a direction S. 42° E., with a dip N.E. A drive S.E. has been put in for about 69 feet, from which a crosscut goes N.E. 14 feet to intersect a tin-bearing lode exposed in a costean pit 52 feet above. This has not been cut. Where the crosscut was driven, a small vein yielded some large zinc blende crystals. The main drive was first on a lode 2 feet wide, but this was thrown, by a fault, just inside the entrance. The assays at mouth of drive were, as usual, high, 7 per cent. tin. A small sink was put down a few feet at the approach to drive on a lode which, Mr. Gaunt tells me, was 6 feet wide at first. He says he took out all the ore, 35 bags, which only realised £8 per ton, although selected samples assayed 34 per cent. and even 54 per cent. metallic tin. This is another illustration of the exceedingly irregular distribution of the tin ore in these lodes.

Both these lodes (main lode and cross-lode) have been exposed by several trenches on their course further south. No. 1 trench exposes the main lode, pyritic in character, and with quartz gangue, stained with iron oxide in grey hackly slate. Twelve feet further east is the costean pit on cross-lode mentioned above.

No. 3 trench is on the cross-lode only. It is about 30 feet S. of No. 2 trench, and uncovers the lode-capping, which is soft and decomposed. Two bands of pyrites, 2 feet 6 inches and 4 feet 6 inches wide, separated by about 8 feet of broken laminated white sugary quartz-rock, represent the lode. A piece of this quartz, assayed by the Government Analyst, contained 2 per cent. metallic tin. The footwall country is hard, silicified slate, or sandstone. The disintegrated pyrites is associated with tin ore, but the trench is not quite deep enough to thoroughly test the nature of the lode.

No. 4 trench, 50 feet higher up the hill, has exposed both lodes. The cross-lode shows at the end, in the bottom of the trench, as 5 feet 6 inches of pyrites and quartz, with a second band 4 feet 8 inches of soft pyrites, separated from the first by flinty slate, with seams of waterworn pebbles, descending six and ten feet from the surface. Loose wash goes down to the floor of the trench, which requires carrying deeper to prove the lode properly. With so much wash in this trench, assays are not safe, unless the samples are taken very carefully. Further W. down the trench the main lode is also shown, 20 feet wide, with the usual soft gossanous capping.

All trenches have been bulked, and assay returns published at 1·2 per cent. metallic tin, but the mixing of samples from distant points on the lode cannot be looked upon as serving any really useful purpose.

At 140 feet above the river the Emu Bay railway cutting, which runs S.W.—N.E., intersects the lodes already known, and has also recently cut through a large pyrrhotite lode 50 feet wide, bearing N. 20° W. in slate country. Mr. Stevens, the mine manager, reports bulk samples as averaging 1·9 per cent. tin. This lode is another example of variable metallic contents. I took samples from a width of 15 feet in the middle of the lode, where it seemed to be purest and most solid. These have been assayed by Mr. W. F. Ward, Government Analyst, who reports the contents at 15·5 per cent. metallic tin. Two other samples from the same spot yielded 54 per cent. and 0·3 per cent. respectively. Another sample, assayed by Mr. W. A. Macleod, B.Sc., yielded no tin at all. The pyrrhotite is associated with ordinary iron pyrites and vivianite, and is abundantly veined with quartz. On the footwall there is a 1-inch veinlet of galena, poor in silver, assaying only 26 ozs. silver to 65 per cent. lead. Since my visit, Mr. N. H Propsting tells me that 40 or 50 lbs. weight of stone have been taken from this lode, over a width of 25 feet and a height of 7 feet 6 inches from the floor of the cutting, and that an average sample from this was assayed by the Government Analyst, and returned 10·8 per cent. metallic tin. The lode here evidently demands serious attention, for these returns are encouraging. This large lode has not been seen either N. or S. of the railway cutting. Further W. in the cutting the cross-lode, 7 to 8 feet wide, is intersected, the footwall of which is formed by a layer of white quartz conglomerate and grit, 48 feet thick (described in the mine reports as the white lode). I was told that this conglomerate contained tin. I felt very dubious about it, but a sample assayed by the Government Analyst yielded 0·03 per cent. tin, so that it may be assumed that the stanniferous vapours from the adjoining lode penetrated the conglomerate to some extent. Still further W. are broken sandstone and black slate for about 30 feet, underlying which is the gossan outcrop of the main lode, which was being cut through while I was at the mine. A point of geological interest is the horizontal bedding of the white grit, as shown by the lines of pebbles in it, while the rock itself is fissile in laminæ, dipping at a high angle to the E., conformable with the adjacent slates.

The pyrrhotite and cross-lodes converge going south, and must unite before reaching the boundary of the section. If the former could be shown to bulk payable tin contents, which ought not to be very difficult to ascertain, an open face on it could be easily worked, with a succession of benches up the hill as far as a vertical height of 200 feet.

About 140 feet above the railway is No. 6 trench, which exposes about 80 feet of black pyritous lode-matter, supposed to be the cross-lode: on its western wall is an exposure of dolomite, with specks of galena and pyrrhotite. Bulk assays here are reported as yielding 1·2 per cent. tin; but a sample which I took, on being assayed by the Government Analyst, only returned 0·03 per cent. tin. The pyrrhotite and cross-lodes may have junctioned here, and originated this broad belt of lodestuff. The overburden consists of a few feet of hill detritus, also said to be tin-bearing. I have seen samples of such detrital lode-matter extremely rich in tin, and a few pieces of it included in the bulk-sampling of a trench, would easily raise the average tin contents to an abnormal figure. The greatest care is requisite in sampling the lodestuff in the trenches, so as to rigorously exclude all loose detritus. To have sampled these trenches properly would have taken me more than a week. I had to content myself with taking promiscuous samples from the most important exposures.

Notwithstanding the local rich concentrations of tin ore, these lodes present an essentially low-grade proposition, and the success of the enterprise will depend upon—(1.) whether the ground between the railway cutting and No. 6 trench will pay to work; (2.) whether the lode below the Great

Blow is payable. I do not attach the greatest importance at present to the lodes lower down the hill. They will have to be explored by underground mining, and will also have to be rich in tin to pay costs.

The small galena vein in the pyrrhotite lode does not look promising enough to spend any money on. It could be intersected, if desired, by a crosscut E. from west side of the mine hut, and then driven on S. under the railway cutting, but the silver contents are too low for it to be payable.

The sledge-track lode, E. of No. 5 trench, was shown to me; and a further one, the Eastern lode, was pointed out, but I had no time available for its examination.

Following the main lode further S.E. up the hill, on Section 2534-87M, it is joined by the Big Blow lode, an apparently faulted lode coming in from the S.W. This is at 500 feet above the Argent. The Big Blow is a large quartzo-ferro-manganese outcrop projecting, by measurement, 30 feet above the surface on its lower side, bearing S. 20° W., and having a surface width of 20 feet, but narrowing towards N.E. Light yellow, rusty, quartzose slates dip E. under the footwall of the gossan. This wall is exposed to sight for 3 chains, and the outcrop continues 3 chains further all along the hillside, and then goes out of sight long before reaching the western lode. Some rich lumps of gossan, assaying as much as 60 per cent. tin, have been found, but these are exceptional. One of my rich samples, assayed by the Government Analyst, returned 56 per cent. tin. Mr. Ward has also assayed other specimens of this gossan, returning 52·2 per cent., 28 per cent., 36 per cent., and 67 per cent. tin.

A drive S. has been put in 82 feet on the footwall of the main lode, at its junction with the Blow lode, 60 feet below the latter on the underlay, and the E. side of the drive follows the footwall. A rich flat vein of cellular quartz and greenish-black pug crosses the drive at entrance, and dips rapidly down to the sole. This vein bulged to 3 feet thick, and thinned down to 3 inches. The level takes a bend west in its course, and behind the end short crosscuts have been put out E. and W. The crosscut W. is in the light-coloured slate, which is seen beneath the footwall of the Blow lode at surface. Some oxidised lode-stuff is in the end of drive, and since my visit the cutting of a stanniferous pyrrhotite lode in the E. crosscut has been announced. Mr. W. F. Ward's assay of a sample of this returned 30·7 per cent. metallic tin. The ore contains much iron pyrites, and the tin is present as oxide. It would seem, therefore, that the Big Blow is the capping of a pyrrhotite lode carrying tin oxide. The tin is confined to the darker grey parts of the veinstuff, but, from its association with pyrrhotite and iron and arsenical pyrites, will be troublesome to treat, involving calcining and dressing operations. I understand the quality of the lodestuff is far from being uniform. It is this patchy character which tinges the prospects here with uncertainty. The latest news from this drive is that it has been extended to 156 feet, and that a second crosscut E. (No. 2) has been driven at 122 feet in, with about 75 feet backs, cutting the same lode, with good stanniferous pyrrhotite ore further in the hill. The main drive, also, is reported as continuing in good tin-bearing lodestuff. This development is full of promise, and ought to stimulate prompt and vigorous work. In conjunction with the lode in the railway cutting, it has improved the prospects of the property, and no time should be lost in developing the discoveries.

About 70 feet S. of the tunnel entrance on main lode another lode branches off to the W. of S. The strike of this suggests that it is the other part of the faulted Big Blow lode, but this point requires clearing up, and will be settled by continuing the present end on the main lode south. I may mention that on the east side of entrance to tunnel a crosscut has been driven S.E. into the main lode, without reaching its hanging-wall.

Just sufficient prospecting has been done on the property to establish the occurrence of rich concentrations of tin ore in the upper parts of the lodes, but not enough to enable any satisfactory estimate of the value of the lodes to be formed. The lodes, which have been pricked into, require to be proved systematically, and the work which I would suggest as of primary importance is—

1. Drive on the Big Blow lode where it has been struck in the upper crosscut, eventually also crosscutting lower down. It is essential that the lode below the huge outcrop should be properly explored. There is every inducement to do this, and it is surprising that the work has not been

attended to before. The outcrop itself, too, should be carefully examined, with a view to determine the parts which carry the rich concentrations. The main lode should also be driven further on in this adit, as far, at least, as the supposed heave of the Big Blow lode.

2. Well establish the bulk value of the large pyrrhotite lode in and above the railway cutting. To do this, some bulk parcels will have to be sent away. Until that is done, there will be nothing but uncertainty, as the tin percentage in different parts of the lode is excessively variable. Not only the tin contents, but the cost of treatment must be ascertained, for the association of the tin ore with pyrites will necessitate calcining and increased milling expense. If an average of 3 per cent. could be relied upon, I believe the lode would pay to develop.
3. Drive on the main lode at the river, and follow it into the hill, establishing connection with cross lode by a crosscut E. Another 200 feet ought to be driven on it to ascertain its character as a tin-bearing lode.

I may add that there is a possibility of the big blow lode uniting with the main lode in depth below the present upper drive, as its underlay is flatter than that of the latter lode.

The property has been allowed to slumber far too long. Assays of rich specimens may be very encouraging, but are not sufficient to bring a mine to the front, if no serious work is carried out. It is freely admitted that stanniferous lodes exist: what is now necessary is to be assured that the tin is in payable quantity, and the way to ascertain this is to adopt some working programme identical with, or similar to, the one I have sketched out above.

All the tin lodes on the property will probably be found in depth to be composed of stanniferous pyrrhotite, iron and arsenical pyrites, and still lower down the pyrrhotite may give place to the bi-sulphide, iron pyrites, the magnetic iron pyrites (pyrrhotite) having lost the original second atom of sulphur. The tin does not occur as tin pyrites, but as the oxide. The solid pyritic veinstuff, which is met with just below the surface, increases the difficulty of treatment. All said and done, however, exploration should not be abandoned. It is possible, especially with present prices of tin, that the pyrrhotite lode may develop into a payable proposition. In the eastern part of the Renison Bell property, the North Renison Bell people began a crosscut tunnel, which they extended 600 feet N. 20° E., through Silurian slates lying at a low angle. The last 20 feet are in dolomitic limestone. No lode has been cut in this tunnel.

The occurrence of tin lodes and tourmaline quartz porphyry in this district, of axinite in the Colebrook field, and the tin minerals, tourmaline, fluorite, bismuth, wolfram, &c., at Mt. Black, indicates the underlying basement rock of this part of Tasmania to be stanniferous granite.

Copper Lode at Renison Bell.

The main tin lode at the Argent River passes across to the N. bank, opposite the low tunnel, and shows as a quartz pyrrhotite lode. It is bounded on the E. by slate, which, opposite the tunnel on the cross-lode, is seamed with quartz and impregnated with iron pyrites. What has drawn attention to this exposure is a little native copper and green carbonate found encrusting the pebbles in the wash which clings to an exposed face of the slate. Where the copper has come from is uncertain; probably, from copper pyrites, though I could see none anywhere, nor any native copper in the solid slate. To make a trial it will be necessary to get into the solid bedrock below the old creek wash. At present, it is impossible to say whether the quartzose vein will open out into a true lode, or is only one of the numerous small veins which intersect this hill.

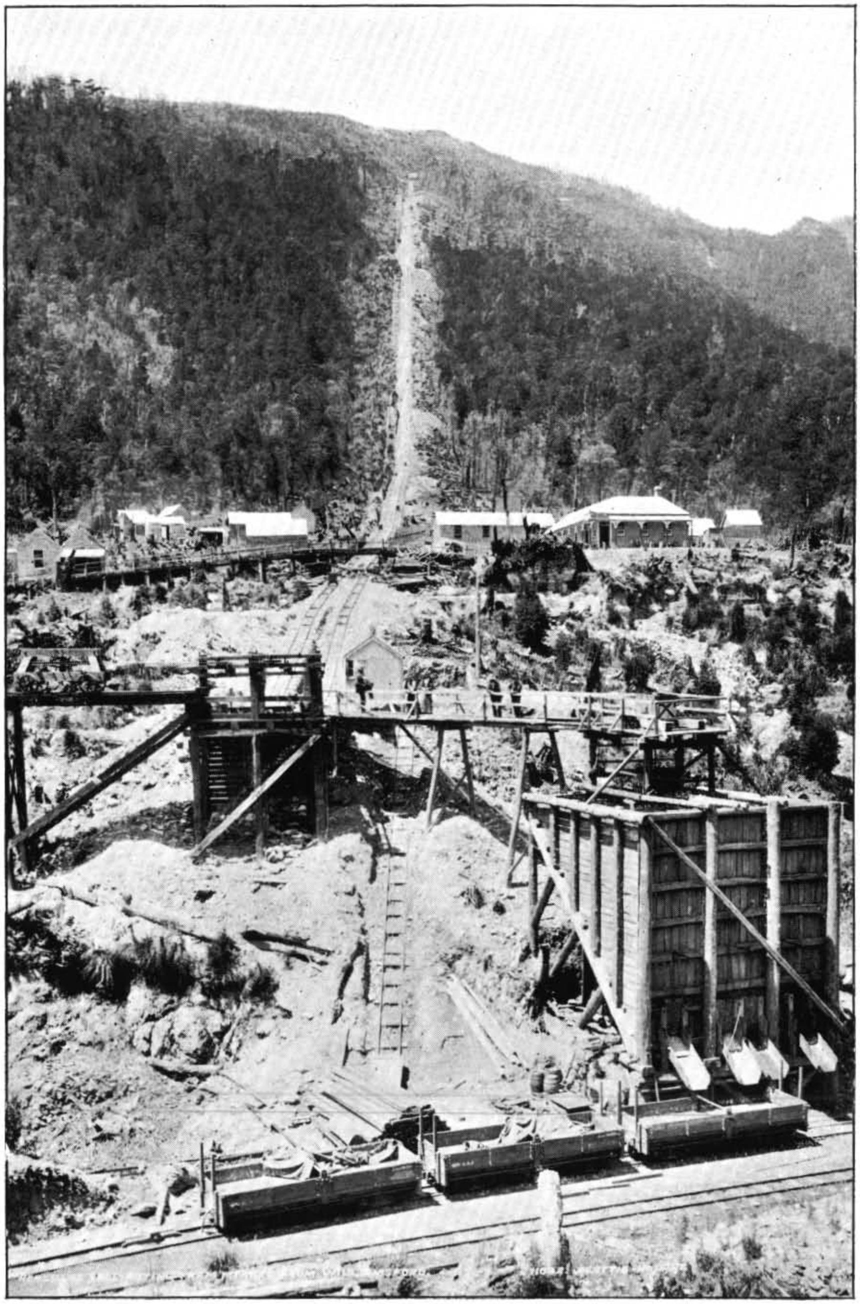
Tunnel Mine.

Returning to Zeehan through the Emu Bay tunnel, at the south end of the latter, I saw an E. and W. lode crossing the approach. It had been driven upon a few feet east, and was shown to be a quartz-galena lode, running in serpentine, and dipping south. It is about 2 feet wide, and some galena has been bagged from it. This ore is associated with chromate of lead and pyromorphite: the drive was about to be let on tribute when I saw it.

Evenden Mine.

This mine is on Section 299-93M, at Moore's Pimple. A low tunnel has been driven E. about 330 feet, for the first 270 feet in slate and quartzite, coursing N. 10° W., and dipping N.E. At 270 feet a 3-inch gossan vein was intersected, containing a little galena, and a drive south was carried along it for 40 feet; the vein widens a little going S., but nothing payable has been met with. In the end, the hanging-wall carries 6 inches of gossan, said to contain slugs of galena now and then. The line of gossan is the real vein, and the rest of the drive is bedded quartzite. Some zinc blende was met with in the floor of the drive. The end of the main tunnel is in magnesian rock, seamed with dolomite, and stained green with nickel or chrome. It is very probable that the vein is a contact one between serpentine and the stratified rocks. In the tunnel are a few vughs, which contained slugs of galena: this is No. 4, the galena lode. Some surface excavation has been made above the drive in soft gossan, which has yielded galena. At surface, about 100 feet south of the end of the south drive aforesaid, there is a large ferro-manganese gossan outcrop, containing, besides iron and copper pyrites, some galena and crystals of lead chromate. This outcrop measures 80 feet in width on the slope of the hill, and can be traced through the bush for 7 or 8 chains. By continuing the drive another 100 feet, it would come under this gossan, and a rise could then be put up to surface about 130 feet. If this work justified further outlay, a lower tunnel could be got in 200 feet lower down.

Although the work, so far, has not resulted in anything really good, it ought not to be finally abandoned before testing the lode under the great gossan outcrop, which can be accomplished, as said above, with a comparatively trifling outlay. It may be as well to say, however, that I do not anticipate that the lode below the gossan will correspond at all in size with the surface exposure. The iron in the adjacent serpentine has contributed largely to the formation of the gossan, and its segregation has most likely taken place in minute infiltration channels. But the occurrence of lead minerals in the outcrop denotes the existence of lead ore below it; whether in payable quantities, or not, can only be ascertained by actual work.



HERCULES SELF-ACTING TRAM.

Geologically, the contact position of the lode is a favourable sign. If the gossan is found to descend to the level of the drive, a winze must then be sunk, with a view of following the oxidised mineral down to the sulphidic ore. The silver ratio to the unit of lead in this mine is 1·3 ozs. to 1 per cent.

S. of this, on the track to Dundas, I saw what is known as the copper lode, which is a band of quartzite, impregnated with copper and iron pyrites, and a little native copper in the bedding planes. I could not satisfy myself that this occurrence was a real lode. On one side of the quartzite are slates or schists; on the other, conglomerate; and the copper ore exists in oxidised and indurated bands of country-rock. A few trenches have been cut across these bands, but the indications do not encourage more than a trifling expenditure in prospecting.

Hercules Mine.

This well-known mine is the property of the Hercules Gold and Silver Mining Company, which holds 15 sections (154 acres) on the west slope of Mt. Hamilton, a spur of Mt. Read. The mine offices are about 2900 feet above sea-level, and 1800 feet above the Williamsford terminus of the N.E. Dundas tram, with which communication is effected by an inclined self-acting tram-line, upwards of a mile long. The present work of this incline is to bring up the mine stores and run down the ore, which the neighbouring (British) Mount Reid Mining Company, Limited, is consigning to the Zeehan smelters, for the Hercules Company has not yet begun to send away its own produce.

This company has now been at work for five years, exploring its ore deposits and endeavouring to obtain satisfactory evidence of their permanence. Five crosscut tunnels have been driven into the hill across the schists, the lowest, No. 5, being extended nearly 900 feet, with its face ascertained by survey to be 433 feet below the surface; No. 4 is 140 feet above No. 5, and No. 3 is 53 feet above No. 4. These tunnels have intersected bodies of zincy silver-lead ore as well as copper sulphide ore occurring in the argillitic schists or phyllites conformably with the dip and strike of the laminations of the latter, and, so far as has been observed, of lenticular form. These occur at intervals in the schists, in more or less parallel bands, or, more frequently, *en echelon*, and several levels have been driven upon them, establishing their nature and behaviour in a fairly reliable way.

The schists are aluminous and have undergone hardly enough reconstruction to be called true schists. They might more properly be termed argillites, or, at the most, argillaceous schists. Sometimes a step further in the process of metamorphism may be noticed, when they become phyllites, or clay-slates, with a surface made glossy by the development of mica. The occurrence of patches of unmistakable slate shows the real nature of these quasi-schists. At the same time the talc schist occasionally found has probably originated from different rocks, and would seem to indicate originally eruptive members of the series. The strike of these schists is a little west of north, approximately 10° to 15°, with the dip always east of north. The angle of dip varies from 45° to 75°. The dip of the strata shows that Mt. Read does not form an anticlinal arch, for the easterly dip continues east right across the mountain, until within a mile of Red Hills, where a western dip first comes in. Consequently, Mt. Read owes its form and existence as a mountain entirely to denudation. I do not mean, however, to say that the schists have necessarily been exposed to surface denuding agents during excessively long periods, for there are signs of a former capping of conglomerate, which has been removed subsequently to the elevation of the schist. This conglomerate may be seen lying horizontally on schist on the White Spur track, a few hundred yards S.W. of the shaft on Dunne's Blocks. I am doubtful as to its age; it is, however, either Devonian, or Permo-carboniferous. The schist, which underlies it, strikes N. 20° W., and dips, as usual, N.E.

There is nothing available for the determination of the geological age of the schists. No fossils have been found in them, and their stratigraphical relations with the middle Silurian strata at Zeehan have not been investigated. Their physical aspect does not count for much in solving the question: they are, doubtless, of the same age as the associated slates, yet how different in appearance. The nearest approach to a fair guess is, that they belong to the lower Silurian slate series; but this interpretation must be considered subject to correction, in the light of later researches.

The ore deposits, besides possessing economic importance, are also geologically interesting. They do not occupy fissures or cavities produced by violent fracture of the country-rock, but have been formed along lines and planes of weakness which have originated from the foliation of the rocks. Along these lines mineral-bearing solutions may be conceived as travelling, attacking the rock on either side, removing its constituents in solution, and depositing in exchange their own mineral contents. The deposits thus fall into the category of bedded veins. This class of deposit is often looked upon as inferior to a fissure vein in point of permanence, but this fear is unfounded. Continuity may not be so absolute as that of the gangue of a true lode, but it may reasonably be doubted whether it is not equal to that of the ore-shoots in a lode. It has, moreover, the additional advantage of indicating, as a rule, the existence of parallel deposits along parallel laminations of the schist.

This theory of replacement pre-supposes the country-rock to have been already laminated or foliated before the mineralising solutions found their way between the laminæ; and the way in which the ore follows the lamination, even when the latter is minutely arched, without breaking or otherwise suffering a solution of continuity, strongly supports this. If we accept this view, the alternative theory of the ore having been precipitated on a lake bottom is quite untenable. Even at the stronghold of the latter theory, Mount Lyell, I saw reason to doubt its applicability. The tongues of schist extending at right angles into the pyritic ore, or *vice versâ*, seemed to me strong evidence against the deposition of the mineral on the floor of a lake. I believe the facts warrant us in taking a wider view of the important ore deposits of the West Coast range, and compel us to look for an explanation which will cover the mineral occurrences, not only in sedimentary strata or crystalline schists, but in igneous rocks as well. The theory of metasomasis harmonises with the facts observed at Mount Read, and distinct evidence of it has been found in the eruptive quartz-porphyry or quartz-felsite at Red Hills, where the rock passes into hematite, and iron pyrites occurs in patches in the country, unconnected with fissure veins. Clearly, no lake theory could apply here. Further confirmation is afforded by the consideration that, as the eruptive rocks are not so liable to deformation as the softer slates, the latter would naturally furnish the easiest channels for ore deposition.

The primary ores met with in the Hercules Mine are zincy silver-lead ores, copper pyrites, and a little fahl ore. Near the surface these have oxidised, and produced gossan ores with enriched gold and silver contents.

The longest run of zinc silver-lead ore driven upon is 270 feet. Several drives from Nos. 1, 2, 3, and 4 tunnels have been put in on the course of various ellipses and other masses of sulphidic ore, though, for the past half-year little or no work has been done on this class of ore, owing to the unsettled state of the question of the treatment of complex zincy sulphides. The owners believe that the work actually done shows that there are 90,000 tons of sulphide lead ore above the level of No. 4 workings; this does not mean that that quantity has been actually disclosed by blocking-out, but that by drives, rises, and winzes, &c., its existence has been rendered fairly certain. The assay values vary from 9 per cent. lead and 11 ozs. silver to 10 per cent. lead and 12 ozs. silver for the bulk of the ore, with an average of 0·140 ozs. gold. 52,000 tons are estimated to contain 29 per cent. zinc, and 25,000 tons, 25 per cent.; 5000 tons, 30 per cent.; 5400 tons, 31 per cent. zinc; so that, probably, 29 per cent. to 30 per cent. zinc contents is a fair estimate. Full values of gold, silver, and lead contents of sulphide ore, without cost of treatment on furnace deductions for zinc, would be about £3 10*s*. per ton; consequently, if this ore is to be turned to account, it must be either by recovering the value of the zinc, or by assisting the infinitesimal margin of profit by realising at the same time the oxidised ores, of which the company estimates it has 15,000 tons in sight. According to the published assays, the value of most of these oxidised ores at 0·6 ozs. gold, 25 ozs. silver, 3 per cent. lead, may be taken as £5 13*s*. per ton, without smelting charges and deductions. The total value at the mine of lead sulphide and gossan ores on the above basis would be nearly £400,000, subject to the deductions aforesaid, and subject to the ground defined by the exploratory work done proving to correspond with the estimates made.

Unfortunately, the silver-lead ores are associated with zinc blende, and zinc blende is the smelter's bane. It bridges over the difference in specific gravity of slag and matte, which require to be separated. Matte and slag become pasty, and the difficulty of separation is increased, resulting in foul slag, which requires smelting over again. In thus decreasing the fluidity of slag and matte, the zinc causes wall accretions or hangings to form in the furnace, composed of zinc oxide, lead, iron, sulphur, and silica. These are remains of imperfectly smelted charges, which have to be barred down and smelted out. With ores containing an excessive proportion of zinc, these hangings are constantly forming, and interfere with the regular settling down of the furnace charges, and if they are not removed in time, the furnace has to be blown out. In the ordinary smelting process the zinc is not recovered, but drowned out by working it off with a larger proportion of non-zinciferous ores. For this service to their customers, smelters make a fixed charge for each unit of Zn. in excess of 10 per cent. They can manage pretty well with 10 per cent. or 12 per cent., but if this is exceeded, they experience difficulties. The zinc contents, of course, are not recovered. Though zinc is not quite so volatile as lead, it carries off silver in the excessive fumes which it creates. Some silver enters the slag; some remains in the infusible sulphide. The Hercules ore would probably sustain a loss of a few ounces per ton.

Seeing that the recovery of the greater part of the zinc from such ores as these, poor in silver and lead, is practically indispensible to profitable mining, metallurgists and chemists all over the world have for several years been at work upon the problem—the zinc problem, as we call it here. Certain advances have been made in laboratory manipulation. Some of the experiments have answered very well from a laboratory or technical point of view, but when we inquire whether they can be utilised commercially for these Mt. Read ores, we find we are still condemned to an expectant attitude. These processes are, as a rule, not so satisfactory on a large scale as in the laboratory. The conditions surrounding the trials which have been made have also to be taken into account. It does not follow that successful tests under the favourable circumstances prevailing in Europe will determine commercial results on the West Coast of Tasmania.

The enumeration of various processes which claim some measure of success will suffice to illustrate the close attention which has been paid to the subject. We have—(1.) Bartlett's system, (2.) Burnham and Fry-Everitt process, (3.) Greenway's dry process, (4.) Ellershausen's process, (5.) Wetherill magnetic process, (6.) Angel process, (7.) Ashcroft process, (8.) Marsh-Storer process, (9.) Gentle's process, (10.) Gitsham's process, (11.) Carmichael's process, (12.) Henrie's process, (13.) Worsey's process, (14.) Phœnix process, (15.) Siemens-Halske's electrolytic process, and (16.) allied processes devised by Swinburne, Lorenz, and Cowper-Cole.

A few remarks upon some of these will be made here :—

(1.) *The Bartlett system* comprises two stages, in the first of which the ore is treated with an air blast, fumes being condensed which contain sulphide, sulphate, and oxide of lead, and zinc. The fume is roasted, traces of extraneous metals are driven off, and a product is left which consists of about 60 per cent. oxide of zinc and 40 per cent. sulphate of lead, forming a zinc-lead pigment. The second part of the process is the reduction of the remaining half of the zinc and a little lead and copper. A copper matte is produced, but nearly all the lead has been accounted for in the first stage. The remainder of the zinc contents is volatilised. It is stated that the loss of silver is 15 per cent. of the total contents. The principle, therefore, is to expel the lead and zinc in a form which can be refined into a zinc-lead pigment, and this is a disadvantage.

(2.) *Burnham and Fry-Everitt Process.*—The Fry process has, as a matter of fact, treated large quantities of Broken Hill silver-lead ore (20 per cent. to 35 per cent. lead, 25 per cent. to 30 per cent. zinc, and 30 ozs. silver). The ore is calcined, mixed with salt-cake, and then smelted in a blast furnace with a small proportion of iron oxide. 90 per cent. of the zinc passes into the slag, from which it is driven off as oxide in a Siemens' gas furnace. The lead is reduced, and the iron and sulphur form the matte. About 70 per cent. of the zinc contents of the ore are stated as recoverable.

The Burnham Syndicate experimented with this system in 1897, and gave up their patent and works at Swansea to the Smelting Corporation in 1898. The process was examined by the metallurgist, A. Raht, who estimated the cost of treatment at £2 4*s*. 8*d*. per ton of ore, and that it was reasonable to look for a recovery of 70 per cent. of the zinc contents, 87 per cent. of the lead, and 90 per cent. of the silver. The drawbacks here are the cost and the inferior form, from a marketable standpoint, in which the zinc product is recovered.

(3.) *Greenway's Process.*—In this process the mineral is roasted with salt, and volatile chlorides, easy of condensation, are produced. Sodium sulphate is leached from the remainder, which is raised to 35-50 per cent. zinc, when distillation can be effected.

(4.) *Ellershausen's Process.*—This, the Sulphides Reduction (new) process, has been in operation on a commercial scale at the corporation's works at Llanelly, in Wales. Broken Hill sulphide ores (20 per cent. lead, 25 per cent. zinc, 10 ozs. silver) are smelted there in ordinary blast furnaces, the zinc (90 per cent. of it) being volatilised, together with a large proportion of the lead. The fumes are afterwards condensed and treated. The zinc product is, therefore, in the form of flue dust and deposit. The lead is recovered in the form of bullion; any copper present, as a low-grade matte. All these products have to be re-treated, which handicaps the process, if we wish to apply it to the Hercules ores. As the lead settles out of the zinc solution, a sodium sulphide solution is admitted to the latter, and zinc sulphide is produced. The sodium sulphate flows away, leaving the zinc sulphide, which is then converted to an oxide by roasting in a reverberatory furnace. The marketable product is, accordingly, in the undesirable form of oxide.

It is claimed that the cost of treatment is not more than 20*s*. per ton, but, while this may be the case in countries where sulphide of sodium can be produced cheaply, it is evident that it would be much higher in Tasmania.

The trials made with this process last year on Tasmanian ores at Angoulême, in France, were not altogether satisfactory, owing, it is alleged, to defective plant, and to the final details of the method not being definitely settled. The experiment resulted in only a partial recovery of the metals, viz., 50 per cent. zinc., 60 per cent. lead, 60 per cent. silver, and 65 per cent. gold. I understand further improvements have been effected since then, and it may possibly be brought within the range of practical metallurgy. The progress of experiments will be watched with interest, for this is one of the processes which have been subjected to trial on a commercial scale.

(5.) *Wetherill Magnetic Process.*—This process aims at separating weakly magnetic minerals from non-magnetic ores, and in this way improving the residue as a zinc ore of marketable value. Zinc, iron, and manganese minerals can be separated, spathic iron ore and zinc blende. Rhodonite can be separated from blende. The process is especially suited for working in conjunction with concentration by ore-dressing machinery, and subsequent smelting. On the one hand, the blende can be raised to 40-45 per cent. zinc; on the other, the concentrates can be reduced from 10 per cent. to 15 per cent. zinc. It is obviously unsuitable for the Hercules ores.

(6.) *Angel Process.*—The principle of this system is to calcine the ore with sulphate of soda, and then to condense the volatilised zinc. The precious metals are concentrated in the reduced lead.

(7.) *Ashcroft Process.*—At one time this promised to be a success, but the Sulphide Corporation had finally to close down the leaching department in their works at Cockle Creek. The ore used to be roasted in reverberatory furnaces and leached with ferric chloride (and sulphate). It was then passed into electrolysing vats, but the liquor proved corrosive, attacking the pumps, and, consequently, a zinc sulphate solution had to be adopted. So many difficulties were found in roasting and leaching, and the preservation of the electrolyte, and the cost so great, that the process proved a commercial failure. The whole process is complex, and involves no fewer than 13 different operations. Precipitates and residues go to blast furnaces and refinery. Originally, the ore, after roasting, was leached out with sulphuric acid, and zinc sulphate produced, to which $Zn\,O$ was added, afterwards decomposed by heat and $Zn\,O$ resulting, two-thirds of which had to be returned for re-treatment.

(8.) *Marsh-Storer Process.*—By this system the ore is roasted, the zinc sulphate leached out with acid, and the zinc precipitated as a hydrate, which is afterwards calcined to oxide. The cost of magnesia as a precipitant is a drawback.

(9.) *Gentles' Patent—(Metals Extraction System).*—The inventor has died, but the system is not defunct. It is primarily a process for treating complex low-grade auriferous and argentiferous zinc or copper ores (or both). The copper pyrites is desulphurised, and soluble sulphate produced. Sulphuric acid is made, and used for treatment of the burnt ore in lixiviating vats. The resultant solution is then treated with chloride of lime, and the dissolved metals converted into chlorides, which are decomposed, the copper and iron being precipitated as an oxy-carbonate, and afterwards sintered and smelted. With zinc ores, the separation of copper and zinc in solution is effected by the addition of zinc oxy-carbonate, and the product can be brought up to a value of £14 to £17 per ton in England as oxy-carbonate, and if converted to oxide, up to £30. The copper, zinc, and sulphur thus being removed, auriferous and argentiferous lead remains. Cyaniding may be resorted to, or the gold and silver can be left in the copper for parting.

This process is not so well adapted for the zincy-silver-lead ores of the Hercules by themselves, but if these are mixed with the cupreous ore which occurs in the mine, the two classes form a description of ore which the method has in view. Sulphuric acid enters into the process, and this would be manufactured from the copper and iron pyrites.

(10.) *Gitsham's Process.*—The Australian Zinc Recovery Company, at Footscray, is working this with small parcels. It is understood to be a roasting and lixiviation process. Results on a larger scale are looked forward to.

(11.) *Carmichael's Process.*—This has a novel element in it in the form of sulphate of ammonia. It is understood to consist of (1) a preliminary sulphating roast, (2) calcination of the roasted ore with sulphate of ammonia, (3) the solution of the zinc and filtration from the smelting product, (4) precipitation of the zinc as oxide, and recovery of the sulphate of ammonia.

The roasting is conducted so as to produce as large a percentage of neutral sulphate of zinc as can be conveniently done. The roast is then mixed with sulphate of ammonia in the proportion required to furnish sufficient SO_3 to satisfy the zinc oxide and basic zinc sulphate in the ore. When the mixture is heated, it agglomerates at a temperature far below the dullest red, and as the heat is raised, the anhydrous $ZnSO_4$ tends to consolidate the ore into a hard mass, which is the chief practical difficulty to be contended with. The calcined mass, when wetted, slakes readily. The residue, after the solution of the zinc, is filtered and washed free from $Zn\ SO_4$ with a filter press. This can be done, owing to the absence of gelatinous silica, which is such an obstacle in processes depending upon sulphuric acid for the solution of the zinc.

The solution filtered from the ore contains the zinc, with copper, iron, manganese. The copper is readily acted upon by sulphate of ammonia. If the ammonia gas evolved during calcination be passed through the liquor, the zinc is precipitated as a granular white oxide. The dilute sulphate of ammonia liquor is evaporated for the recovery of the sulphate crystals, and the residue of the ore briquetted and smelted as usual. 90 to 95 per cent. recovery of the sulphate of ammonia is said to be obtainable.

The price of sulphate of ammonia is higher now than it used to be, and would form a drawback in the case of the Hercules ores.

(12.) *Henrie's Process.*—This is a leaching process worked out by Mr. Henrie, the resident metallurgist at the Tasmanian Copper Company's mine at Rosebery. His experiments are reported to have effected a satisfactory recovery of gold, silver, lead, and zinc. The zinc is marketable in the form of oxide. Sulphuric acid has to be used. The process may be said to be still in its experimental stage.

(13.) *Worsey's Process.*—The Hercules directors have had some of their ore treated by this process, which is a humid one, but the result was not satisfactory commercially.

(14.) *Phœnix Process.*—This process has the great advantage of recovering the zinc in a metallic form. It secures the decomposition of zinc sulphide "in an electrolyte of fused zinc chloride, sulphur vapour coming off at the anode, and metallic zinc at the cathode, lead sulphide being capable of decomposition in a similar manner. In the treatment of lead-zinc sulphide ores, as described in the patent specification, it is proposed to mix the pulverised ore with molten zinc chloride in a pot, and electrolyse, first, for the deposition of lead, and then, in a separate pot, for the deposition of zinc." From this description, the method appears to be a direct one, and not too costly, but there will no doubt be the usual difficulty of maintaining the electrolyte in a proper condition, and the antecedent difficulty in purifying the solution before it passes into the electrolysing vats.

(15.) *Siemens-Halske Process.*—This agrees in principle with the Ashcroft process, but is not so complicated. The ore is roasted and leached with sulphuric acid, or an acid zinc-sulphate solution, and the resulting sulphate of zinc solution electrolysed. Iron pyrites are almost a necessity. Difficulties are present in the condition of the electrolyte.

(16.) *Swinburne's, Lorenz, and Cowper-Cole's Methods.*—These are all electrical processes for dealing with these ores, worked out with considerable ingenuity. They are subject to practical separation difficulties, and are too costly for installation on the Hercules Mine.

Other processes have been devised, but the above are such as have attained any degree of importance. The principle which underlies most of the humid methods is roasting to form sulphate of zinc, and leaching it out in solution. The next step is to precipitate the zinc by either lime, soda, or magnesia. In practice, enormous difficulties are encountered: all the zinc is not changed into sulphate; the iron is not kept entirely out of the sulphate solution; gelatinous silica forms; etc.

I could not undertake here to discriminate closely between these different processes. Some of them are quite out of court when considering the Hercules ores. Others which are less disadvantageous would have to be tried on a fairly large scale, and the owners of this mine are not in a position to afford expensive and uncertain experiments, which might involve the company in irretrievable disaster. On reviewing the history of the several methods, it is apparent that though certain difficulties have been, I will not say entirely, overcome, but minimised in the laboratory, a commercial process is still a desideratum. After all the experiments, I fear we are as far off as ever from the solution of the difficulty of recovering the zinc successfully from this ore. I do not refer to technical success, but to commercial results.

During the last twelve years the production of spelter has increased by 50 per cent. Additional uses have been found for it in electrical science, and the cyanide treatment of gold ores is also partly responsible for an increased demand. According to Merton's list, the world's production of spelter in

1890 was	....	342,616 tons
1893 „	....	371,059 „
1896 „	....	417,460 „
1898 „	....	436,202 „
1899 „	....	460,895 „

A sudden solution of the zinc problem would undoubtedly depress market prices, and seriously upset present estimates of costs and returns.

It seems to me that in pursuing a waiting policy, which was justifiable while experiments appeared to be on the eve of success, the Hercules Company is locking up a large portion of its resources for an indefinite period, and that it would be preferable to make some arrangement with the Zeehan smelters for the conversion of the lead sulphide ore into cash. As said above, this ore can be smelted by diluting it with less rebellious ores, and it would be a pity if the mine-owners and the Smelting Company could not arrange matters on a workable basis, even if the profit be less than mutually anticipated. If such an arrangement is not practicable, the only alternative is to leave this ore intact, and wait till the solution of the zinc difficulty has advanced to a stage permitting its exploitation to be resumed. But it is only right to warn the owners that no immediate practical solution is in sight.

Last year, ore consisting of copper and iron pyrites was met with, in a course 40 feet long, in the south drive from No. 3 tunnel, of an average assay value of 6 per cent. copper, mixed with a small proportion of zinc blende. The north drive from No. 4 tunnel came subsequently below this occurrence, and the body of ore was found to widen out to 20 feet and extend for about 80 feet in length. The No. 5 tunnel at 550 feet entered schist with impregnations of copper pyrites; from 670 to 700 feet it passed through cupriferous schist, carrying bands of iron and copper pyrites, some of it payable (up to 5½ per cent. copper). At 700 feet this formation was explored by N. and S. drives, which showed copper ore to exist in payable quantity for 60 feet in length.

This ore is sometimes very clean. A rich sample, assayed by the Government Analyst, returned 14 per cent. copper, 0·5 per cent. zinc. The average contents seem to be about 6 per cent. copper for fair quality ore. The assays stated by Mr. Sydney Thow are:—

From	Silver.	Gold.	Lead.	Copp'r %	Zinc %	Iron %	Insol. %
No. 4 tunnel	1 oz. 13 dwts. 5 grs.	8 grs.	—	6·2	3·7	34·4	12·0
No. 5 tunnel	1 oz. 0 dwt. 15 grs.	11 grs.	—	6·3	—	22·1	36·2

Altogether, a belt of country exists, 140 or 150 feet wide, more or less cupriferous, payable at intervals; in one instance, from 10 to 20 feet being of this nature.

The task of the company will now be to develop this discovery, of so much importance for the welfare of the mine, and to assure itself of the existence of this kind of ore in sufficient quantity to justify the erection of smelters. Drives N. and S. on the best part of the ore-course will prove its longitudinal extension, and rises and sinks will test its vertical behaviour, though not quite sufficiently without a lower tunnel.

The occurrence of the copper ore is in every way similar to that of the zinc silver-lead ore, of which such a large quantity has been exposed. Looking at the usual mineral character of the schists on this range, the zincy silver-lead ores seem exceptional, while copper is the more staple metal. From indications elsewhere on Mt. Reid (Ring River), I think it very likely, though I can furnish no explanation, that the zinc-lead sulphide will generally be replaced at lower levels by copper ores; and, if this is found to be the case with the Hercules Mine, the prospects of ultimate success will be much better.

The gossan ore can be worked off slowly in smelting the pyritic ore by adding it in quantities moderate enough to avoid too rapid reduction and consequent enrichment of slag, or it can be disposed of to the local smelters, as the company may find more advantageous; in any case, the quantity of it estimated to be in sight is a sound asset, and can be turned to account in one way or the other.

Sullivan's Reward.

Between 500 and 600 feet above the No. 5 tunnel, and on the crest of the hill to the east of the mine, is a large ferro-manganese quartz blow, which has been taken to be the outcrop of a lode. On examining it, I found it to be country schist of a very quartzose nature, gnarled and rough, which, with its iron gossan, may be pardonably mistaken for lode capping. Traces of gold are said to have been found in it, but no other valuable mineral. The outcrop is conformable in strike and dip to the enclosing strata, viz., strike N. 20° W.; dip, N.E. 70°.

East Hercules.

The mine is in the valley E. of Mt. Hamilton, just E. of the small creek at the foot of the hill. A shaft has been sunk about 40 feet in green chloritic schist; the pile of schist at surface obtained from the shaft and drive shows the rock to be faced and impregnated with copper pyrites. A heap of three or four tons of ore at shaft-mouth looks as if it would yield fully 4 per cent. copper. The change in the country-rock which has occurred at the creek is favourable for this metal. Unlike the Hercules schists, this chlorite schist has been originally an eruptive rock, probably a quartz felsite.

The small creek is a tributary of the Ring River. The mine is in a very awkward place for getting working supplies. It could best be worked from the No. 2 tunnel of the Hercules by extending that through the hill. Its geological position is favourable for ore, and I anticipate that some day it will be taken in hand again.

Mount Reid Mine.

Section 3302-87M, 80 acres. The British Mt. Reid Co. (Mr. Luke Williams, General Manager), is carrying on work here, both quarrying and mining, on a large body of zincy lead-copper sulphide ore. The workings have been described so often that I need not repeat uselessly. I was taken over the mine by Mr. Luke Williams, who afforded me every opportunity of investigating it geologically. By this means I was shown that the ore-body is a huge, lenticular mass of sulphides, between 800 and 900 feet in length, tapering out towards north and south. The greatest width of the lens at the surface is 83 feet. At the open cut at shaft the width is 50 feet, but 27 feet below, it has widened to 74 feet. It is here interstratified with quartzite right across, and is occasionally a very dense sulphide. The fahl ore in the quartzite is considered rich. It is worth noting that the hanging-wall of this body always carries the richest ore.

The deepest level has a present depth of 150 feet from surface, but is called the 300-feet level, because at the south boundary it will give that quantity of backs. The drive is just about half-way through the block now, and will be driven 1,800 feet further to the south boundary-line. There is a run of 140 feet very dense sulphide ore, which has been crosscutted 26 feet, with no sign of a foot-wall yet. A 50-feet winze has been sunk on the underlay, with good ore down to 35 feet, after which lower-grade sulphides prevailed. A rise has been put up to the next level, 27 feet above, for stoping back on good smelting ore. There is a good deal of quartz along this level.

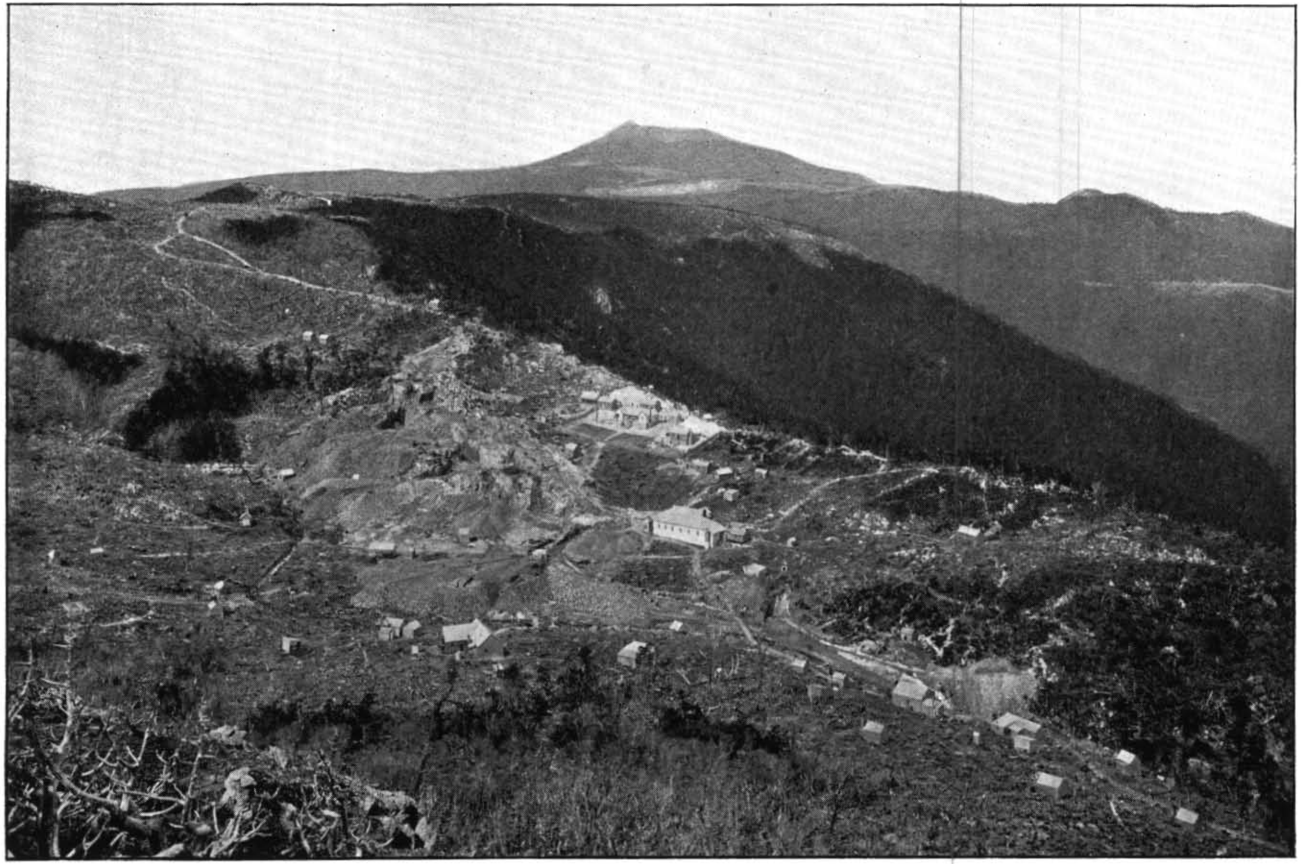
The face in the south end of main drive, not being worked, is in a mixture of solid sulphide and mineralised schist, not so good as seen further back: schist on each side of the drive. The surface width of the ore-body some 150 feet further south of this is 25 feet. The schist inside the apparent walls is still mineralised. Work has been discontinued till the arrival of air-compressors. Crosscuts are required here to prove the width of the ore lens, which I take to be narrowing rapidly, and will probably pinch out completely within another 150 feet.

No. O bench was being worked in red gossan, containing up to 33 ozs. silver and ½ oz. gold per ton. The darkest red is the best matrix. Manganese is present, and cerussite crystals, with sulphate of copper, occur. The N. end of cutting is about 12 feet wide, the formation widening to 80 feet. 634 tons sent to the Zeehan smelters contained $\frac{1}{2}$ oz. gold, 18 ozs. silver, and 2 per cent. up to 5 per cent. and 6 per cent. lead per ton. No. 1 bench was not working. The schist here has some galena, but is poor. No. 2 bench was going to start. It is in siliceous schist, containing good grade ore. No. 2 prospecting shaft is about 14 feet down, in quartzite and schist, carrying some good dense ore, assaying 7 dwts. 20 grs. gold. No. 3 prospecting shaft (also called No. 14) is down 20 feet. A bulk assay from the pile returned 13 dwts. 1 gr. gold, 9 ozs. silver. No. 4 shaft (also called No. 15) is down 29 feet, and its ore, obtained by chipping the wall, returned 12 dwts. gold, 17 ozs. silver. At 20 feet down, the ore-body proved to be 25 feet wide. This is ahead of the end of tunnel. 25 feet further south Williams' shaft, No. 18, has proved the ore 10 feet in width, which has been driven on for 40 feet to within 10 chains of the south boundary. The ore is banded. Beyond this to the S. no work has been done.

About 40 hands were employed on the mine, and Mr. Williams kindly informs me that the total tonnage of sulphide ore sent to the Tasmanian smelters up to the 31st March was 2457 tons, of an average assay value of 5 dwts. 4 grs. gold, 20 ozs. 15 dwts. 4 grs. silver, 6·8 per cent. lead, 25 per cent. zinc. Gossan ore for same period, 632 tons, assaying 9 dwts. 21 grs. gold, 18 ozs. 17 grs. silver, $4\frac{1}{2}$ per cent. lead. Mr. Williams further furnished me with the following return of ore sold to the smelters for the quarter ending June 30th, viz.—1019 tons, containing 7 dwts. 16 grs. gold, 16 ozs. 12 dwts. 19 grs. silver, 10·8 per cent. lead, 0·78 per cent. copper, 23·9 per cent. zinc.

Over 500 tons of ore-bulking, 40 per cent. zinc, have been stacked on the mine. It is intended to develop the mine vigorously with rock-drills (worked by an air-compressor), to break down large quantities of ore, to send the suitable descriptions to the smelters, and to decide upon some treatment for the bulk of the stuff.

The New Palace Blocks, 121 acres, are those on which air-compressors and a large concentrating plant are to be fixed. The ore from this plant will be run direct to the Williamsford Railway, and so to the smelters. I feel doubtful as to the advantage of submitting these ores to concentration. Some of the ore exists as a double



Mt. READ MINE AND TOWNSHIP.

sulphide of lead and zinc (huascolite), which cannot be separated by dressing. Much of it has its constituent minerals too intimately blended to suffer perfect separation, and imperfect separation means loss of the precious metals. Concentration tests have been carried out in the Silver Queen, Oonah, and Montana mills, at Zeehan, on upwards of 200 tons ore. 102 tons dressed at the Silver Queen assayed, before treatment—gold, 2 dwts. 15 ozs.; silver, 5 ozs. 3 dwts. 5 grs.; lead, 7·1 per cent.; zinc, 19·4 per cent.; copper, 0·37 per cent.; iron, 14·1 per cent. The jig tailings, which comprised ore sized up to ½-inch diameter, assayed—gold, 1 dwt. 23 grs.; silver, 5 ozs. 9 dwts. 2 grs.; lead, 5·9 per cent.; and this, as Mr. Luke Williams remarks, proves that practically no concentration takes place with this coarse crushing, but that finer crushing does result in a certain release of the minerals is shown by the assays of the Frue Vanner concentrates—gold, 9 dwts. 4 grs.; silver, 20 ozs.; lead, 36·3 per cent.

100 tons ore were put through the Oonah mill, assaying, before treatment—gold, 2 dwts. 15 grs.; silver, 6 ozs. 9 dwts. 7 grs.; lead, 9·2 per cent.; zinc, 19·8 per cent.; copper, 0·40 per cent.; iron, 16·41 per cent. Exhaustive assays of the products were made, proving a concentration of gold contents, heavy concentration of silver and lead, increase of copper contents by 50 per cent., a slight concentration of zinc, and a decrease, *i.e.*, separation of iron. Progressive concentration took place in the slimes. The Silver Queen and Oonah slimes treated on the Montana Wilfley table showed irregular concentration. The results of these elaborate trials show that concentration to a certain extent can be effected, but information is still needed as to the amount of loss which takes place in the operation, as this is the crux of the whole matter.

The same difficulty which confronts the Hercules proprietors in the treatment of zincy ores applies to this mine also. There is no reasonable doubt as to the large quantities of ore available, but a profitable zinc process is still a desideratum. In the meantime, the company is doing the only thing which can be done under the circumstances, viz., sending ore for reduction in the smelting furnaces at Zeehan. The work at the mine is being ably and vigorously carried out.

Dunne's Mount Read Mine.

Sections Nos. 164-93M, 19 acres, and 218-93M, 44 acres. This property is adjoining and south of the Mount Reid Mine, and the line of the main ore-body on the latter property enters Dunne's Blocks. The rock formations on the two estates are identical, and the sulphidic belt continues through both blocks, as, indeed, it does through the Hercules property also. It must not be assumed, however, that the ore-body is continuous through all these properties. This is not the case, as was specially seen, with unfortunate results, on the South Hercules section. The ore makes in lenticular masses, wedging out within certain distances and making again further along, often not on the same strike, but parallel to it, *en echelon*; so that really nothing further can be said than that the metalliferous schists prevail on all these sections, and each property must stand on its own merits.

Unfortunately no work was being done at Dunne's when I was there, and I could only notice the pyritic schist lying about at the mouths of the two prospecting shafts. There are great facilities for deep tunnelling. The indications are that the ore will be similar in character to that of the Mount Reid; but nothing very definite can be said as to quantity in the present undeveloped state of the mine.

Red Hills District.

The mines in this field are in the country to the south-east of Mount Read, and can be approached from the Mount Read mines by an old foot-track over the summit of that mountain, 3800 feet above sea-level, through button-grass moors and thin scrub. None of the mines at the Red Hills were working when I was there, but since I have returned work has been resumed at the principal mine, the Red Hills. Subsidiary mines are North Red Hills, South Red Hills, Red Hills Proprietary, and the Moxon. A good bridle-track from the White Spur, 7 miles, may also be used in making this journey. The inclement weather on these high ranges prevented me from visiting any other than the Red Hills and Red Hills Proprietary, about six miles from Mount Read.

In proceedinig east from Mt. Read, we appear to leave the Read argillitic schists, and traverse chloritic schists and quartz felsites. The argillites are confined to the west slope of Mt. Read, at the summit of which green chloritic schist prevails. All these rocks have an easterly dip, which continues on descending the eastern slope. On this side there are compact felsites, sandstones, and schists, till we ascend the north end of Rob's Lookout, which is also the north end of the Tyndall Range, about a mile west of the Red Hills blocks. The rock here begins to dip west, and turns to massive pink quartz-felsite, which forms the eastern slope and stands up in bold cliffs on the crest. East of this, chloritic schists occur, then slate, also with westerly dip, just above the Red Hills Camp, 2000 feet above sea-level. Lakes Westwood and Julia lie about a couple of miles south, having the aspect of tarns occupying rock basins in glaciated country. Despite these suggestive lakes and the general appearance of the country, which is in harmony with the former occurrence of a glacier epoch, I could find no direct evidence. No *roches montonnées* are to be seen, and the numerous large boulders may have come to occupy their present position by gravitating down the adjoining hill slopes. They do not look waterworn, nor do they appear as if they had travelled any distance. The surrounding hills are composed of grits and conglomerates (Devonian ?) resting unconformably on quartz felsites and chloritic schists, and this upper formation has been greatly denuded. The denudation has liberated enormous boulders of conglomerate, which have simply fallen down to positions of rest. The conglomerate is part of the widespread beach formation which caps so many mountains on the West Coast, and always overlies the Silurian slates and schists. Its exact age is not settled, but it is probably Devonian or at the base of the Carboniferous. It is usually horizontal, but, occasionally, is slightly arched. The Red Hills, which is a flat-topped ridge, bearing a few degrees west of north, consisting of quartz felsites and chloritic schists dipping W. and rising to 2600 feet above sea-level, were once covered with the conglomerate, and the felsites can be seen east and west passing beneath it. This fact indicates that the removal of the conglomerate was not completed so very long ago, and that the felsite has not suffered much from denudation. As the ore deposits do not extend upwards into the conglomerate, the process of mineral deposition took place, probably, prior to the Devonian. Sometimes the blebs of quartz in the felsite are abundant and well defined; or the rock is non-porphyritic and homogeneous to the naked eye. When well preserved, porphyritic crystals of pink felspar are visible, and the hue of the rock is dark brown or reddish. To this is due the name Red Hills. This reddish colour changes to green with the development of chlorite, and where the rock has been crushed and foliated, the processes of dynamic metamorphism have converted it into a dark green chlorite schist. Viewed microscopically, porphyritic crystals of felspar still survive in the most densely chloritic rock, and I am strongly of opinion that the chlorite schists of this district are metamorphosed felsites, though the physical change is so great that, at first, it is difficult to believe both to be the same rock.

Red Hills Mine.

The sections comprise 485 acres to the south of Mt. Murchison, and the mine works have been carried on upon a broad flat hill, 2700 feet above sea-level, called the Red Hill. The hill is about three-quarters of a mile long, one-quarter of a mile broad, and bears a little west of north. A large outcrop of hematite, averaging 150 feet in width, and occurring in quartz-felsite, traverses Sections 954-93M and 714-93M. Its linear extension is in the same direction as that of the felsite belt. It is often soft and earthy, sometimes more solid, and on Section 714 I noticed it was magnetic. It contains crystals of felspar, and, to my mind there is little doubt that it is a replacement of the original felsite. As the original rock is an igneous one, there can be no reference of the hematite to any ancient lake bottom, and as the felspar crystals themselves are occasionally seen partly converted into hematite, it must be inferred that the latter has not resulted from the oxidation of pyrites, but has been deposited by way of substitution. If this process is established for a typical area of ore deposition in the West Coast range, it is probable that further instances of it will be found along the same mineral belt. This belt of quartz-felsite rock, with bodies of hematite and magnetite, and containing pyritic copper ore distributed with some irregularity through its mass, is continuous in an unbroken line from Mt. Farrell in the north to Mt. Darwin in the south, and forms the backbone and crests of the range (often capped with the later conglomerate). It passes at the back of Mt. Murchison, through Mts. Tyndall, Huxley, Jukes, and Darwin, and its characteristic features, from a mineral standpoint, are the constant occurrence of masses of iron oxides and copper sulphides. Up to the present the copper ore has not been found in sufficient quantity to form any payable mines along this belt, but there is no saying what continued prospecting may not result in. There is no use in comparing it with the Mt. Lyell copper deposits. It is not on the same strike, but lies between the Mt. Read series on the west, and the Mt. Lyell schists on the east. If we could be sure of its age, and of the eruptive, or rather, intrusive nature of the felsite, it might be possible to formulate a theory connecting the copper deposits of the flanking schists with the igneous felsite as a source. But these questions are unsettled. There is a good deal of evidence in favour of the felsitic rock having been a lava flow, contemporaneous with the schists, and subjected, with the latter, to later foliation and mineralisation. Further examination may be expected to throw more light on this interesting point. The students at the Zeehan School of Mines have a grand field open to them in the investigation of the relations of these copper and iron bearing felsites to the cupriferous schists as well as to the associated granite.

On Section 954 two tunnels have been driven by the company from opposite sides of the ridge, one N. 85° E., and the other S. 85° W. The former is the No. 1 west tunnel, the latter the No. 2 east tunnel. The distance to drive right through the hill would be about 1500 feet, and the backs above No. 2 tunnel (100 feet lower than No. 1) are mostly between 180 and 200 feet vertical. If either of these tunnels is driven right through the hill it will intersect the lens or body of hematite. No. 1 west has been driven 104 feet in dark green chlorite rock, which I take to be a modification of the quartz-felsite. The tunnel is a little shallow for good prospecting: the present end is not more than 30 feet below the surface, and it would never be over 100 feet in depth. No. 2 tunnel E.

has been driven 77 feet into the hill, and, if continued, as it ought to be, it will cut into the hematite at a good depth, and enable the contact line to be explored. Some copper and iron pyrites are in the rock at the approach, but these disappear further on in the drive, and the end is in barren, dense felsite. It will take nearly 400 feet of driving to get under the line of hematite outcrop, but until the footwall of that formation is reached, there is no need for despondency. The tunnel may or may not cut across hidden ore-bodies in its course, but its objective is the hematite, and its purpose is not attained until that is reached, and the footwall country well tested. The trend of the hematite, N. 20° W., is the same as that of the laminations of the country-rock, wherever the latter is at all schistose.

No. 3 east tunnel, driven S.W. 57 feet in rather soft chloritic rock, is on the north section, just below an outcrop of hematite and magnetite, but is not more than 30 feet below surface, and will not increase its backs by additional driving. It carries a little copper ore, and has been sampled in 10-feet sections, but, all through, assays of under one per cent. were obtained. The end is in soft green chloritic rock, with a good deal of iron pyrite.

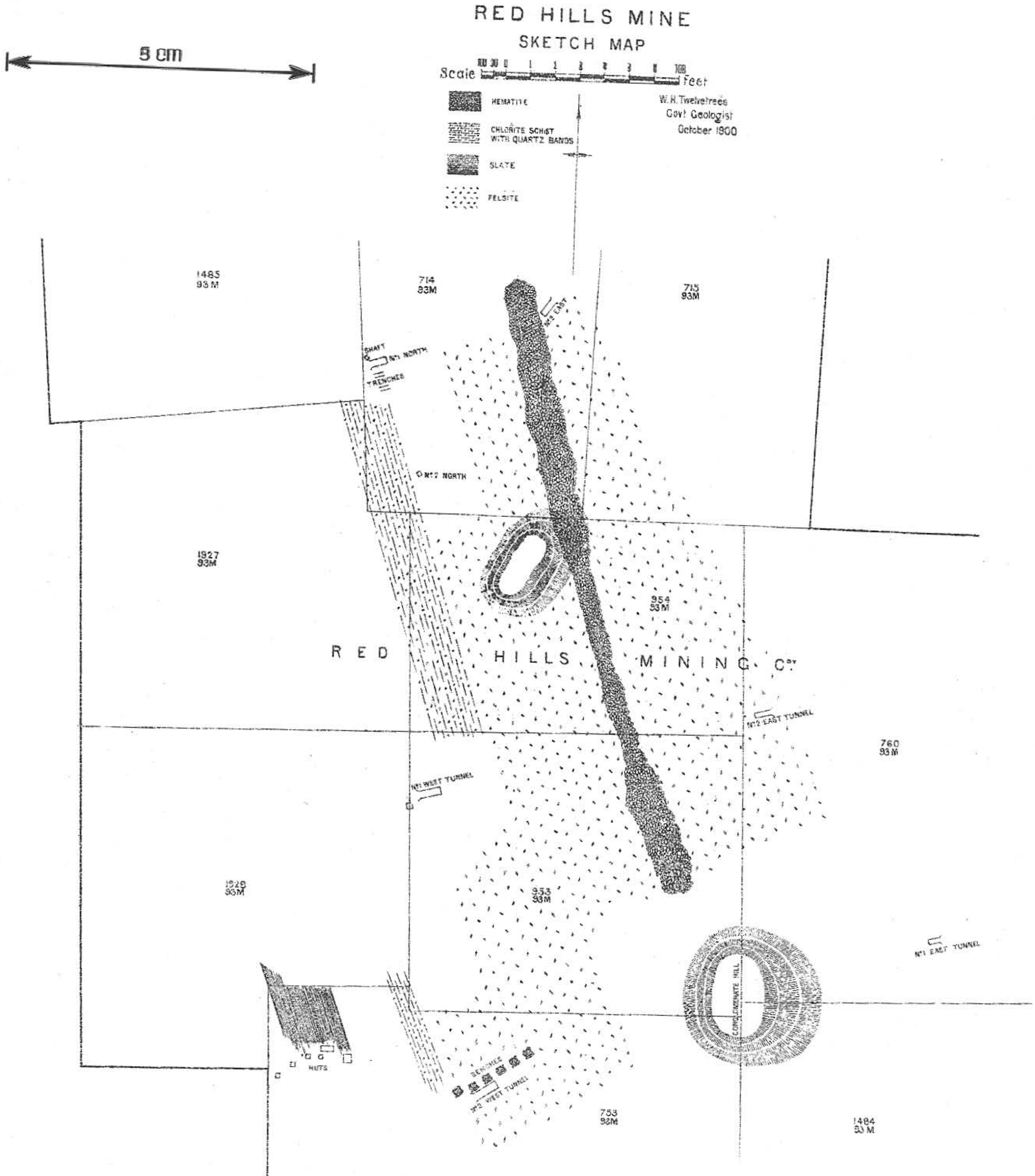
At the S.W. end of the hill is No. 2 tunnel west, driven 157 feet N.E. below a series of benches which have been cut in the face of a ravine, descending from the button-grass flat above. The country-rock is dark green chloritic felsite, impregnated here and there with iron and copper pyrites. It is massive, with cross-jointing, which gives a delusive appearance of horizontal bedding. The tunnel has passed through hard, dry, unpromising rock. Just behind the face it is jointed into flat floors, and grows softer. The sole encouragement is the softer nature of the rock. It has nearly come below No. 2 bench (140 feet above), which has a face of dark green chloritic rock (not quite so hard as elsewhere), showing nice patches and veins of pyrites in the joints and the rock mass. No. 1 bench is higher up, and is in the same rock-as No. 2, only it has less copper, being very slightly impregnated. The tunnel would get here 200 feet of backs for an equal distance of driving. This ore is a good bit west of the hematite, and seems to be part of a chloritic ore-bearing zone running along the western slope of the hill. About 400 feet to the west of these benches are the mine huts and office, which are on a belt of slate; consequently, this line of country, well sprinkled with copper pyrites, lies along a contact margin, though its intrusive nature is very uncertain. The No. 1 west tunnel probably passed through the last of the bench line of mineral at its approach, and left it behind to the west.

Last year a Melbourne option syndicate carried on exploratory work for six months, spending £1500 on the property. At the expiration of the term they withdrew, finding the results unsatisfactory. Their principal work was at the north end of the ridge, where trenches and open cuts exposed good copper pyrites. A No. 1 north tunnel has been driven N.E. a little over 100 feet, which, if continued, would get 100 to 150 feet backs. This tunnel has a good band of ore at the approach and in the open cut above it. Two pyritic quartz veins intersected in the tunnel have been driven upon a short distance south. The south drive on No. 2 vein is in rock, slightly disseminated with pyrites. This drive is 36 feet from mouth of tunnel, and has been driven 22 feet. The drive on No. 3 vein is 75 feet from the approach, and is 51 feet in. The end is in barren chloritic felsite. The drive hugs a quartz vein on the E. side, behind the face. At the entrance to the adit a winze was sunk 40 feet, and a crosscut driven east into a body of ore represented by a small pile stacked at surface. There are also here two stacks of ore won from the first 70 feet of the tunnel, mostly from near the entrance. The first-class ore comprises a heap of about 40 tons, and the second-class about 200 tons. The published bulk assays of these heaps are: first-class, 4·9 per cent., and second-class, 2 per cent. copper. Some selected pieces from shaft and crosscut returned 22·1 per cent. and 16·4 per cent. copper.

Numerous assays have been made of bulk samples from the different workings on the property. As might be expected, they vary greatly, and unless they are based on workable quantities of ore, do not give any really important results. Bulk assays have been made from the south benches and No. 2 west tunnel, showing considerable variations. Thus the assay of the first 12 feet across No. 2 bench was 1·7 per cent. copper, and of the second 12 feet 2·1 per cent., while the average of the country all through these benches was only 0·48 per cent., and the average of the tunnel 0·252 per cent. The average of the ore-body at entrance to tunnel No. 1 north was from 4·15 per cent. to 5·1 per cent. copper. Clearly, payable quantities have not yet been met with, and the undertaking simply resolves itself into a large prospecting proposition. The prospecting carried out by the option syndicate comprised the following:—Two open cuts N., shaft at No. 1 N. adit, crosscut from shaft, continuation of No. 1 N. adit, driving on two veins intersected by adit, continuation of No. 2 tunnel W., and a little work on No. 2 bench S.

No prospecting has been done along the trend of the hematite, and, looking at operations as a whole, I should say that too little driving on the course of the ore-belt has been done in proportion to the amount of crosscut tunnelling, though the latter also is quite insufficient for the proper testing of the property.

No. 3 tunnel E. could be continued W., and then a drive extended south with any quantity of backs. There is a band of chlorite schist with quartz S.E. from Nos. 2 and 3 open cuts which might be explored. Above all, the hematite line must be prospected by continuing No. 2 east tunnel, and driving along the footwall of the iron ore-body. This line is the one which offers most chance of success. Since my visit a little exploratory work has been continued at the north end, I am told, with promising indications. Of course, there is a possibility that an ore-body may make anywhere in this felsitic country, and one may be struck haphazard at any time when least expected. But, reasoning from analogy, the ore is more likely to occur in the neigbourhood of the concentrations of iron than at a distance from it, and a programme of thorough prospecting ought to take account of this probability. This has not been done, and the present unsatisfactory state of things is the result. The property, in its actual imperfectly developed condition, does not excite any very sanguine hopes, nor, on the other hand, does it deserve utter condemnation. It will probably stand or fall with the whole of West Coast range south of Queenstown, where the conditions for ore depositions are identical. The same country-rock, the same hematite and magnetite masses, the same general absence of true lodes, the same disseminations of iron and copper pyrites through the rock-mass



5 cm
RED HILLS MINE
SKETCH MAP
Scale
Feet
HEMATITE
CHLORITE SCHIST WITH QUARTZ BANDS
SLATE
FELSITE
W. H. Twelvetrees
Govt Geologist
October 1900
1485 93M
714 93M
715 93M
SHAFT
No 1 NORTH
TRENCHES
No 2 EAST
No 2 NORTH
1927 93M
954 93M
RED HILLS MINING Coy
No 2 EAST TUNNEL
760 93M
No 1 WEST TUNNEL
1928 93M
953 93M
CONGLOMERATE HILL
No 1 EAST TUNNEL
HUTS
BENCHES
No 2 WEST TUNNEL
753 93M
1484 93M

exist there as here, and the suggestion that more profitably concentrated deposits of copper ore exist somewhere within reach seems a reasonable one. Consequently, continued judicious prospecting appears to be perfectly justifiable. My thanks are due to Mr. Hy. Castle, the manager, who took me over the property in stormy weather.

Red Hills Proprietary Mine.

Section 1325-93M, 40 acres. This is S.W. of and adjoining the Red Hills property. A quartz outcrop is visible on the top of a N. and S. hill of quartz-felsite rock. About 70 feet down, a tunnel has been driven into the hill E. for 40 feet, but has a long way to go yet before it can intersect any vein below the surface outcrop. The felsite joints have a general dip to the W., and the rock is impregnated with a little pyrites and galena, especially along the bottom of the tunnel. West of this tunnel the felsite becomes laminated, and further west chloritic schist, the westerly dip continuing. Across the flat to the W. is a heavy capping of bedded conglomerate.

South Red Hills.

The felsitic rock of the Proprietary spur continues south into this property, and has been trenched and prospected without satisfactory results. The section is now lying dormant.

Mt. Tyndall Copper Mine.

Section 3709-93M, 80 acres, at Mount Tyndall, Mr. M'Peak, Manager. The mine is on the W. slope of the mountain, seven miles S.E. of the mines on Mt. Read. The country is the contact of the Red Hills quartz-felsite with green schist. Button-grass hills and gum forest surround the mine, which can be approached from Mt. Read by the Tyndall track—available for horses. The mine is about 640 feet above sea-level.

A large quartz lode, carrying clean galena, blende, copper and iron pyrites, crosses a creek in a direction N. 15° W., and dipping N.E. Its exposed width is about a chain, including bands of the quartz-felsite rock interstratified with it. It has been trenched for about 300 feet along its course. It is mainly in the felsitic rock, but towards the south shaft it seems to be along, or very near, the contact of that rock with the schist which is seen on the west bank of the creek, and continues further west below the house. From its position it is permissible to judge the ore-channel to have been influenced by this contact.

A north shaft has been sunk on the east side of the creek, 46 feet deep, but had been stopped, owing to heavy water, and was about to be unwatered when I was there. This has since been done, and, at the 60-feet level, a cross-cut is going west through the lode, showing some galena and copper pyrites. Another shaft, 230 feet south of the previous one, has been sunk 38 feet, and a crosscut W. into schist intersected a little galena and copper ore. I fancy the main part of the lode lies to the E.

The minerals met with in this lode, so far, are clean and solid. They are not blended with each other in the way prevalent in the zinc sulphide schists, but are clean, bunchy, and scattered, after the fashion characteristic of the quartz-felsite zone. From my observations of the mineral deposits of this zone, I believe, notwithstanding the handsome galena ore which has come from the Tyndall lode, that the staple mineral will be copper pyrites. Too little is yet known of the behaviour of ore deposits in the felsite belt to dogmatise on the probable character of the lode in depth. In such a siliceous rock, the origin of the lode quartz is uncertain. At the first blush it looks like the filling of a fissure, but, bearing in mind the occurrence of scattered copper pyrites in the country-rock for miles along this belt, the veins might just as well be the result of segregation. It is of no use to compare this mine with mines in the schist belt, for the latter are not parallel cases. We have, as yet, no properly productive copper mine in this felsite belt, but the copper ore which I saw at Tyndall was nice-looking, and went 25 per cent. copper and 3 ozs. silver per ton. The galena, too, was inviting, but I do not anticipate this will be a permanent ore. A sample, assayed by the Government Analyst, returned 51·82 per cent. lead, 19 ozs. 12 dwts. silver per ton. Mr. J. R. Booth's assays were 70 per cent. lead, 30 ozs. silver; and 81 per cent. lead, 50 ozs. silver. The company's published assays by Mr. Ahern are—lead, 82·5 per cent.; silver, 51 ozs. The average ratio of silver would thus be about ½ oz. to the unit of lead—a good deal lower than the proportion ruling in the productive Zeehan mines.

This lode should be well tested. If operations here prove successful, useful guidance will be furnished for the exploration of other points in this cupriferous zone.

Eden Coal Mine.

Coal measures have long been known to exist along the Zeehan-Strahan Railway line. Last year, while dragging piles for the Strahan wharf to the railway, to the south of the Eden station, a small seam of impure clod and coal, about 4 inches thick, was disclosed in the bush track half a mile west of the line. It was overlaid by surface clay, and was associated with greenish micaceous grit and sandstone belonging to the lower coal measures.

The coal has been analysed by the Government Analyst, and contains:—

	Per cent.
Fixed carbon	61·6
Ash	10·5
Gas, etc.	26·5
Moisture	1·4
	100·0

It is a caking, quick-burning coal, and has been favourably reported on at Lyell. The fixed carbon is rather low, and the ash a little high for a first-rate coal, but really good samples have not been available.

The dip of the seam is towards the N.E., at a low angle, and a trench dug while I was there higher up the hill to the N., about 100 feet from the track, showed, below the subsoil, indications of coal in the same strata. A small prospecting shaft was sunk here 50 feet, in green micaceous sandstone, containing imprints of fossil leaves and carbonaceous markings, with a few pebbles here and there. It passed through the following indications of coal:—At 30 feet down, a small 1-inch seam; at 38 feet, a 3-inch seam, tapering off to a mere track at east side of shaft; at 40 feet, a 1½-inch to 1-inch seam, thinning out on E. side; at 45 feet some clod.

The bottom is in grey greenish sandstone. The seam met with at 38 feet is probably the one uncovered in the track, and is useless. The syndicate, therefore, may be said to have accomplished their object, and definitely proved the nature of the seam found at surface. Having done this, they naturally decided to spend a little more money in testing the ground still deeper by means of boring. They put down a bore not far from the shaft, and passed through two of the small seams already intersected, but work has recently been suspended for want of funds. The boring enterprise is a perfectly legitimate one, and there is no geological reason for stopping it before the Silurian strata are reached.

Southwards along the railway to the Henty River the country consists of white and light-coloured sandstones, belonging to the Permo-carboniferous system. North of the Henty, under the white grit, is soft, dark brown, clayey shale, full of plant impressions, among which I noticed a frond of *Nœggerathiopsis*, a familiar plant of our lower coal measures. Between this and Eden there is a tract of such country at least two miles square, and I believe it highly probable that the measures extend southwards to Strahan below the Tertiary sands, which form the superficial covering of this area. Along the railway line are spots which could be selected for boring with the diamond-drill. Seeing how important a coal discovery would be for the whole of the Coast, it seems desirable to risk some expenditure, and see whether concealed seams do not exist in these strata. Without such a test, it can only be said that there are here beds belonging to the Tasmanian coal epoch, and in which coal may be quite reasonably expected to occur.

Conclusion.

I ought not to terminate this Report without referring to the smelting works erected a couple of miles south of Zeehan by the Tasmanian Smelting Company. As Mr. Max Heberlein, their General Manager, has lately furnished a detailed description of the works, I need not do more than emphasise the important assistance which this establishment has given to the mining industry of Zeehan and neighbourhood. Its proximity to that mining centre enables several mines, which would otherwise be heavily handicapped, in getting their products to market, to sustain their output, and contribute to the mineral revenue of the district. Some of the increase in quantities exported may be fairly credited to the establishment of these works.

The Emu Bay Railway Company may also be expected to constitute a factor in the development of the resources of this part of the Island. Its line will be open to Zeehan at the end of this year, and will contribute in various ways to the general welfare.

As bearing indirectly on the progress of the fields, mention may also be made of the Zeehan School of Mines and Metallurgy, upon which I have reported elsewhere more particularly. This laudable institution, under the direction of an indefatigable committee and Messrs. Waller Bros., imparts instruction to about 40 students annually, with the intention of equipping them in assaying and metallurgy, or qualifying them for posts as mining managers. It has been doing good work, and the growing demand for its tuition is now compelling the committee of management to decide upon the erection of a larger building, towards which the Government will contribute £1000, conditionally on the remainder of the required sum being raised locally, which, thanks to the public spirit of the district, has been almost done.

In conclusion, the present state of the mining industry in this part of the Coast is both gratifying and promising. There is a steady increase in the volume of the output, and fresh ground within the borders of the field is being worked. In several instances, old sections, abandoned when the conditions for profitable working were not so favourable as at present, are being resumed, and with an increased disposition on the part of the Government to assist and foster the industry, there are increasing indications of activity among those engaged in mining. No feverish excitement about our West Coast ore deposits need be anticipated, but there are sound reasons for looking forward to a quiet, steady continuance of development and exploitation for many years to come.

I have to gratefully acknowledge the valuable assistance of Mr. James Harrison, Inspector of Mines for the West Coast, who accompanied me on several journeys, and the courtesies and attentions which were so readily bestowed upon me by mine managers and others too numerous to name.

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 MINERAL DISTRICTS OF MOUNTS HUXLEY, JUKES, AND DARWIN.

Government Geologist's Office,
Launceston, 30th November, 1900.

SIR,

IN compliance with your instructions, I left Queenstown on the 30th April last, to examine the new mineral fields situate on Mounts Jukes and Darwin, and, on my return, I visited Mount Huxley, where some underground prospecting is being conducted. I was accompanied by Mr. James Harrison, Inspector of Mines for the Western Division, to whom I was indebted for much assistance on this journey, and some of the enterprising citizens of Queenstown very thoughtfully provided me with a prospector, Mr. John Anderson, who acted as an efficient pilot in the wild and rugged country on Darwin. My thanks are also due to Messrs. Bean, Allen, Collins, and Sumpter, mining managers, living on the heights of Mounts Jukes and Darwin, also to Mr. Havill, on Mount Huxley, for without the shelter of their camps our party would have been badly off.

General Geology.

These three mountains are elevations on the West Coast range of Tasmania, which here has a linear direction of north and south, or a few degrees west of north, and they occupy a line 12 miles in length. Mount Huxley is the most northerly of the three, four miles south of Gormanston; the southern end of Mount Darwin is three miles north of Pillinger, in Kelly Basin. This chain rises to heights of between 3000 and 4000 feet, and is skirted on the east by the comparatively flat valley through which the North Lyell Railway runs. This valley is plainly a glacier one, for along the railway line, especially on its eastern side, are peculiar long hillocks of pebbly wash, which are nothing else than glacial moraines. These have their long axes in a north and south direction, and are the lines of transported material left by the retreating glacier. I picked up a few ice-scratched stones from the ballast on the line. A powerful glacier would seem here to have descended to Kelly Basin. This is interesting, as furnishing some proof that the ancient glaciation was not confined to the higher elevations, but descended to not far from sea level, for this valley is not more than 500 feet above the level of Macquarie Harbour. The valley bottom is mostly button-grass soil, strewn with large quantities of angular white quartz. Below the soil are sedimentary rocks, sandstones, conglomerates, grits, quartzite, limestone, &c., belonging to the Silurian system. Descending from Lake Jukes eastward, these stratified rocks form the lower flank of the mountain down to the button-grass plains north of Darwin township, which are strewn with conglomerate, sand, and pebbles. On the railway line, where it passes through Spotswood's 40-acre section, one mile north of the township, there is an outcrop of grey non-fossiliferous limestone, and further south, approaching the town, the railway cutting exposes slates striking N.W. North-west, behind the township, soft brown schist strikes in the same direction. Ascending Mount Darwin from the township, yellow soft sandstones prevail, and higher up, soft greenish schist. These grey and greenish schists are the depositories of copper ore: they are intersected by various seams of quartz; the ore is pyritic, and its habit corresponds with that of the occurrences at Mount Lyell. I judge this belt of pyritic schist, which hangs on the eastern flank of Darwin, high above the plain, to be the southern continuation of the Lyell belt of copper-bearing strata. All the sandstones and schists strike a little west of north, and dip south of west. They accordingly underlay into the mountain range, which is not an axis of elevation, but a range carved out by the processes of denudation; they are not seen above an elevation of 1000 feet up the mountain side; they are then succeeded by a flinty-looking quartzose rock, locally called quartzite, which forms the upper part of the mountain mass, where not overlaid, as on Jukes, by conglomerates. On Darwin, the exposed thickness of this massive eruptive rock is considerable, exceeding 2000 feet. It forms the crest of the ridge, but is accompanied by coarse granite towards the southern end. It varies in colour from white to reddish, and is changeable in structure, though the texture is mostly compact and dense. The characteristic pink or reddish-brown colour is probably an original feature, arising from the iron oxide which is minutely diffused in the rock. It has most frequently a homogeneous felsitic appearance, but is occasionally porphyritic, with quartz or green chloritic pseudomorphs after felspar. According to its variations and to different systems of petrology, it is quartz-porphyry, quartz-felsite, felsite and micro-granite (in the sense of micro-granitic quartz-porphyry). Genetically, it is the effusive modification of the granitic rock-magma, and may have been either a rhyolite lava, or a protrusion from, or the marginal part of a granite mass. In Germany it is regarded as effusive, and called quartz-porphyry, micro-granite, granophyre, felsite, felsophyre. In England, where it is intrusive, it goes under the name of quartz-porphyry, and also bears the name of felsite and quartz-felsite. The older rhyolite lavas are also called felsites in England. Where it is intrusive in large masses, I should like to call it quartz-porphyry; where it is a devitrified lava, felsite.

There is a difficulty in calling the present rock as a whole "quartz-porphyry," because, more often than not, it is non-porphyritic. It is often associated with chloritic and quartz schist, which I am tempted to regard as a modification of the felsitic rock, as the latter, even when massive, sometimes acquires a dark green colour, due to the development of chlorite. From an examination of numerous microscopical slices, it may be seen that the minute structure of the groundmass is crystalline, even when the larger constituents have separated out. It is not granite-porphyric, but has mostly the microgranitic and felsitic structure of quartz-porphyries, with a slightly granophyric tendency now and then.

The structure has a parallel in that of European quartz-porphyries, *e.g.*, the microgranite (quartz-porphyry with a crystalline granular groundmass) of the Donnersberg, in the Pfalz, where it occurs as a sheet; and the felsophyre (quartz-porphyry with a felsitic groundmass) of Elfdalen, in Sweden.

I have devoted a little time to the consideration of this rock for two reasons: first, because it is important to elucidate its relation to the copper deposits; and, secondly, because it is such a constant and integral feature of the West Coast mountain range, forming, as it does, a crest line for 40 miles from north to south, from Mount Farrell to Mount Darwin, and probably extending beyond these limits.

A distinct lamination, or a certain degree of fissility, may be observed in the rock, and this suggests that it was involved in the foliation of the West Coast schists. The granite which is here and there associated with it (at Mt. Farrell and South Darwin) appears to be of younger date. Field examination of these felsites has been so extremely scanty that their relative age to the strata which now form the schists cannot be regarded as settled, but, so far, I am inclined to think, they were contemporaneous and pre-granitic. In this case they are, probably, Silurian, but the age of the schists themselves is in doubt, for it would be unsafe to refer the latter to the age of the Queen River fossiliferous sandstones (Middle Silurian). Some brachiopoda belonging to this series have been found at Gormanston, but in the creek, and not *in sitû*.

The felsite habitually merges into chloritic and quartzo-felspathic schists along its margins, both on the eastern and western sides of the belt, and even passes into these along its line of strike. This, and the occurrence of chloritic cupriferous schist in the heart of the felsite, seem to me to indicate that we are dealing with one and the same rockmass. Though the felsite is so massive, it probably had areas of weakness, in which it succumbed to a pressure which produced schistosity. In other parts the yielding was so slight that nothing more than a coarsely fissile structure resulted; and again, elsewhere, the rock is rigid and massive. In any case, the weight of evidence is in favour of an eruptive, and not a sedimentary, origin for these chlorite schists, in which an original porphyritic structure may occasionally be seen, sufficiently well-preserved to indicate their true nature.

In the felsite, iron and copper pyrites (the latter argentiferous and auriferous) occur as strings, patches, and along joint faces, also as branching veins; as impregnations or replacements of the schist; and in the substance of large outcrops of hematite and magnetite. The outcrops of iron oxide are a characteristic feature of the felsite. They occur all along the line—on the Osborne Copper blocks, Mt. Farrell, at Red Hills, Mount Huxley, Mt. Jukes, and Mt. Darwin. They are frequently besprinkled with copper pyrites. This development of copper ore gives the stimulus to prospecting throughout the belt. No productive mine has yet been opened in this zone; that is to say, no mine has yet sold or reduced the ore raised. A few mines, such as Red Hills, Jukes Proprietary, Prince Darwin, and one or two others, have raised a little ore, and the developments in some of these seem to show that they are on the verge of becoming payable. I have not found any undoubted lode in the rock; the nearest approach to one is a large barren quartz reef on the crest of Darwin. The Tyndall Copper Mine may also be in a lode, but the huge iron ore masses seem to indicate, by their associated copper ore, that, somewhere, there exists cupriferous deposits which it is worth while searching for. This, in a nutshell, is the real position of the mining industry along this band of country. A large prospecting field is about to be opened up, and it deserves all the attention and assistance which geological science can furnish.

The iron ore occurs in linear masses in the substance of the igneous rock. The discussion of its origin is important, as bearing on that of the copper ore.

1. I think that we may put out of court the theory that the iron ores are detrital concentrations: they could only be so by being deposited in superficial depressions of the quartz porphyry, and there are no signs of sedimentation to support the hypothesis.

2. We may further exclude their origin by differentiation or segregation of a basic element (iron) during the cooling of a rock magma. They are manifestly subsequent to that phase of rock formation, as they have replaced the constituents of the original rock (as mentioned in a previous Report).

3. Again, we need not consider their origin by direct fissuring action, as lodes are nearly absent.

4. There is the theory that bodies of pyrites may have oxidised to limonite, and that such limonite has, by

metamorphism, become magnetite. If this supposition is correct, prospecting in depth will prove it.

5. There is a further possibility of the iron ore collecting from the adjacent country-rock and concentrating in the ore-bodies. We know very well that iron oxide is present in quantity in a finely-divided state in the quartz-porphyry, as indicated by its reddish colour, but the porphyry is poor in heavy silicates, which would yield appreciable quantities of iron, and the rock does not seem sufficiently permeable to allow steady molecular migration to take place.

If none of the above solutions are admissible, and I think only (4) and (5) have any chance, we may consider the remaining supposition that the felsitic belt, as well as the siliceous schists east and west of it, including the schists of Mount Lyell, have been permeated by later solutions from below, connected with the consolidation of the granites. These solutions may be conceived as carrying dissolved copper, and were forced through the superincumbent rock under a hydrostatic pressure, which compelled them to seek directions of easy passage along the existing lines of schistosity. Sedimentary and other rocks, already transformed to schists, as at Lyell, Read, &c., were most easily permeated with the mineral solutions and replaced by the precipitated mineral. In the harder quartz-porphyry those parts, the chloritic schistose porphyries, which were exceptionally soft and had a pronounced lamination, formed the most favoured channels for the deposition of copper ore, while in the more massive felsitic rock the ore was limited to joints and accidental fissures. The iron was introduced at the same time, collected from other parts of the rock-mass, or segregated, it is best to confess, in some way which we cannot at present trace. The persistent occurrences of magnetite and hematite along this line of quartz-porphyry suggest the prevalence of uniformly favourable conditions for their deposition, and I believe are best accounted for by ascribing them to heated solutions along the granite contact. A very important confirmation of this view is the fact that on South Mount Darwin, where we have an outcrop of granite parallel with the hematite (about 20 chains from it) the outcrops of magnetite and hematite are the largest on the entire range ; and the felsite towards the southern end, where the granite is most exposed, becomes unusually flinty and hackly—an indication of contact metamorphism. At Mount Farrell, too, at Harris' cage, the granite is is also associated with an outcrop of hematite near the contact with felsite.

In postulating a common source for the cupriferous deposits of the West Coast range, we account for the prevalence of copper all along the line, not only in the quartz porphyry itself, but also in the schists which flank it. Under the circumstances alluded to, it is reasonable to suppose that the copper in the deposits of Lyell, Read, Red Hills, Jukes, and Darwin has been derived from a common source. If the felsite was a lava flow, it cannot have been the source. The ore solutions were more probably connected with the granites ; and I believe this will still hold good, even if it be shown hereafter that the felsite was intrusive, for its intrusion must have been anterior to the granite.

I think, in the present incomplete state of our knowledge, we cannot safely theorise further than I have ventured. Additional data are requisite for the formulation of a satisfactory explanation of the genesis of this metal; and these cannot be acquired without a prolonged residence on the field.

Ores found in this Belt.

Copper Pyrites (Chalcopyrite) is the most common ore of copper in the felsite and schists, often mechanically combined with iron pyrites, which is too apt to constitute the larger proportion of the mixture. It also occurs in the iron ore masses, but sparingly so far.

Bornite or Erubescite, containing more copper and less iron than the preceding, is derived from it, and below ground water-level will pass into it. It has been found in ramifying veins in the felsite at Lake Jukes.

Copper Glance, containing no iron and more copper than either of the preceding. At Lake Jukes.

Malachite and Azurite.—These are the blue and green carbonates of copper, appearing on faces and joint planes of the felsite on Mount Jukes.

Native Copper is present in the iron ore masses in small quantity, and occasionally in the felsite.

Magnetite and Hematite, occurring in veins and masses throughout the belt. In masses of considerable magnitude on the west slope of Darwin.

Galena.—Occasionally, in small quantities.

Gold.—In the pyrites on Jukes and Darwin: in the felsite at Mount Huxley: in ferruginous and quartz seams in the syenite-porphyry at King River Mine: in quartz at Harris' Reward. Alluvial in creeks on Mount Ellen, Mount Huxley, Mount Jukes. The copper ores contain small quantities of gold and silver.

The all-important question, seeing the tendency of copper pyrites in the felsite to occur in splashes, and in the schist as impregnations, is where to seek for the permanent ore bodies, which may be assumed to be near at hand. The iron ore may be taken as a general indicator; but the specially favourable channels appear to be bands of schistose chloritic rock. As a general rule, I noticed that where the rock is hard, massive, square-jointed, and void of fissility, it is unfavourable; but numerous observations will have to be made throughout this untried region before generalisations can be made safely.

Examining even the most massive occurrences of magnetite, as on the Prince Darwin section, where the solid iron ore is sprinkled with iron and copper pyrites, plenty of quartz can be seen in the substance of the ore, the indications of replaced country-rock being, to my mind, quite plain.

The magnetic oxide does not belong to the type found in basic rocks, such as serpentine and gabbro (containing titanium, nickel, cobalt, &c.), but is wholly in acid-eruptive rock. It is dense, crystalline, granular in texture, and passes by gradations into magnetitic hematite and hematite proper.

Mines on Mount Jukes.

These may be approached by a track from the North Lyell Railway on the east, or by the pack-track from Lynchford, which crosses the King River (by cage), near

Harris' Reward, and then proceeds east for $2\frac{1}{2}$ miles. The usefulness of this track is discounted by having to cross in the cage. Passing eastwards, the path traverses the northern section of

King Jukes Mine.

The company has two 40-acre sections, 1737 and 1861-93M, which it has prospected for copper. These slope down steeply to the north, towards the King River, which flows far below, in the gorge between the mountains Jukes and Huxley. The country-rock is chloritic schist and felsite, the latter pink where fresh, but green where modified by a secondary development of chlorite. I visited an abandoned tunnel a little below the track, driven into mineralised chloritic felsite, dark-green, and black. The massive walls are only fissured country. These joints or fissures run with the tunnel east of south, and the pyritic ore takes the same direction. The face in the end is well splashed with copper pyrites, and some nice-looking copper ore is stacked outside the entrance. This mineralised band appeared at the tunnel mouth to be very wide. Any amount of backs is available, and, as the ore-bands seem to run parallel on different meridians in the same belt, crosscutting ought to open up new ground. It is probable that in this way soft zones of cupiriferous schist would be intersected, in which the ore seems generally to be more concentrated than in the harder rock. Appearances on this section are encouraging, and it is a pity that financial difficulties compelled the company to stop work for a time. The country-rock resembles some of that seen on the track between the White Spur and Mount Tyndall—dark-green, with red patches.

Jukes Comstock.

This section, 40 acres, No. 1713-93M, is N.E. and adjoining the preceding. It descends the steep northern slope of Mount Jukes to within a short distance of the King River. It is bounded on the N. by an 80-acre section, which has been floated into the Jukes Consols. I wished to examine Turner's property on my visit to Jukes, but the weather prevented me. The Comstock has two tunnels driven into the hill below the Proprietary Mine, apparently on the same ore-belt. The upper tunnel, about 300 feet below the No. 2 Proprietary, had just been started at the time of my visit, and was 15 feet in. It was being driven in reddish felsite, carrying abundant iron pyrites, some of it very solid. Some of the ore from here assayed $3\frac{1}{2}$ per cent. copper and $3\frac{1}{2}$ dwts. gold. The lower tunnel is 250 feet beneath this, and was 84 feet into the hill, driven also through red felsite (quartz-porphyry), with patches and strings of copper and iron pyrites. A little galena has been found in a small seam of pug in the crosscut near entrance. This pug is four to five inches thick, and is the contact between the reddish quartz felsite and Silurian sandstone, which is here in the middle of the felsite country. The tunnel face is barren, but it is intended to crosscut east through the felsitic rock. This must be done, for there is no defined ore-channel, and, if work is restricted to the line of a tunnel, valuable ore-deposits may be missed. The tunnel, so far, has been a disappointment. Outside the entrance is a great face of carbonate-stained felsite, which suggested copper minerals further in. This leaching of carbonate was the first discovery of copper. Lime is sometimes associated with the ore. The huge cliffs contain a little mineral here and there, but the country is very tight and hard. If ore is found, it is likely to be clean. Some of the ore from the tunnel, assayed at the North Lyell office, contained copper 6·02 per cent., iron oxide 9·66 per cent., lime 3·90 per cent. Vigorous prospecting work is what is wanted here, and nothing better can be devised at present than the proposed crosscut, and, later, a lower tunnel. On this section the ore-bearing felsitic rock is bounded by sandstone on the west and pale schists on the east. Six men were working.

Jukes Consols.

The section below the preceding is an 80-acre one, partly on Mt. Huxley and partly on Mount Jukes, with the King River traversing it. It has a tunnel driven in the great felsitic belt, in which the other mines to the south are situate. Work was abandoned prior to my visit, and in the awful weather we experienced on the mountain I did not think it worth the risk to descend the rocky precipice down to the drive; but I went down as far as the Comstock, the mine immediately above it, and could see very well that the cupriferous formation continued. I should say that the Consols have as good a prospect of tapping ore as the upper mines have.

North Mt. Jukes.

Section 2699-93M, 40 acres, situate between the King Jukes and the King River. The hill has been driven into, but without getting any ore worth speaking of. The ore-bearing formation, however, is there, and if the King Jukes strikes ore, this section is in a good position for the continuation of the deposit.

Mt. Jukes Proprietary.

Jas. Bean, Manager. Two 40-acre sections, 1711, 1712-93M, south of and adjoining Comstock at the north end of the mountain. The track to this mine is bad after leaving the King Jukes, being only a footpath on the precipitous side of the mountain. The King River is 1,500 feet below the upper tunnel. Satisfactory signs of industry were noticeable on this property; there were some good huts and a couple of blacksmiths' shops.

To the south and west is the lofty face of Mt. Jukes, capped with conglomerate, which reposes on the felsitic and chloritic schists. The mine works are in the rocky slopes at the base of this face. An upper tunnel (called No. 1) has been driven west in the S.W. corner of section 1711 for 125 feet. At 18 feet from the entrance it intersected a dark quartz schist ore-body 22 feet wide. To this grey quartzose schist, with blebs of quartz in the planes of lamination succeeded, and further in some seams of dark ore-impregnated schist were met with. The schist is often dark-green from chlorite. The dark schists are considered favourable for copper; the grey schist is dry and unpromising generally. These schists exhibit a rock unmistakably deformed, and their origin is not altogether free from doubt, but, from the preliminary examination which I have been able to make, I am inclined to think they are schistose felsites. They alternate with felsite, are formed in the middle of the felsite zone, and are sometimes continuous with the latter rock on its strike. I have detected twinned felspars in them, and this supports an igneous origin. The face of the tunnel at present is in grey schist; but both grey and green are really the same rock and alternate. A winze has been sunk on the 22-feet ore-band 60 feet in-ground, which, though poor at times, may be described on the whole as payable. The best ore occurs at the bottom of the winze; a good sample from here assayed 15% copper, 2 ozs. 12 dwts. silver, $3\frac{1}{2}$ dwts. gold. From the bottom of the winze a level has been driven 30 feet N. and 32 feet S. Behind the end of the south drive poor schist comes in. A crosscut west has been put in 24 feet across the ore body and has penetrated 5 feet into barren grey schist. Measuring from the east wall of drive there are 14 ft. of good ore succeeded by 10 ft. of impregnated schist which may do for milling on the spot. The crosscut has probably not exhausted the ore ground, as, doubtless, parellel zones exist. The west wall of level at bottom of winze is poor going north, but a crosscut east from this end passes through 10 ft. of dark impregnated schist suitable for dressing. I saw a pile of good ore at surface said to have been raised from this winze. The published average assay value of the lode in the winze and drive is 12 % copper, with small quantities of gold and silver. A piece of stone which I picked from the pile at the mouth of the tunnel and judged to be an average sample was assayed by Mr. W. F. Ward, Government Analyst, and returned 3·7 per cent. copper, with traces of gold and silver.

Further north, a lower tunnel. No. 2, 300 ft. below the upper one, is being driven S.W. to cut the schistose ore body above mentioned and connect with the upper workings. It will have to be about 500 feet in length in order to intersect the ore formation. Seams of copper pyrites and pyritous schist have been intersected in the tunnel. The ore from one of these seams is stated to have assayed 29 per cent. copper. The ore met with has no apparent connection with the band further west. At the entrance to this tunnel native copper is disseminated through the hard felsitic rock.

In the N.W. corner of this section there is a large hematite outcrop, which, considered by itself, would be taken as the oxidised outcrop of the schistose ore body, for where it has been cut into down to 12 or 13 feet it seems to split up into veins of iron and copper pyrites in schist. But it must be interpreted in connection with other exposures in this field. The band of hematite passes N.W. into the Jukes-Comstock section.

Below the lower tunnel mineralised rock has been trenched across for 100 feet. It carries copper pyrites everywhere, but not sufficient to pay where exposed. The belt of felsitic and schist rock which carries ore on Mount Jukes is roughly about a mile in width, but in any one place it varies from 5 to 10 chains wide. The hematite appears and reappears in veins over a width of 5 or 6 chains.

There is no zinc associated with the ore on this field, and if enough copper can be found the mines will be opened out vigorously, despite the present inaccessibility of the claims. If the cage were done away with at the King river, and a bridge constructed, stores and ore could be packed *via* Lynchford, but the company's natural outlet will be to the North Lyell Railway. The set of mines just referred to are all at the north end of Mount Jukes. Their value at present is largely prospective, but the good ore in the Jukes Proprietary is decidedly encouraging. Defined lodes need not be looked for, but there may be numerous lenses of ore in the schist and in the felsite in connection with the hematite outcrops. The latter are ill understood at present. Future work will no doubt unravel the relations between the iron ore and the copper deposits. All facts which bear upon this relationship should be carefully noted. Communications upon the subject will be gladly received and acknowledged by this office.

To the east of Mount Jukes Proprietary is an 80-acre section held by the Great Southern Mount Jukes Co. The track south from the Proprietary to the Lake Jukes passes first through company's section held by the Great King Jukes syndicate, and next across the South Mount Jukes 80-acre block. Some surface prospecting has been done. The track skirts the eastern face of the Jukes range and passes over the schists, conglomerates, and sandstones which hang on the flank of the great quartz-felsite mass. The great white conglomerate cap can be seen here resting on the central summit of Jukes.

The Queen Jukes sections comprise four 40-acre blocks, three of which are south of the King Jukes. There has been some driving in the steep eastern face of the mountain where the rock is mineralised, but very little work has been done up to the present.

At the survey camp the ascent is made to Lake Jukes through myrtle forest over sandstone, chloritic schist, and silurian red conglomerate, highly inclined.

West of the King and Queen Jukes are the Mount Jukes and Crown Jukes sections, also in the cupriferous zone, and this country would appear to run south through E. H. C. Oliphant's section. These lie in a part of the belt which was inaccessible to me. A published assay by Messrs. Spiedie & Co. of surface ore from the schist at approach to tunnel on the Crown Jukes gives, copper, 2·36 per cent., gold, 18 grs., silver, 19 dwts. 14 grs. per ton.

The inaccessibility of the 40-acres, 3632-93M, held by the Jukes and Darwin Junction Company, prevented my visiting the section during the short days of that season of the year. It is high up on the mountain, and I understand nothing payable was found, though only a little surface prospecting has been done on it. In position it is north-west of Lake Jukes mine, but I should judge it to be in the same cupriferous zone as the other mines on Jukes.

Imperial Jukes, 4046-93M, is an 80-acre section in the name of W. P. Motton, east of Lake Jukes. Some money has been expended in surface prospecting on a mineralised belt which traverses the block S.E. to N.W.

Lake Jukes.

This property comprises two 80-acre sections south of South Mount Jukes. The name is due to the existence of a deep lake high up on the mountain side. This sheet of water covers about 8 acres, nestling in a recess under steep cliffs. It freezes over in winter with 2½ inches of ice. Its appearance is that of a glacial tarn. There is no foundation whatever for the supposition that it is the crater of an extinct volcano. These mountains have been carved into their present shapes by the denuding agencies of weather, water, ice, &c. Another lake exists on a neighbouring section to the S.E.

The Lake Jukes Mine is in massive quartz-felsite rock, which has been denuded into the form of a narrow spur, or razor-back, measuring, at the base, 600 or 700 feet across, and narrowing as it goes up. The mine had been working for a few months only when I was there. A lower tunnel was being driven in the face of the hard felsite to strike the veins of rich bornite and glance copper ore, which, at surface, ramify through the country. These veins are thin where cut into on the surface, but it is hoped they will widen out in depth. A possible drawback is the likelihood of the veins meandering through the rock instead of filling a straight fissure. From what I saw at surface, I fear this will be their habit. If they improve, the Lake Jukes will be an important mine, for the quality of the ore is the best on the field; and from the configuration of the country, I think a great depth will have to be attained before the rich secondary glance and erubescite give way to the poorer chalcopyrite, which will ultimately constitute the vein. There is more than one outcrop of such ore on the hill, and there ought to be a good deposit in connection with all this ore. It must come to light if perseveringly and judiciously sought. Picked samples of copper glance assayed 50 to 60 per cent. copper, 9 ozs. silver, 2 dwts. gold per ton. A rich sample which I took of the bornite ore (accompanied by a little vein or vugh quartz) was assayed by Mr. W. F. Ward, Government Analyst, with the following result:—73·5 per cent. copper, 5·7 per cent. iron, with traces of gold and silver.

There is no blende here, but a little accessory galena is seen. Native copper is found in the rock, whence it has been carried into the creek. Stains and facings of azurite and green carbonate of copper are visible on joint faces in the rock. This is one of the few mines in the belt where there is a reasonable chance of the ore deposit turning to a lode. At Lake Jukes a quartz schist lies east of the quartz-felsite. A speckling of the latter is noticeable, which may be the commencement of a chloritising process. The rock, upon microscopical examination, is found to be identical with that at the Jukes Proprietary.

There is every encouragement for perseverance in testing these rich veins, for, if they make strong at a moderate depth, this mine will be an undoubted success.

A track is being cut to connect this claim with the low country to the east: about five miles ought to bring it to the railway. There are heavy falls of snow here in winter, and a good track will be indispensable.

Mount Darwin.

The ore-belt continues south from Jukes to Mt. Darwin, the two mountains being connected by a saddle.

The field, at present, may be described under two divisions, viz. :—North Mt. Darwin and South Mt. Darwin. At the Northern end are Hal Jukes and some other sections, which I did not visit. They are lying idle, waiting for the introduction of capital. The other mines in the northern division are on the eastern slope of the mountain, above the Darwin township, and by pack-tracks and aërial tramways could be put into easy communication with the North Lyell Railway, which runs through the flat country below. Naturally, these mines are favoured and fostered by North Lyell investors, who count upon them growing into important feeders of their railway line. This line furnishes them with a splendid get-away for their output, notwithstanding their lofty position on the side of this bold and majestic range.

Mt. Darwin Proprietary Mine.

Mr. B. Pearse, Manager. This Company has two forty-acre sections on the eastern slope of Mt. Darwin, 700 feet above the township, 3066, 3067-93M. The tunnel which is now being driven takes a S.W. direction across siliceous schists and quartzite. When I was there, the end was in quartzite, and it is intended to drive far enough to get below an ore body disclosed by surface trenching. At 130 feet in, a south drive has been put in 90 feet, and then a crosscut started parallel with the main tunnel. Little bunches of good copper ore were met with all along the drive. The country rock is grey quartz schist, and the ore resembles the siliceous ores of Mt. Lyell. The rock has no connection with the felsite, but forms a narrow belt flanking it on the east. From the nature of the ore, and from its position, I take it to be the southern prolongation of the Lyell belt, 9 miles to the south of Gormanston. The line between here and the sections belonging to the Great Lyell South should be traced, and, if examined properly, will probably be found to be a more or less continuous ore-belt. This is an instance in which it may be permitted to place some confidence in geological reasoning, and, without actually travelling along this belt, I have not much hesitation in predicting its continuity. Future prospecting will, I believe, show this prediction to be justifiable. It has been too much the fashion to draw an arbitrary line at Mount Lyell, and to assume that the deposition of ore did not take place south of it. We have now the discovery of identical ore in similar schists on the same strike several miles to the south, and there are no reasons which require us to believe that the intervening country must be blank.

The mine was started in 1899; 8 men were employed at the time of my visit. Ore has been found at intervals along the line of formation for over a thousand feet, and the formation traverses both blocks. Ore at the show in the creek is stated to have yielded as much as 19 dwts. gold. Published assays of ore are—

(1.)	Copper, 17 per cent.	Silver, 10 ozs.	Gold, 19 dwts. per ton.
(2.)	„ 12 per cent.	„ 9 ozs.	„ 14 dwts. per ton.

a sample of the rich pyritic ore which I took has been assayed by Mr. W. F. Ward, the Government Analyst, as follows—

34 per cent. Copper, 2 ozs. 0 dwts. 20 grs. Silver per ton.

South Mount Lyell.

J. Dillon, Manager. The two 40-acre sections south of and adjoining the Darwin Proprietary, are held by the South Mt. Lyell Mining Company, Limited, 2158-9-93M. The mine is about 650 feet above the railway, and is in the same favourable grey schist as the Proprietary. The light yellow copper pyrites, which is the ore here, is identical with that of the Lyell district further north. The deposit is not in the form of a fissure lode, but constitutes a replacement of the schist. The schist is slightly talcose. It strikes N. 20° W., and a tunnel has been driven S.W. across it, proving impregnations of copper all the way. At about 200 feet in, a winze has been started, where good ore showed, and some nice looking metal has been obtained, assaying 13½ per cent. copper, and 9 dwt. gold per ton. A pure sample which I selected from the ore paddock was assayed by the Government Analyst and yielded 33·1 per cent. copper, 2 ozs. 2 dwts. 11 grs. silver per ton, and traces of gold. Fifty feet further in, the tunnel passed over the top of black schist, also carrying pyrites. In the end of tunnel, the face shows schistose quartzite (or felsite ?), also slightly impregnated with pyrites. There is an upper tunnel about 40 feet higher, which has been driven 100 feet, and a winze sunk at entrance. If the quartzose rock in the end of the lower tunnel is felsitic, a decided change of country will take place. Although the change may not be intrinsically favourable for ore, the contact zone is promising for ore deposition, and I regard the country all along this contact in the Proprietary and the south sections as likely ground. Ore may or may not be met with in the quartz-felsite, but will probably be found by sinking on the schist or tunnelling through it lower down, and then driving on parallel bands of mineralised country which will prevail at or near the boundary between the two descriptions of rock. There seems to me to be every inducement for courageous prospecting.

Mount Lyell Extended.

Mr. David Sumpter, Manager. Twenty chains south of the South Mount Lyell property is a 40-acre section, 2549-93M, held by the Mount Lyell Extended Company. This mine is 1500 feet above the railway, and in a splendid position for an aërial ropeway. The track south from South Mount Lyell, along the mountain side, crosses the cupriferous schists, and leaves them to the east ; it then courses along pink, flinty, felsitic rock, often green with chlorite, and possessing some degree of lamination, in a N.W. direction, and with a S.W. dip into the mountain. This rock contains specular iron in veins and on the cleavage faces. Further south-west the rock merges into a chloritic schist, with disseminated iron pyrites.

Close to the manager's hut is a cut, in which explosives are stored, and which exposes a green chloritic schist impregnated with pyrite and specular iron. A couple of hundred feet higher up the hill a hole has been put into the same sort of schist, but harder, and containing more quartz. The rock is well impregnated with iron pyrite. To the west it is succeeded by talcose schists. The top cut is in speckled talcose schist, the chloritic specks bearing a resemblance to similar chloritic pseudomorphs in the felsites: this schist also carries iron pyrites. A lower cut in the chlorite schist shows iron and copper pyrites running through the rock in seams parallel with the laminations. The iron pyrite is abundant.

A tunnel has been driven across the soft talcose and chloritic schist for 107 feet. Some bunchy copper ore was found at the approach, and slight disseminations of iron pyrite throughout the course of the drive. The face is in greenish chloritic schist. The only thing to be done is to continue driving. Just N. of the tunnel is an open cut which exposes grey-green chlorite schist, seamed with copper pyrites, where soft, and charged with disseminated iron pyrites. The Lyell Extended appears to be west of the south Lyell and Darwin Proprietary zone. Search should be pursued where the schist rock appears the softest, as the softness is, apparently, the result of crushing and the deposition of mineral. Five men are employed here.

Mount Lyell Consols.

Manager, Mr. David Sumpter. S.W. and adjoining the Extended is the Mount Lyell Consols section, 2585-93M, 40 acres, about 2200 feet above the railway; consequently, a good height above the Extended. A tunnel has been driven 128 feet across green chloritic and talcose schist, with a hackly fracture, containing veins of iron pyrites and a little copper pyrites. The end is still in the same schist. About 30 feet higher up a cut has been put in hard green quartzitic schist, carrying a little copper and iron pyrites. The tunnel below has gone through this, and prospects are none too encouraging, for the country is hard and tight, and the soft schist, which carries the most ore, is absent. Four men were employed here. I was greatly indebted to Mr. D. Sumpter for hospitality and assistance on the mountain.

To the N. of Lyell Consols is the Darwin Consols, Section 3196-93M, 66 acres, where some work has been done without much result, so far. Operations had been suspended here, as also on

Brumby's Sections,

2746-7-93M, 80 acres each, which are now known as the Melbourne Darwin, and are ¾ mile west of the South Mt. Lyell. In going to these from the Lyell Extended a zone of felsite is passed over, and then, further west, chloritic schist. A belt of mineralised schist traverses the eastern section from S.E. to N.W. Three trenches have been cut in the schist just at the beginning of the western slope of the mountain. The strike of the schist is N. 20° W., and its dip, S.W., and rather flat, 45°. The rock carries iron and copper pyrites, sometimes associated with quartz. The principal trench or cutting has been put in 20 ft. on some pyritous schist, containing copper. Some of this is stated to have assayed 6 per cent. This is not the bulk value; but some of the ore could, under more favourable conditions, be concentrated, as there is not an excessive quantity of iron in it. This chloritic schist is on the strike of the felsite which forms the backbone of Darwin, and my interpretation of all these quartz and chloritic schists is, that they are crushed felsitic (quartz-porphyry) rock. The igneous rock has yielded, in these places, more to the crushing action, which has developed lamination and the minerals characteristic of dynamo-meta-morphism. The ground being flat, tunnelling is out of the question, unless excessive length is accepted, consequently, prospecting will be rather difficult. Some of the disadvantages of its position will be remedied by the construction of a track, which is necessary for the transport of material. The ease with which surface exposures of cupriferous schists have been discovered indicates the existence of a copper-bearing zone, which should be explored.

The properties on this mountain suffer from the absence of tracks. Some of the syndicates have cut paths to their claims, but of an indifferent character, and there will always be some difficulty in getting supplies to the ground, even with the best of tracks. The enterprise already displayed by owners in prospecting their ground under difficult conditions commands attention, and is entitled to encouragement on the part of the State.

The above comprise the mines which I visited on North Darwin. The remaining mines are on South Darwin, and on the western slope of the range.

South Darwin.

From Mt. Lyell Extended I ascended by a foot-track to the summit of the mountain. The crest is composed of quartz-felsite rock, and is clothed with grass. The rock is reddish in tint, and has a hackly fracture. At times it contains veins of hematite. The track runs south on the ridge of the mountain, and on the strike of the felsite. To the west is the Sorell range, separated by a tremendous valley, into which the winter's sun shines but little. The extreme southern end of Darwin is seen in the distance as a knob, several hundred feet lower than the northern apex.

Proceeding south a little to the east of the centre of the ridge, a line of granite is struck, which runs N. and S., flanking the felsite on the east. It is coarse-grained, and fresh specimens can hardly be obtained from the weathered exposures. It crumbles easily, weathers white, and the dark silicates are present only in very small quantity: the rock is composed practically of quartz and felspar, but the structure is granitic rather than aplitic.

Going down the western slope of the ridge by a steep footpath through the forest, we reach the 80-acre section, 2662-93M, of the

Prince Darwin Copper Mine.

The feature of this property is a large belt of hematite and magnetite traversing the section from N. to S., sometimes attaining a width of 200 feet. This large outcrop carries iron and copper pyrites, a little copper carbonate, and some native copper. Upon carefully examining the hard green and red rock in which the iron ore is enclosed, I found it to be quartz felsite. On this section the felsite is sometimes brecciated.

The lower tunnel, 1500 feet below the summit of Mt. Darwin, has been driven 50 feet N.E. in hard green and red felsite. The rock carries a little iron pyrites as well as native copper, and the magnetic iron formation is a little ahead of the end.

An upper tunnel is being driven obliquely across the magnetite, which has disseminations of iron and copper pyrites, native copper, and is permeated with quartz. The rock is strongly magnetic, dark grey in colour, and has every appearance of being a replaced quartz-porphyry. The tunnel is 50 ft. in. Where a shot was put in above the tunnel, the ore assayed 2½ per cent. of copper, but it is believed to average 1½ per cent. all through. But the tunnel is in ore which appears to be improving with the drive. Mr. Cundy's recent assay of some ore showed 7 per cent. copper, 2 ozs. silver, 16 to 19 grs. gold. Speedy's assay of ore from the end was 7 per cent. copper, 3 ozs. 16 dwts. silver, 1 dwt. gold. It has sensibly improved in the last ten feet. Mr. Ward's assay of my sample is 54 per cent. iron oxide, but no gold, silver, copper. This looked a fair sample of the iron ore well sprinkled with iron pyrites, but not showing any copper to the eye. Lower down the hill, and about 3 chains above the west side-line is a parallel band of hematite about a chain wide. The rock is still felsitic. In the ore formation are quartz and remains of country rock. Some iron pyrites are found in it.

Going down the hill W. a fragmentary or brecciated felsite occurs, denoting shattering. This brecciated form is found down to the bottom of the valley.

The ore formation on the Prince Darwin is the most important on the field, and the task of exploring it should be taken in hand with earnestness. The iron outcrops are not, in my opinion, cappings of lodes; but it is necessary, nevertheless, to test them in depth, and see whether the oxide is accompanied by any sort of sulphide. In the neighbourhood of their margins ore deposits are most likely to occur, and, as the iron ore bodies, as well as the felsitic rock, dip west, the work for the Prince

Darwin owners is considerably facilitated. Up to the present, work has been retarded by the difficulty of of access to the mine. I am told it cost £10 to get the bellows and anvil to the smithy, but the proposed Government track from Kelly Basin to the south end of Darwin will put a new complexion on matters.

Casboult's Section.

4245–93M, 59 acres.—The iron ore formation continues southwards on this section. It is here a parallel lens with the huge outcrop on Prince Darwin, and is exposed for a width of about 15 feet just after crossing the boundary between the two sections. I saw some specular hematite in the outcrop, but no sulphidic ore. The country rock is still felsite. The surface is flat here, and it would be necessary to sink on the blow. Further south, on the same section, the continuation of the hematite crops out, still preserving a north-westerly bearing. Here, too, sinking would have to be undertaken, though a little more adit depth could be obtained than on the previous outcrop. This section has never been tested, and its resources may be said to be unknown.

South Prince Darwin.

Section 2689–93M, 80 acres. C. E. Russell and A. Machejefski.—This is south of Casboult's, and on the steep slope of the mountain falling away to the Clark River. A little below the brow of the hill is a wide and bold outcrop of hematite, which may be a parallel development to the large upper ore body on Prince Darwin. These outcrops habitually appear *en echelon*, instead of being prolonged in a direct line along the strike; this fact is not detrimental, but each occurrence must stand on its own merits. The outcrop on this property carries the usual impregnations of iron pyrites, and will, doubtless, be properly tested as soon as proper conditions of work are established in this valley. The marginal portions and the adjacent country will probably be found to be the zones of ore deposition. In this untried country it is hazardous to predict whether or not the iron oxide will yield to sulphidic ore in depth.

Tasman Darwin.

Section 3365-93M, 70 acres. A. F. Brittingham.—This is south of and adjoining the South Prince Darwin. A tunnel has been driven S.W. for 50 feet, in dark, red-seamed, very hackly quartz-felsite, charged with a little iron pyrites, and stained with copper salts. The rock is sometimes green with chlorite. With the ore is associated some quartz, which is in nests and patches rather than in veins. The face of drive is in black flinty felsite. Higher up on the slope of the hill to the east is a large outcrop of hematite, 3 or 4 chains wide. A tunnel has been driven towards this band of iron ore, but was stopped within 60 or 70 feet from it. It would acquire 200 to 250 feet of backs, but afterwards sinking would be necessary. Still higher up hematite is well exposed, and shows along its junction with the country felsite plentiful splashes of iron pyrites, which must have been accompanied by copper, as a few azurite stains have appeared since the shots were put in. But this outcrop crosses only at the N.W. angle of the section. Like the rest, this property is awaiting better means of communication before work can be resumed to advantage. A specimen of magnetite I brought away with me from this section (from the open cut), when assayed by the Government Analyst, did not yield more than a trace of copper.

Tasman-Darwin Extended.

Section 2598-93M, 80 acres. A. Machejefski and C. E. Russell.—This is west of and adjoining the Tasman Darwin, and is situate high up on the S.W. slope of the mountain. Hematite veins and outcrops of moderate size occur in the western and central parts of the section. The work done on the property shows the occurrence of iron and copper pyrites, with native copper in the country rock, and the configuration of the country lends itself admirably to adit-driving, as the mountain side rises steeply. Though I did not see the huge blows here which are seen on some of the adjacent blocks, this section has the advantage of being nearest to the granite outcrop which occurs on the southern end of Darwin; and if the hematite, as seems probable, is connected in any way with the contact between the two rocks, the property occupies an interesting and a promising position.

The ground falls away here south towards Macquarie Harbour, and there are sections in that direction in the names of C. E. Brown and J. Armstrong. I could not visit them, but was told that prospecting on them had disclosed a continuation of the same features which I have above described on the northern blocks.

Cowen's Section.

3934-93M, 61 acres, is situate on the top of the Darwin Ridge, to the east of Casboult's block (59 acres). The southern and eastern parts consist of granite, which underlies a covering of button-grass. Towards the northern boundary a shot in felsitic rock showed some iron pyrites, and on the northern side of the boundary, in Hepburn's, Lewis', and Hiscox's section 2663, 80 acres, hematite is disclosed, also with iron pyrites; but owing to approaching darkness I could not fully examine these exposures.

North Prince Darwin.

Section 2632–93M (80 acres), north of and adjoining the Prince Darwin. It is located near the bottom of the valley under the precipitous western face of Mount Darwin. There are a couple of strong outcrops of hematite 9 or 10 feet wide, earthy to dense in character, and showing impregnations of iron and copper pyrites. One of these appear to have come in from the Prince Darwin Section. They are in chloritic felsitic schist, with a N.W. bearing and dip as usual to the S.W., and are about 500 feet apart. In the low tunnel, the ground passed through was chloritic schist, green and red, with occasional layers of brecciated felsite. The tunnel would strike the iron-ore body at a good depth in a short distance, but was stopped after driving 15 feet. Work was evidently begun here in a ridiculous, half-hearted way.

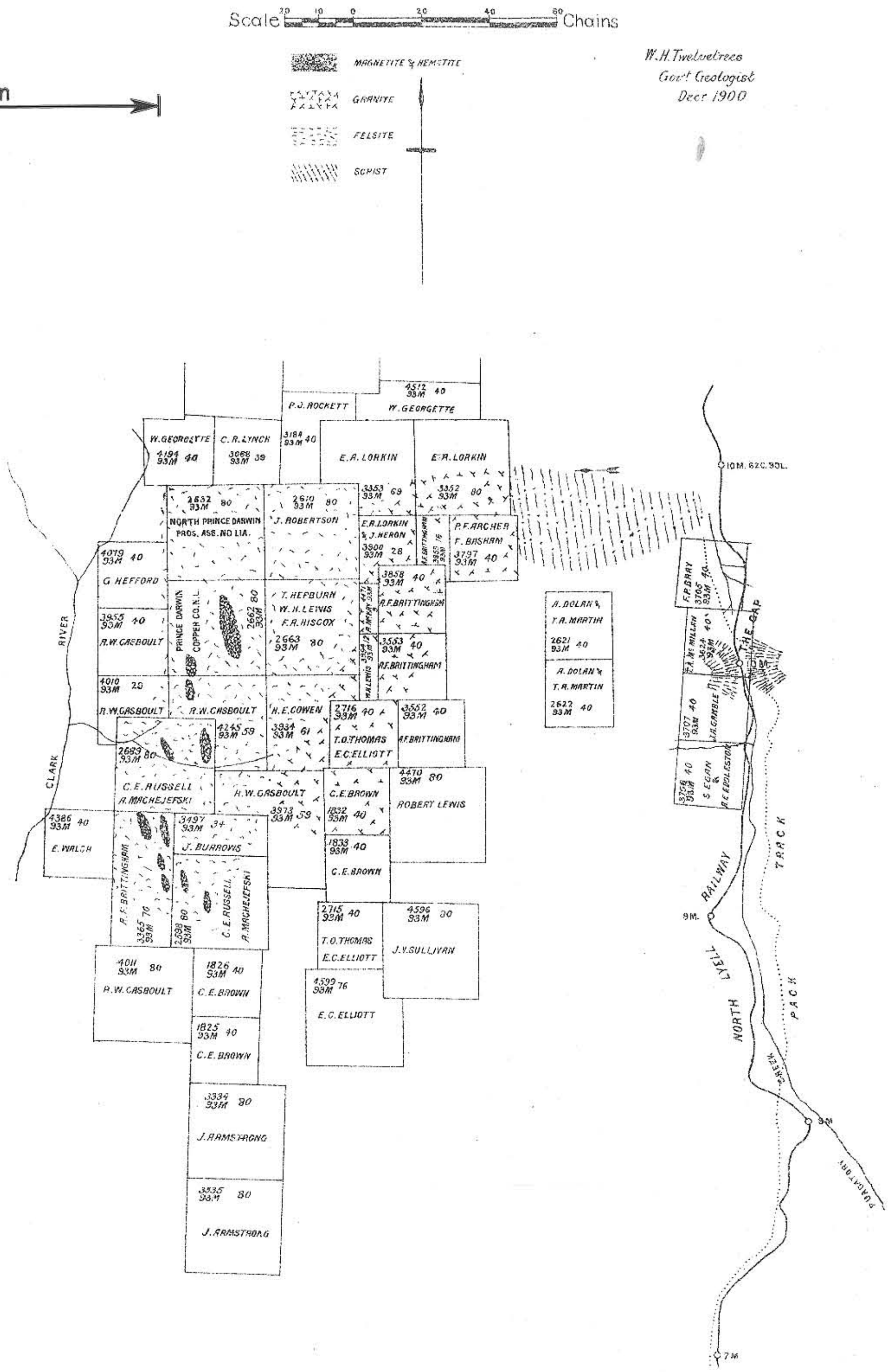
General Considerations.

From the above remarks, it will be seen that these Darwin Sections are still in an utterly undeveloped state. Hitherto the absence of railway communication and pack tracks, and their remoteness from any settlement whence supplies might be carried, have impeded work, and the little work which has been done upon them has been achieved under such stupendous difficulties, that those who have attempted it deserve the utmost credit for their courage. Under these circumstances, there has not been much done which can serve as a certain guide in forming an opinion of the value of the ore formations. The field, however, is not on that account to be despised and shunned. On the contrary, I consider the outcrops and the nature of the enclosing rocks justify one in attaching considerable importance to the formations as receptacles of copper ore. It may be that prolonged and continuous prospecting is necessary to lay bare the ore channels, but there is every reason to hope that exploratory work will eventually succeed in disclosing them. On the top of the South Mount Darwin ridge, I came across a large quartz reef, which appeared barren, but fissure lodes seem to be quite the exception in the quartz-porphyry. The payable copper ore will, I think, be found to occur either (1) in the country-rock, where it has been rendered schistose or laminated by pressure and crushing, and is further softened by the decomposition of mineral, in a word, in the cupriferous chloritic schists; or (2) in such parts of the felsitic rock (often near its contact with granite) as have been permeated with silica and replaced by iron ore. Portions of the iron ore bodies (as at Prince Darwin) may possibly prove cupriferous enough to pay for working for copper. On the whole, however, I think it more likely that the richest deposits will be found outside the iron. As the conditions of life and work on these rugged heights grow easier, the chances of striking remunerative portions of the deposits will improve. A few successes will convert this great range into a busy hive of industry.

I wish to be sufficiently guarded to avoid raising, unduly, hopes with reference to any particular enterprise, but I recognise that a general expression of opinion is expected from me; and I feel warranted in saying that there is every incentive to perseverence. The mere fact that the mineral exposures are not always so solid as could be wished is a mere matter of accidental denudation; and the superficial or shallow indications, though they may be guides, are no measure of what may lie beneath them. The valleys east and west of Mount Darwin are valleys of denudation, where the softer rock

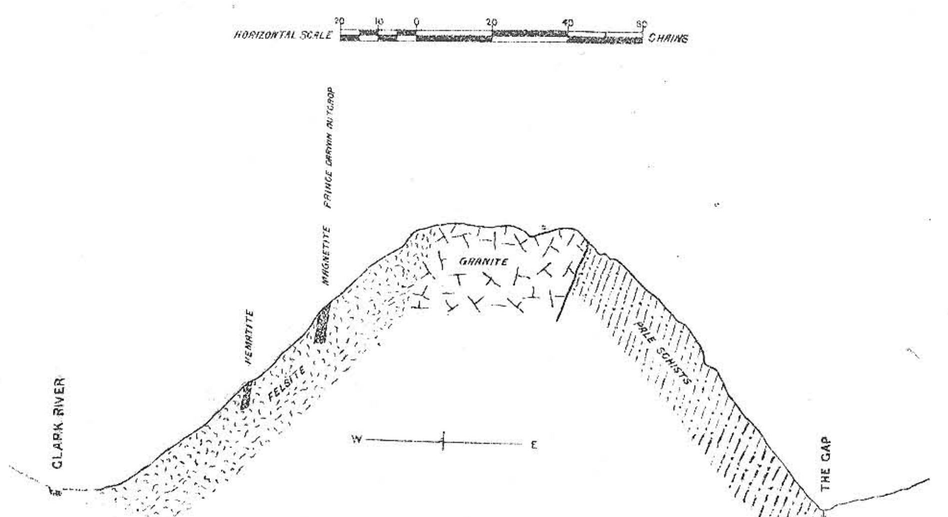
SKETCH MAP

SECTIONS ON SOUTH Mt. DARWIN



SKETCH SECTION ACROSS SOUTH Mt. DARWIN

SHEWING RELATIVE POSITIONS OF ROCKS



has been worn down and removed, leaving the hard granite and felsite backbone to form the mountain itself. We may be sure that the copper will continue down to its source, and that the water-level can form no bar to its existence below. It will take time and unlimited capital to explore this mountain thoroughly and systematically; but the work has already been commenced; and if it is persevered in there is a fair chance, fortified by every reason which mining geology can adduce, that this great range south of Lyell will, sooner or later, become a flourishing seat and centre of copper-mining in our Colony.

The market price of copper is now eminently satisfactory; and, consequently, the present is an advantageous time for prosecuting exploration. The copper stocks are low; the demand for the metal is increasing, and may be looked upon as certain to continue to do so. The present prices are not the result of manipulation of markets, but are undeniably the outcome of the state of the world's copper supply. There is every prospect of maintenance of values for some considerable time, as the numerous copper mines which have been started or resumed the last year or two cannot augment the total production appreciably all at once; and at the same time, the production, so far, is not overtaking the consumption.

The fact that no really payable mine has been opened yet must not be allowed to discourage exploration. The prospecting work, in consequence of the enormous difficulties in getting supplies to the field, has been trifling, and in no way commensurate with the importance of the indications. The indications, too, occurring in a country of new, unstudied rocks, require attention and examination before they can be profitably followed. Influx of capital has to be influenced, which requires time. There is therefore nothing extraordinary in the fact of progress being slow, painfully slow, from the investor's point of view. An improvement, however, seems about to occur in the conditions surrounding the work. Capitalists are beginning to turn their attention to the district, a useful railway line now skirts it from N. to S.; the projected North Lyell Smelters are necessary for the success of the field. A few tracks have been made, but more are requisite. Investors will have to exercise patience. A great field like that of Jukes-Darwin cannot be developed in a day or a year, but it is encouraging to notice that there are already signs of a somewhat more marked success attending prospecting operations. Mt. Jukes Proprietary, Lake Jukes, and Prince Darwin are at present the most important centres in the quartz-felsite belt, and South Lyell and Darwin Proprietary in the siliceous schist zone. Looking at the circumstances quite soberly, I think my visit justifies me in saying that although no great metal deposit has been tapped as yet, the announcement of discoveries may at any time electrify the whole of the Jukes-Darwin range, and transform it into a mining centre of the first magnitude. The deposits will in all probability prove to be low grade propositions, but it is exactly such as these which modern mining enterprise most frequently turns to profitable account.

Mount Huxley.

On my return from Mount Darwin I proceeded to Lynchford, and visited the sections on Mount Huxley. This mountain is north of the King River and north of Mount Jukes, the river flowing between. It is another summit of the same chain, and its geology is similar, for the same quartz-felsite and chloritic and quartz schists continue to prevail. On the road from Lynchford, not a mile out of the township, is the old

King River Gold Mine.

Four men (Russell and party) were tributing when I passed. Several tunnels have been driven here, but only one is now open, the main tunnel. This has been put in by the side of a large reef or blow of quartz as wide as 10 feet, running with the country. The tunnel goes in at an angle, and comes back on the reef, which crosses the drive as a flat vein dipping N.W., and containing no gold. The tunnel is stated to be 400 or 500 feet long, but I could only get in 125 feet. At this point a crosscut N.E has been begun, and a rise was going up from crosscut. In 30 or 40 feet the rise is expected to strike the flat reef. Just behind the present end a small $\frac{3}{4}$-inch flat leader, black and quartzose, shows fine colours of reef gold in the dish, and here and there some flat ferruginous clinker lies on the footwall of the reef. The gold is associated with the clinker, but none is referred to the reef itself. The country rock is soft yellow clay, with black irony seams, and the clay is stated to be auriferous only where intersected by the ferruginous seams. This clay seems to be a decomposed portion of the green eruptive rock which prevails from here to Lynchford, and which microscopical examination shows to be an augite-syenite porphyry. Segregations of silica, much resembling pebbles, have been taken for foreign inclusions, and have led to an ascription of tuffaceous origin to the rock. It must be admitted that the appearance of the pseudo-pebbles is deceptive. North of the mine the rock is laminated, and forms a kind of green schist, but nearer Lynchford it is massive. At times it is bleached, or, rather, preserves an original pale tint, and acquires a dense compact texture. One is tempted to speculate on its having any connection with the felsitic rock of the range, or with the keratophyre belt of Mounts Read and Black. Its age is not definable at present, but, as it is schistose in one part, and is traversed by quartz reef, I do not think it can be later than Silurian. It occupies the area between Lynchford and Specimen Creeks, but its boundaries require tracing. Students of Geology might profitably take this work in hand. In the course of the work, its relation to the asbestos found 20 chains N.E. of the King battery, would be studied. Just south of the railway and Queen River, clayey-banded slate occurs in the face of the hill, but, going up the Lynchford Creek towards the mine, the green syenite-porphyry continues on both sides of the track to just S.E. of the mine, where it occupies the creek bed and the hills on both sides. To the naked eye it is usually granular, specked more or less with black porphyritic crystals of augite. Patches and blebs of segregated siliceous matter, often with sharply defined regular outlines, simulate pebbles.

In this mine we have an instance of a phenomenon frequently met with on the West Coast, a decomposed rock, constituting a formationwhich is dependent for its gold contents on the veins of quartz traversing it. On this hypothesis, the country itself in the immediate neighbourhood of the quartz stringers may be gold-bearing, but the gold has been derived from the veins, and not distributed promiscuously through the country as an original constituent. The ferruginous nature of the clay is probably due to the decomposition of the augite; but what really caused the extensive decomposition of the rock itself is not easy to surmise. The nature of the auriferous formation leads one to expect only a moderate yield from this mine. East of the mine the rock is replaced by slates and quartzites, afterwards sandstone and schist, until we ascend to.

Mt. Ellen Gold Mine.

There are 8 ten-acre gold sections here, charted in the name of J. B. Curran. On one of these is the old tunnel of the Mt. Huxley Mine. Mt. Ellen is really a spur of Mt. Owen, and not a part of Mt. Huxley at all. I found Mr. J. H. Havill living here, and he kindly showed me all there was to see.

What looks like the western boundary (though I am not sure as to this being the real limit in this direction) of the quartz-felsite, crosses Martin's Creek N.W. from Mt. Ellen. The felsitic rock and cupriferous chloritic schist form a belt over a mile wide. The old Huxley tunnel has been driven east over 100 feet in the felsite. For half the distance in, the felsitic rock has decomposed to a soft reddish clay seamed with flat quartz leaders and thin veins of iron ore. The laminations of the clay dip flat to the N.E. This soft material passes further in into massive cubically jointed hard felsite, though this softens again wherever the quartz appears. In the end of tunnel is a softish pink felsite. No gold has been found in the hard felsite: it seems restricted to the softer parts of the rock. The mouth of the old tunnel had fallen in, but had been cleared out by Mr. Havill, and a long approach of 70 feet hewn through the soft clay from 4 to 10 feet deep. The dish prospects obtained showed mossy gold and flakes, and some of the gold was attached to fragments of white quartz. The gold in this approach is apparently confined to the quartz and iron seams. The way to handle the stuff would be to take it down with the pick and send it along the approach for treatment at a lower level. A sample

I took from the cutting, when assayed by Mr. Ward, failed to show gold, but I had abundant opportunity of assuring myself that the formation does carry a little gold, though I should not like to commit myself to a definite estimate. In any case, the material would have to be very economically handled. To the east of this, at what is called the Eastern Point, the clay has been trenched through for a couple of hundred feet in length, and from this run, Mr. Havill, who is an energetic prospector, has washed a good deal of gold. In the soft iron-stained clay here are oxidised cubes of what was originally iron pyrite.

The tunnel above alluded to is near the top of a low hill, about 30 feet below the crown, and the ground would allow benches to be cut down to a depth of 100 feet below the present tunnel, making a total vertical height of 130 feet by 60 feet wide, and say 300 feet long, which could be worked without much difficulty. The visible soft ground is about 40 feet in depth.

The formation at Mt. Ellen is another illustration of auriferous deposits in decomposed rock; the gold is not alluvial, but *in sitû*. Prospects can be got from crushed clay in Martin's Creek to the N.W., below where the felsite crosses it, but not above; nor is gold found in Fraser's Creek, which comes into it from the E. Huxley gold, stated to be worth £3 15*s*. per oz., is known by its ragged form. The coarse water-worn gold from Nuggety Creek further north, where it joins the united stream of Martin's and Fraser's Creeks, is said to command £4 2*s*. 6*d*. per oz. We have here, evidently, an auriferous district, but the gold is sparingly distributed, and seems restricted to a few peculiar formations which may here and there contain concentrations fit for working where the circumstances are exceptionally favourable.

Mountain Maid.

Section 3956-93M, 80 acres, in the name of J. H. Havill. A trench has been cut E. and W. in siliceous schist (felsitic ?) for about 20 feet in length. The light grey schist is very flinty looking, sometimes talcose, and is impregnated with iron pyrites. It is said to be cupriferous. Its dip is S.W. About 140 feet lower down the hill a tunnel has been driven for 150 feet S.E.

to get below this outcrop. The adit is reddish dark and chocolate-coloured felsitic rock, carrying iron pyrites (and galena?). The country is hard and massive throughout. Near the approach an 18-inch seam of decomposed ferruginous felsite is stated to have assayed 9 dwts. gold. Care must be taken not to drive too far, for the flinty schist at surface may graduate downwards into felsite, and the continuation of the outcrop in depth may be passed without knowing it. There is nothing very definite or encouraging in the exposure at surface, and if no ore is found in the tunnel some more surface prospecting had better be undertaken before continuing expense underground. The position of the section is favourable for ore, as it is on the strike of the Mount Jukes belt.

Lady Havill.

Section 4064-93M., 80 acres, in the name of J. H. Havill. An outcrop in this section has been cut into to a depth of 10 or 11 feet in green chloritic schist impregnated with iron and a little copper pyrites. The idea is to test this by the level below and see whether it improves at that depth. Eighty feet lower down is a level being driven west of south into the hill, now 90 ft. in. The strike of the country is N. 20 deg. W., and the dip S.W. The schist is impregnated here and there with a little copper and iron pyrites. A little erubescite was visible. In this tunnel another 20 feet will intersect the downward extension of the outcrop. Behind the face a fair quantity of water is dripping through a band of harder rock.

On Havill's Section 4340-93M, 80 acres, I saw a few cuts in soft green talcose-looking schists with a little iron pyrites and hematite. I was told the formation contained copper, which is likely enough, but falling snow prevented thorough examination of these sections.

On another of Mr. Havill's sections, 4149-93M, 80 acres, further east, called the Red Blow Section, there is a bold outcrop of indurated ferruginous schist passing into hematite. This ought to be prospected. On a northern section (the Sunrise) 3713-93M, 39 acres, J. H. Havill, a little work has been done in pyritous rock, as shown by a small abandoned shaft, now full of water.

These sections on Mt. Huxley are in the cupriferous zone of Jukes and Darwin, and though they do not exhibit anything at present which may be described as encouraging, it must be remembered that a very insignificant amount of work has been done on them. Future work may give them an improved value.

Harris' Reward Gold Mine.

This is an abandoned mine, now about to be resumed, four miles from Lynchford, just south of the cage over the King River. A tunnel was driven on the course of a quartz reef for 60 feet, when it narrowed out, and 20 feet more driving failed to find any continuation of it. Further south a crosscut tunnel cut a little isolated quartz near the entrance, but 30 feet was driven without finding any more. Eight tons of quartz were taken from the surface, giving 15 ozs. gold. A shaft was sunk 40 feet for the reef, and a crosscut driven 10 feet, which cut a vein, stated to be 2 inches overhead and 5 inches underfoot. The water filling the shaft, work was discontinued. No pyrites appears in the quartz, but it contains a little galena, and the encasing sandstone (strike N. 20° W.) is chloritic. I saw a large boulder in the creek with good splashes of gold, and some stuff washed showed some light gold. The value of the gold here is said to be £3 17*s.* per oz. Nugent's shaft, at mouth of tunnel, is 35 feet deep, and went down on the reef, they say, 30 feet, but then lost it or went through it.

The quartz is said to be running with the country and dipping with it as well, which will explain its thinning out. The encasing sandstone is soft, and has been exposed to some disintegrating agency. No solid reef will be found here without sinking; and the probability is, as foreshadowed by its strike and dip, that it will be irregular and inconstant in width. I believe it is intended to sink a main shaft 100 feet and then open out, which is the best thing that could be done.

Oliphant's Asbestos Show.

Since my return some asbestos has been discovered about 20 chains north-east of the King River Mine battery. Samples which I have seen are good in respect of infusibility, but inferior in point of purity and strength of fibre. They seemed to have come from oxidised rock, and the iron impairs the quality. From the nature of the rock I judge this asbestos to be altogether different from the chrysotile at Beaconsfield and elsewhere in serpentine rock in the Colony. This appears to be in acid rock, probably the quartz-felsite of the coast range, and the fibre is true asbestos, viz., derived from hornblende. The texture of the quartz-felsite is microgranitic. The seams of fibre are not likely to be so wide as they are apt to be in serpentine. It is the only occurrence of hornblende-asbestos yet known in the Colony, and should be prospected. It will be remembered that the famous Italian asbestos is of this nature, being a fibrous form of hornblende, as distinguished from Canadian asbestos, which is chrysotile, or fibrous serpentine. Some of the Lynchford asbestos might be utilised for paint: if the quality improves at other exposures, it is possible that the fibre could be treated for boiler-covering, &c. The seams should be well examined and driven on for short distances, as the fibre is likely to be found in bunches and pockets and swollen parts of the seams. A great deal will depend upon the shrewdness of the prospectors in recognising indications to be followed up.

This kind of asbestos requires a rather more expensive treatment than the ordinary serpentine fibre. The lumps have to be broken by machinery gently, so as to disintegrate them without rupturing the fibres, and this, together with the pockety nature of the occurrences, makes the mining of hornblende asbestos more costly than that of chrysotile deposits, as a rule.

Coal at Farm Cove.

Some Tertiary coal having been found on the shore of Macquarie Harbour, boring has been started in the neighbourhood by the Farm Cove Prospecting Association. When I was there, the bore was down 15 feet, through 13 feet of sand and 2 feet of sandy clay. The pump was stopping them temporarily, being too small for sand.

Three-quarters of a mile to the W., and 40 or 50 feet above sea-level, is a short drive, 12 feet long, W. of N. on a seam of lignite 2 feet 6 inches, dipping 5° N.E. Above the seam is a foot of soft grey pug or clay, often containing resin: above this a 4-inch seam of coal, then pug again. On the shores of Macquarie Harbour below this drive, flat carbonaceous seams are visible, and in the layers of brown sandy clay specimens of fossil leaves may be collected, showing the reticulation characteristic of European genera, and stamping this series of beds as of Tertiary age.

Mr. David Bissett informed me of a shaft sunk on the N. shore of Farm Cove to 58 feet below highwater mark, in sand, silt, and soft brown shale. No coal seam has been passed through; only a little lignite occurs wherever there is a change in the sedimentation. The bottom of the shaft is now in sand and brackish water. The fossil leaves which were shown to me were obscure and not decisive, but the formation continues round Pillinger harbour to the North Lyell brickyards, and there can be no doubt of the Tertiary age of these beds.

The Government Analyst's assay of the Farm Cove coal is—

Fixed Carbon......	36·26 per cent.
Hydro-carbon......	39·14 ,,
Ash	12·60 ,,

Sometimes the coal shows a woody texture, and is then lignite pure and simple; but I saw some very lustrous, jet-like varieties, which would come under the head of pitch coal—the higher quality of brown coal.

Such coal will probably be found at intervals all along the shore of Macquarie Harbour; for the bedding is flat, and the same strata appear to be continuous; but no bituminous coal will be found unless the bores pierce through the Tertiary beds and strike the Permo-carboniferous coal measures below. From the country north of Strahan I think it possible that the coal measures skirt Macquarie Harbour and lie beneath the Tertiary and recent sands along its shore; consequently, the present boring venture may, if persevered in, have some chance of striking true coal.

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 MOUNT FARRELL DISTRICT.

Government Geologist's Office,
Launceston, 20th December, 1900.

SIR,

IN accordance with your instructions, I left Zeehan on the 7th June to examine the mineral country which is being opened up on the flanks of Mount Farrell, and now have the honour to report to you the results of my inspection.

The route which I took from the Pieman bridge, on the Emu Bay railway line, was the pack track which runs along the south side of the Pieman for five miles, and crosses the Murchison River by a suspension bridge half a mile above its junction with the Mackintosh. The township of Farrell, consisting of a good hotel, two or three stores, and a dozen cottages, is situate on the button-grass plain at the edge of the timbered west slope of Mount Farrell, about half a mile east of the Murchison River bridge. The population of the township and the surrounding district is about 100. A progress committee has been formed to press upon the Government the claims of the township and mines for tracks and improvements generally. Snow lies on the ground in winter, but the aspect is open, and the climate more genial than many West Coast districts, in every way favourable for the cultivation of grass and vegetables. The button-grass, no doubt, covers worthless soil, but the good fern soil of the mountain slopes, when cleared and tilled, ought to yield abundant crops. In this respect there are few mining fields on the West Coast more favoured than Mount Farrell.

Fine weather prevailed during the week I spent here, consequently, I did not see the Pieman track at its worst. I saw, however, that it would get into an impassable state after a little rain, and that it would not bear more traffic than was going over it, unless repaired and improved in places. I understand this has since been done, but at the time of my visit the transport of ore from the North Farrell mine was being impeded by its condition, 80 tons having accumulated at the mine. The North Farrell Company was having a horse-tram line surveyed five and a half miles to the Emu Bay line, but has since commenced the survey of a steam tramway, which will connect with the railway at the 21-mile, north of the Pieman bridge. I believe this will be about eight miles in length, and its construction will relieve that company considerably, for ore was being bagged at the rate of two or three hundred bags per week, and not more than half this quantity could be packed out weekly. The cost of packing to the Pieman bridge, viz., £2 5s. per ton, is an item which can only be borne by high-grade ore. The other companies carrying on work in the district will also be confronted by the same difficulty directly they begin to produce. Even if they connect with the North Farrell tramway, it is not certain that they would be able to arrange satisfactorily with that company for the transport of their output. If an arrangement of that sort could be made, it would perhaps be the best for all parties. The alternatives are for the Government to construct a tramway for the service of both mines and township, or to widen the present pack track and convert it into a road for wheeled traffic. Storekeepers and others residing on the township favour a macadamised road, as answering their requirements better than a tramline. On the other hand, ore transport can be effected more speedily and economically by means of a tramway. The construction of a road would not secure a sufficiently cheap carriage to satisfy mines producing ore of low grade, and as I understand the Emu Bay Company contemplates removing its Pieman station further up the line on account of the gradient, some other route would have to be found for a high road. If matters improve at the Farrell mines, the town will become more important, and sooner or later a cart road will be requisite.

A pack track has recently been formed from Farrell to the Murchison River cage, three miles to the south-east, and this will serve the mines on the Central Farrell, Murchison, North Murchison, and Osborne sections, and, if continued, would lead to mineral country still further east. This was only a footpath when I was there, but has been widened by the Government since to enable miners to get their supplies to the ground.

Innes's track goes north from the township along the western base of the mountain, supplying the North Farrell, Farrell-Mackintosh, Mackintosh, Metropolitan, and other sections. This track was being corduroyed at the time of my visit, as between the township and North Farrell Mine it was in a shocking state.

Mount Farrell is a north and south ridge, one of the summits of the West Coast range, rising to a height of about 1500 feet above sea-level, and 1000 feet above the plain at its western base. It occupies the angle formed by the Sophia and Mackintosh rivers, and was named by Mr. A. Montgomery after Mr. Farrell, the pioneer prospector of this district.

The Mackintosh and Murchison rivers west of the town are running between rocky walls of a metamorphosed grit, the kind of ancient sediment generally called greywacke. In some cases, in the bluffs overhanging the river west of the Mackintosh sections, carbonate of lime has been dissolved out of the rock, and re-precipitated in the form of stalactites and stalagmite. A few hundred feet further east the greywacke is succeeded by talcose slate or schist, which in its turn gives way to a belt of dark slate 200 feet and upwards in width, bounded on the east by schists, which are uncomformably overlaid by horizontally bedded conglomerate, forming the cap of the mountain. This conglomerate is the same as that which almost invariably caps the other summits of the West Coast range, and is of Devonian or Lower Carboniferous age. The slates and schists are presumably Silurian, and possibly Lower Silurian, for Mr. Monogomery noted blue limestone in the bed of the Mackintosh, a short distance above its junction with the Sophia River, charged with fossils of the Gordon River series. This limestone strikes N. 5° E., and dips E., which would make the mountain an anticlinal, as the normal dip of the strata on the west side of Mount Farrell is to the west. This anticline, however, is not what might be expected. The general strike of the slates and schists is a few degrees east of north, though locally, here and there, it may vary to west of north. At the south-eastern end of the mountain, following the Murchison River, the familiar quartz-felsite (quartz-porphyry) of Red Hills, Jukes, and Darwin, comes in, containing similar deposits of copper pyrites. The felsite here looks fresher, and is rather coarser, than on Darwin. Possibly its occurrences in this district may help better to the elucidation of its relations to the surrounding rocks than the exposures further south.

The zone of slate on the western slope is kindly promising country for silver-lead ore. This belt, interrupted occasionally by bands of greywacke, runs through the South Murchison, Murchison, North Murchison, Central Farrell, Mount Farrell, North Farrell, Mackintosh-Farrell, and Mackintosh sections. The galena lodes are, as a rule, veins and sheets of quartz in the partings of the slates, but now and then they do really cross these in the underlay. Thus their bearing is generally east of north. Pyrites and carbonate of iron are associates of the galena, and, at the southern end of the field, zinc blende and copper pyrites. During the last few days stannite has been detected by Mr. F. W. Petterd in the galena of the Central Farrell. This is a further demonstration of the connection of the ores on the West Coast with underlying granite. The Mount Farrell is the second district in the Colony from which this interesting mineral has been recorded. Some fahl ore has been isolated from galena in the North Farrell Mine, assaying 41ozs. silver per ton.

As may be expected from the way in which the ore makes in the partings of the slate, thinning out, disappearing and again thickening irregularly, the field is not traversed throughout its length by one or more master lodes filling defined and continuous fissures. The lode on the North Farrell section is the nearest approach to it. The lodes, as a rule, are *en echelon*, on parallel meridians, so that they cannot always be traced from one section into another. Moreover, there are walls beyond walls, parallel laminations of the slate enclosing ore outside the lode driven upon. This irregularity has caused disappointment in one or two of the mines, but the ore may make anywhere in the slate, and it is highly probable, in fact, almost certain, that each and all of the slate country sections possess galena deposits which would be disclosed by exploratory work.

North Mount Farrell Mine.

Sections 3262-93M, 76 acres, and 4116-93M, 68 acres, Josiah Innes, Manager. The workings are on the 76-acre section, half a mile north of the township, and the mine is at present the only one on the field which is shipping ore regularly.

The lode passes through the section with a mean bearing of N. 20° E., and its enclosing rock is slate. By trenching, the lode-channel has been shown to continue over a thousand feet through the property. For the most part the lode seems to be parallel with the slates, but in one instance, at least, I noticed that it crossed them at an angle of 10°. As a rule, I believe it to run with the bedding planes of the country, but whether it does so or not, does not matter so long as it is metalliferous. I found three levels driven on the lode.

No. 0 is an upper drive 70 feet on its course, going south. Just inside the entrance on the east side a 9-inch vein of galena goes off into the country. On the footwall is a good two-inch vein of metal, and good ore, also, on the hanging-wall, goes underfoot. The end of drive carries two feet of lode material with 4 inches of clean ore. The lode-channel here is filled with curly slate, and the footwall is better defined than the hanging-wall. The drive is certainly following the ore, but it may very well be leaving some behind on the hanging-wall side. Further back in the level the hanging-wall is much more to the west, and carries ore. When the drive is a little more advanced, a crosscut west ought to be put in to prove the width of the ore-channel. The end is now only 20 feet from surface, but where the lode has been trenched 430 feet south of this, 150 feet of backs can be obtained.

No. 1 is the tunnel below the preceding, and, at 70 feet in, cut the western wall of the lode formation. At this point there is a 7-inch seam of carbonate of iron and galena: on the footwall side is a dig of 4-inch pug, assaying 5 per cent. lead, 19½ ozs. silver, 10 dwts. gold.

The tunnel was continued through slate 40 feet further in. Behind the end is a vein of galena crossing the country, and this part of the tunnel is seamed and patched with carbonate of iron and silver-lead ore. Eighteen feet east of the footwall is another dig, the intervening country being lode-slate, with some galena and carbonate of iron, not reported as lode, although mineralised. I noticed that the slate all through the tunnel is traversed by small leaders of galena. North and south drives have been put in from the tunnel: the principal level is the south one. It had been driven 116 feet on a good lode. At 35 feet a rise was put up 51 feet, and the ground thus opened up has been stoped, yielding good ore. In the end of the level are ten inches of solid galena; the width of the lode here is 3 ft. 6 in. The country-rock east of the drive also shows good ore. Below the rise a winze connects with the level underneath. At 76 feet from the flat sheet a branch vein goes off a little south-east, carrying good galena seams, and forming passable concentrating stuff. This branch is really part and parcel of the lode, which may be described as 11 feet wide, containing small veins in all directions, after the manner of a stockwork. Since my visit, Mr. W. B. Cocker, the legal manager, tells me that at 119 feet in this level a crosscut has been driven 106 feet, intersecting first at 24 feet, a vein of galena, assaying 80 per cent. lead, and 110 ozs. silver, proving the lode formation to be 39 feet wide; and at 100 feet, intersecting No. 3 lode, which sampled 73 per cent. lead, 51 ozs. silver, and 70 per cent. lead, and 144 ozs. silver. At 135 feet in the level, a second rise has been put up recently (42 feet) to level No. 0, and passed through a good body of high-grade galena. A winze 34 feet south of flat sheet also passed through good ore 2 ft. 6 in. wide.

The north drive from this tunnel carried only a little ore for half a chain in length. The lode dies away or rather deteriorates towards the north end, where it is represented by seams of carbonate of iron and the dig. The drive had better be continued further north to come over where the lower tunnel intersects the lode.

In going up from this level to No. 0, some seams of galena are seen in the side of the track, which have not been cut in any of the tunnels. They pass down outside the entrance to where the concentrating stuff is being put.

A hundred feet below the preceding is the No. 2 tunnel, which has been driven east across slates dipping west. In the slates are laminæ and bunches of quartz. Before intersecting the lode at 238 feet, a few stringers of ore were cut in the last 30 feet. The underlay of the lode is about 1 in 6 to the W., and where it was cut the ore-vein was 7 inches wide. After cutting it, the tunnel was continued about 14 feet further through slate much seamed with quartz, and a little splashed with galena. These seams, in the end, are perhaps a couple of feet wide in the aggregate. The north drive on lode is 35 feet long. In this direction the lode thins out to two inches on the footwall. The lode-channel, however, is five feet wide with a dig on the hanging-wall, and is filled with lode-slate and flat veins of quartz, carrying fine pyrites. Water is flowing down footwall. Where the lode was cut, no wall was showing. The south drive was 130 feet in length, and some nice fine-grained galena showed underfoot, at its entrance. At first the lode runs with the country, and then seems to cross it. At 81 feet in this drive is a rise to No. 1 level, and Mr. Cocker informs me stopes are now opened out from the rise, both north and south. Along the drive there is a good deal of quartz on the footwall side, and the walls are not at all well defined. In the end the channel is six feet wide, and the dig still continues on the hanging-wall. No footwall noticeable. Four to six inches of solid fine-grained ore, and veins of ore 2 to 3 inches wide through the rest of the slate, with the usual seams of carbonate of iron. This end is improving rapidly. I am told that the ore has since widened out to 2 feet of firsts, and 3 feet of seconds. Behind the end I observed a vein of copper ore going out east as a spur, also spurs of galena running into the country. I think a crosscut is needed here to prove the country on the east side of the lode.

A 320-feet tunnel is to be started directly. I am indebted to Mr. Cocker for the following figures, which cover a period of ten months to the 31st October last.

The output has been 400 tons of galena (firsts) = 8113 bags, of which 5113 bags have been sold, realising £3271 14*s.* 8*d.* net at Pieman Bridge station, and

650 tons concentrating ore. The average price realised at Pieman station has been between £12 and £13 per ton.

The mining manager estimates that the ground between No. 2 level and surface is worth 2300 tons first-class ore, which, at £12 per ton, would be worth £28,000 ; and he further calculates that 10,000 tons of dressed ore (also worth £12 per ton) ought to be obtained from concentrating material contained in the same block of lode. The estimate may come out all right, as it has no doubt been made as carefully as possible, but it is more useful as giving some general idea than as a precise calculation of fixed quantities, which I consider cannot be made yet.

The company will have, in the near future, to consider the question of concentration. The present system of shipping firsts only, a necessity, perhaps, in the early stages of most mines, cannot be continued indefinitely without prejudicing the prospects of the mine, and eventually imperilling its existence. The prospects of this mine are so encouraging, and its success of such importance to the district as a whole, that it is to be hoped wise counsels will prevail. By the time the tramway is nearly ready, the drives will have been extended further, and the ground between the levels blocked out by rises and winzes, and then the construction of a small dressing mill must be taken into careful consideration.

The sale assays of North Farrell ore are given herewith :—

1899.		Weight.				Assay.			Prices.					Net Realisation at Pieman.		
						Silver.		Lead.	Lead.			Silver.				
		Tons.	cwt.	qrs.	lbs.	ozs.	dwts.	Per cent.	£	s.	d.	s.	d.	£	s.	d.
Oct. 16	60 Bags	3	5	0	3	55	1	54·4	15	15	0	2	$2\frac{13}{16}$	24	18	11
Dec. 25	430 „	20	19	0	14	70	10	63·4	17	1	3	2	$3\frac{3}{16}$	225	19	3
1900.																
Jan. 6	249 „	12	7	3	3	65	0	66	16	10	0	2	3	178	10	7
26	69 „	3	5	0	0	60	0	63	16	0	0	2	3	40	13	2
Mar. 7	795 „	39	12	2	25	71	0	62	16	10	0	2	$3\frac{7}{16}$	505	2	6
May 11	292 „	14	10	0	23	74	0	64	16	15	0	2	$3\frac{9}{16}$	196	18	5
June 27	790 „	38	4	3	16	54	0	51	17	7	6	2	4	359	1	3
Aug. 11	629 „	33	1	0	9	64	0	62	17	12	6	2	$4\frac{1}{16}$	419	5	4
	222 „	11	11	3	1	59	0	69						151	12	10
Sept. 27	360 „	19	1	3	6	73	0	73	17	15	0	2	$4\frac{1}{2}$	307	5	7
	458 „	24	1	3	21	67	0	62						321	4	4
Nov. 8	84 „	4	4	0	0	64	0	56						51	5	6
	116 „	5	14	2	24	66	0	67	17	10	0	2	$5\frac{1}{4}$	82	11	2
	559 „	29	6	1	0	65	0	61						387	5	10

From this it will be seen that the average ratio of silver to lead is 1 oz. to 1 per cent. The ratio of 1 or 1½oz. may be taken as the average for the field, notwithstanding special assays of some of the ore from Mount Farrell and Central Farrell mines have given a higher figure.

Mount Farrell Mine.

This property comprises three sections, 2410, 2409-93M, 80 acres each, and 3261-93M, 75 acres, Josiah Innes, manager. The sections are just above the township, and in a good position for adit driving. The mine was started last year on the discovery of a lode cut in some surface trenches, where small quantities of galena were found in oxidised slate.

A tunnel has been driven below this outcrop, and the first metal was cut at 105 feet in. Splashes of galena occurred all through the rock for 15 feet, running horizontally with a 3-inch seam of carbonate of iron. This seam looks as if it might be a continuation of the lode on the North Farrell. I shall return to this question later.

The first drive on the lode is 53 feet north and 13 feet south The north drive follows a splendid footwall, the best seen in the district, carrying a pug lode with it, and about 12 inches good galena at one place. This ought to be risen upon. After driving through this bunch, the lode contracts and the metal dies out. In the end of the drive there is pug on both walls, carrying a little disseminated galena. A south drive has been put in for 15 feet in slate along the footwall. The pug in the end carries a few specks of ore. The strike of the lode at the beginning of the drive north appears to be different from that of the slate, but afterwards becomes parallel. In the tunnel, 7 feet behind the intersection, there is a soft dig, but no metal, though there is a little galena in the slate all through.

At 182 feet a little ore was struck in the sole of the tunnel, and close to here a small boxful of ore was taken from a seam. This showed some fahl ore. At the time this was thought to be the hanging-wall of the lode, and for 15 feet eastwards the slate is more or less mineralised. At 197 feet a drive N. was put in 101 feet, and another one S. 15 feet. Good ore was met with in a bunch in the sole of the north drive. The quality left nothing to be desired. Samples assayed by Mr. Latta returned—

Lead, 51·6 per cent.;	silver,	208 ozs. 3 dwt.	per ton.
„ 71·2 „	„	98 ozs. 4 dwt.	„

and by Mr. Allom—

Lead, 73·8 per cent.; silver, 165 ozs. 9 dwts.; gold, a trace.

Unfortunately the drive went through it, and a 7-feet hole sunk on it proved it to be only a bunch. The end of the drive is in tight curly slate, showing a good deal of quartz, and a little way back some mineral is visible in the roof. At surface, 80 feet above the ore-bunch, I saw a soft dig in the trench corresponding with the lode-wall below. I should certainly say that the drive is on the track of the lode, in spite of the absence of vein-stuff. The clean wall which is carried through on the east side of drive continues without a break. At the surface this lode has been trenched to the north boundary, where it was 8 feet wide, with a little galena and some bands of carbonate of iron. The trenches seem to establish the continuity of the line as far as the north boundary, and some trenches on the North Farrell section show a prolongation of the same country, and it may be that the two lodes are identical, as they are claimed to be, though, on the ground, it looked to me as if the Farrell were east of the North Farrell lode. In this belt, where the deposition of ore has largely followed the lines of bedding, I do not attach much importance to the identification of one lode with another in adjoining sections. The channels will not be continuous, but will give out and re-appear on different parallels, and this necessitates a good deal of cross-cutting and driving in the way of exploration. The Mount Farrell Company has been unfortunate in not coming across a good run of ore, but need not despair, as such runs may be met with in any part of the section, and at any depth.

A lower tunnel was being started to intersect the lode 180 feet below the surface trench. This has since been driven for 92 feet, but a bed of hard quartzite or grey-wacke being encountered at 59 feet, and continuing, the adit was stopped, and another one begun 70 feet below the upper tunnel. It has now been driven 160 feet, and has passed through beds of talcose and graphitic slate, with carbonate of iron, galena, copper, and iron pyrites. It is expected to cut the lode in 330 feet, and then a drive of 80 feet north will bring it below No. 1 adit.

Ten chains from the S.W. corner of the same section (2409) is a large white quartz reef about 40 feet wide, which projects boldly some 30 feet from the surface. It carries a little iron pyrites, and the country should be cut into on each side to see whether any mineral is associated with the quartz. The metals most likely to occur in it are galena and copper. This reef might be intersected in depth by continuing the present tunnel between two and three hundred feet further; but there is hardly sufficient inducement for this in view of the reef being barren at surface. A shorter adit could be put into it at a much shallower depth, about 40 feet. The Farrell Company deserves credit for sticking to its mine after the initial disappointment might well have led to a despairing policy.

Mr. J. L. Foley, the legal manager, has kindly supplied me with the following list of assays of ore from this mine. The normal silver ratio is $1\frac{1}{4}$—$1\frac{1}{2}$ oz. to the unit of lead. The higher rates of silver are exceptional, and only show that some variability exists.

Date.	By Whom Made.	Description.	Silver.		Lead.	Copper.	Sample No.
1899.			oz.	dwt.	Per cent.	Per cent.	
May 18	Mr. G. J. Latta	Fahl ore and galena	41	3	44·7	2·8	...
„	„ „	Fine-grained galena	98	4	71·2	...	...
„	„ „	Coarse-grained galena ...	208	2	51·6	...	...
„	„ „	Pug	37	9	23·7	...	...
„ 30	„ „	Galena	88	18	42	...	...
						Gold.	
June 20	Mr. A. Allom	„	165	9	73·8	Trace	1
„ 27	Dapto Smelting Works...	„	158	0	71	1½ dwt.	1
Sept. 20	Mr. G. J. Latta	Fine-grained galena	99	12	63·4	...	...
„	„ „	Coarse-grained galena ...	78	15	67·8	...	...
„	„ „	Pug	69	12	37·2	...	2

Eleven bags of ore were picked from the material obtained in the course of sinking shaft to a depth of 62 feet about 1000 feet north of No. 1 adit, and about 500 feet from northern boundary. A drive N., was opened out from this shaft. At times this drive contained as much as from two to four feet of concentrated ore mixed with bunches of firsts. Short crosscuts were put in E. and W. from the drive through slate and schist country, with veinlets of galena and some pug. The Government Analyst's assay of the ore is 82 per cent. lead, 70 ozs. 11 dwts. 4 grs. silver.

Farrell Mackintosh.

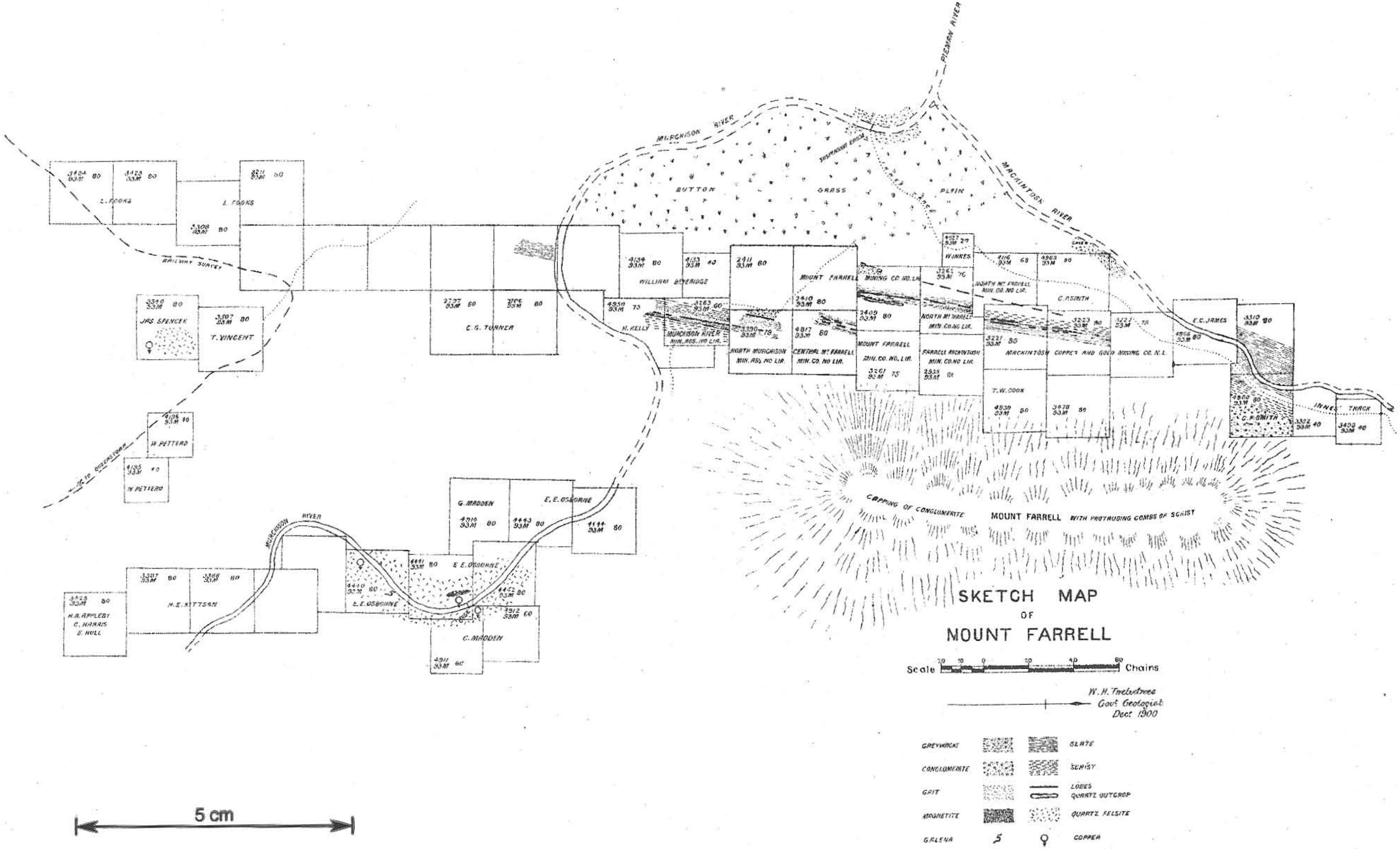
This is west of the North Farrell, Section 3262, and comprises 80 acres, 2935-93M, in the name of J. T. Smith. No work was going on here at the time of my visit, and I believe nothing has been observed beyond disseminations of galena, but if the galena lode of the adjoining Mackintosh property continues, it will come into this block from the north. Prospecting is necessary here.

Central Farrell Mine.

Section 4817-93M, 80 acres, north of and adjoining the North Murchison. T. A. Petrie, Manager.

The slate country is well developed in this section, and the lode, where trenched at surface, is of a highly encouraging nature. The lode channel in the trench is a band of broken slate, 5 feet wide, twisted with quartz and carbonate of iron, and carrying a vein of bright medium to fine-grained galena, 2 to 3 inches wide, lying on a good slate footwall. Lode and country slate dip W., and have an identical strike. Wherever lenticles and nests of quartz occur, I notice that the slates become twisted, evidently a local mechanical deformation. This lode has been supposed to be the same as the North Farrell lode, but this is manifestly impossible, it lying very much further east than that lode. The North Farrell lode is very violently treated, if it is twisted to correspond with all the lodes, which, on this field, are claimed to be its continuation.

Since my visit, Mr. E. Gaunt, the Legal Manager, informs me that the tunnel is now 220 feet in, and at 144


SKETCH MAP
OF
MOUNT FARRELL
Scale
Chains
W. H. Twelvetrees
Govt. Geologist
Dec. 1900
GREYWACKE
SLATE
CONGLOMERATE
SCHIST
GRIT
LODES
QUARTZ OUTCROP
MAGNETITE
QUARTZ FELSITE
GALENA
COPPER
PIEMAN RIVER
MURCHISON RIVER
MACKINTOSH RIVER
BUTTON GRASS PLAIN
RAILWAY SURVEY
INNES TRACK
CAPPING OF CONGLOMERATE
MOUNT FARRELL
WITH PROTRUDING COMBS OF SCHIST
L. FOOKS
JAS. SPENCER
T. VINCENT
C. G. TURNER
WILLIAM BEVERIDGE
H. KELLY
MURCHISON RIVER MIN. ASS. NO LIA.
NORTH MURCHISON MIN. ASS. NO LIA.
CENTRAL Mt. FARRELL MIN. CO. NO LIA.
MOUNT FARRELL MINING CO. NO. LIA.
MOUNT FARRELL MIN. CO. NO. LIA.
NORTH Mt. FARRELL MIN. CO. NO LIA.
FARRELL MACKINTOSH MIN. CO. NO LIA.
MACKINTOSH COPPER AND GOLD MINING CO. N. L.
WINKES
C. P. SMITH
E. C. JAMES
T. W. COOK
W. PETTERD
G. MADDEN
E. E. OSBORNE
C. MADDEN
H. E. KITTSON
H. A. APPLEBY
C. HARRIS
E. HULL
5 cm

feet a lode (No. 1) has been cut, and driven north upon for 148 feet. The main lode is supposed to be still ahead. According to information received from the company, the metal in the No. 1 lode assayed 407 ozs. silver, $64\frac{1}{2}$ per cent. lead. When first cut, the lode was 20 inches wide, but is now broken up into milling ore. There are 100 feet of backs over this tunnel, which will give additional 80 feet in another 100 feet of driving; and over 500 feet could be obtained, if necessary. The silver contents of the lode are very irregular. A small vein of galena, which was cut at 100 feet, and which seems to belong to the same lode, or is a parallel shoot, assayed 60 per cent. lead, and 90 ozs. silver. The samples reported from the surface outcrop above alluded to, assayed 339 ozs. silver, 79 per cent. lead; 266 ozs. silver, 67 per cent. lead. A piece taken by Mr. Jas. Harrison, Inspector of Mines, was assayed in Zeehan, and yielded 100 ozs. silver, 70 per cent. lead; and a sample selected by myself, and assayed by the Government Analyst, returned 184 ozs. 11 dwts. 8 grs. silver, and 70 per cent. lead. These contents are highly encouraging. The width of the lode may be expected to vary from time to time, as there seems to be a tendency for the ore to make in parallel bands, but a few bands of high-grade ore would make a payable lode. The Farrell mountain offers excellent facilities for tunnelling, and this sort of exploration, on an extensive scale, is commendable, for crosscut tunnels must cut the tracks of the numerous parallel lodes known to exist. They may also intersect lodes which remain unsuspected, concealed below a heavy overburden of soil and conglomerate detritus. The rounded pebbles in the detritus might lead to the idea that the superficial covering is a wash, but the stones are, in reality, those released from the conglomerate which caps the mountain.

North Murchison Mine.

Section 3390-93M, 79 acres, south of the Central Farrell, in the name of W. S. Southwell. Mr. Thornton, Manager.

Four men were employed here driving a tunnel east, across grit (greywacke) to intersect a galena lode at a depth of 70 to 80 feet. These backs will increase as the lode is driven upon N. and S. The tunnel was 55 feet in, and expected to cut the lode in another 80 feet. Eighty feet higher on the hillside the lode formation has been exposed, measuring 6 feet wide, and carrying pug on both walls, between which is lode-slate, seamed with carbonate of iron, and charged with disseminated galena and iron pyrites. I saw a 2-inch vein of galena in this slate. The lode-channel underlies W. with the country. The same lode is exposed in the creek a little further south East of the slate is a 9-feet band of grit, which is succeeded further E. by slate again. The long trench, extended up the hill, traverses slate all along its course, and has not intersected any fresh lodes. This trench was intended to pick up the main lode of the Murchison River, M.A., but has not been driven quite far enough for that purpose. The North Murchison lode, lower down, is evidently a parallel one. Some 400 feet further north, at contact of slate with greywacke, trenching shows country-rock impregnated with pyrite and a little galena.

Murchison River Mine.

Section 3263-93M, 60 acres, Maurice Callaghan, Manager.

This is about a mile from the township, south of and adjoining the North Murchison. A north and south lode runs through the centre of the section, bearing N. 5° E. In parts of its dip it is a contact lode, situate between slate on the east, and greywacke on the west. Where it has been cut into at surface, it is about 9 feet wide, with a good quartz outcrop, containing pyrite, arsenopyrite, galena, and blende, and forming a very kindly-looking gossan cap. At surface, a trench up the hill discloses the succession of strata, as follows from W. to E.:—(1) coarse hard quartz grit in the western part of the property, and up to the western wall of the lode; (2) lode; (3) green quartz schist (containing grains of quartz) for 60 feet; this carries a little galena; (4) slate for 100 feet; (5) schist up to the east boundary. This is green with chlorite, carrying disintegrated grains of quartz, pressed and elongated in the direction of the laminæ of the schist.

An upper adit has been driven for 294 feet, a little south of east, cutting the lode at 76 feet in, with 56 feet of backs; and a bottom adit for 270 feet, a hundred feet lower down. The backs increase going north. The top tunnel first goes 40 feet through decomposed, but somewhat hard, gossanous material, then into mottled quartz grit. At 76 feet from entrance, the hanging-wall of the lode was met with, dipping W., with the country strata at an angle of 70°. The first 16 feet of the lode consists of reef quartz, with galena and pyrites in veins, strings, and pockets. For another 6 feet the lode carries galena, and widens out to 9 feet in the sole. No footwall is noticeable; the lode formation fades away into the slate. Levels have been driven on the lode N. and S. The south drive is only 12 feet in; and the lode carries fair galena the full width of the drive, with a good deal of pyrites, and much carbonate of iron. The galena in the sole is very clean. It is a good strong lode, but the drive has not much backs, and consequently was stopped. The intention is to drive the lower level. The north drive is in 107 feet, with at first a mixed galena, blende, and pyrites lode, the full width of the level. There is some very solid cubical galena here. The slate wall is well seen on the east side of drive, veined with iron pyrites. After going north, however, for 70 feet, the country bends round a little, and we get slate on both sides of the level. The lode track is visible in the roof for a little distance, but is then lost. The slate in the end is clean, nice looking, with splashes of galena, and charged with iron pyrites. Pug and broken slate, about a foot wide, hug the footwall on the east. At 90 feet in this level a crosscut has been driven W. for 20 feet through slate, up to the contact with the quartz grit (greywacke), and full into the latter for about 3 feet. No galena, or sign of a lode, is seen at the contact. This crosscut has been a judicious piece of work. Opposite to it is a crosscut E. 20 feet through country slate, a good deal mineralised, charged with iron pyrites, carbonate of iron, and a little galena here and there. The lode is evidently not in this crosscut. Both of them are of great use, as they enable us to affirm with some confidence that the main drive is still on the track of the lode. At the surface, too, 160 feet north of this, there is a blow of gossan.

At 117 feet from entrance in the main tunnel, which still traverses slate, a lode slate formation 18 inches wide (at top) was cut, consisting of puggy, broken slate, with slugs of cubical galena, and copper pyrites. A drive south was put in on this for 25 feet, but the galena died out, and the end is now in clean slate, with a solitary slug of galena on the hanging wall.

At 225 feet from entrance the tunnel cut a one-inch vein of galena, and they drove 24 feet south on it. A quartz-veined lode slate formation, 16 inches wide, with disseminated galena, was carried by the drive, and some solid bunches were reported. This is in the slate country, but the end of the tunnel, 6 feet further, is in grey schist.

A lower tunnel has been driven 140 feet further N. than the upper tunnel, and 100 feet lower down. It begins in slate, which lies W. of the grit. At 96 feet a lode slate formation 8 or 9 feet wide was cut and driven upon N. for 10 feet, with a one-inch vein of carbonate of iron and galena on the hanging wall. On the footwall is puggy slate; the centre consists of slate, carrying iron pyrites. Twenty feet further, in the main adit, the slate country is succeeded by quartzite for 15 feet, and then the rock becomes slate again. This gives way to about 70 feet of quartz grit, replaced to the E. by slate. At 238 feet from the mouth a drive north has gone in upon a calculated line of lode expected to come under the end of the south drive in the level above where the good galena is showing. The drive follows a small seam of lime in the slate. At 280 feet the adit cuts through a small pug formation, with splashes of galena and seams of baryta in slate. The slate is twisted. The pug forms the footwall of a metamorphic slate formation 7 feet wide, containing large splashes of galena and blende. This might be worth while proving.

A few hundred tons of ore are stacked at surface. The firsts are good looking ; the seconds contain a good deal of zinc blende. Copper pyrites, too, is an ingredient.

Twenty men have been employed at this mine, but at the time of my visit the number had been reduced to three, engaged in sampling ore. All driving had been stopped till a bulk shipment of 20 tons had been made, and the results shown to justify re-starting on a larger scale. The assays are 60 and 70 oz. silver to 70 per cent.

lead. A sample which I took from the upper level was assayed by Mr. W. F. Ward, the Government Analyst, and returned 105 oz. 10 dwt. 6 grs. silver per ton, and 85 per cent. lead The track to the township is excessively soft and muddy, much cut up by horses. It has had some patching in extra bad places, but will need a good deal more before it is fit for traffic. In its present state it will take over 45*s*. per ton to pack the ore out to the Pieman, but since my visit I understand it has been repaired by the Government.

The mixture of metals in this mine forms a drawback, but the drives show that a good deal of these can be got clean and separately, and it is probable that in depth one or the other will predominate. The mine will be subject to the usual conditions of deposits on this field, but it is well worth serious prospecting. The ore deposit in the upper level requires proving in depth. The sooner work is resumed on this encouraging property the better.

South Murchison.

Section 4950-93M, 73 acres, in the name of H. Kelly, adjoins the Murchison River property on the south, and is in a good position for prospecting. Just before I left the district, they started to trench on a north and south lode near the northern boundary. The lodes from the north will, no doubt, traverse the section.

Mackintosh Mine.

Sections 3222-93M (79 acres), 3223, 3221-93M (80 acres each), north of and adjoining the North Farrell and Mackintosh-Farrell, Wm. Tresize, Manager. These three sections are in a north and south line on the rising ground between Innes' track and the mountain. On the southern section a main adit is being driven across black and grey twisted slates, with a view of cutting the North Farrell lode in about 300 feet of driving. It was in 34 feet when I was there. About six feet of overburden rests on the slates above the tunnel capping at entrance. Some canary copper ore was cut in a bunch at the approach. The level is estimated to have 90 feet backs when the lode is intersected, and these will increase going north and south. A surface trench, higher up the hill, ahead of the adit, discloses a little galena, with quartz, in the laminations of the slates, much broken here. This point will be reached after driving about 90 feet. The ore is disseminated rather than clean. A galena lode has been costeaned further up the slope, showing a black lode formation, 10 feet wide, of slate, pug, and quartz, with a little galena and copper. It carries a good deal of bunchy quartz. It is here a couple of hundred feet from the south boundary-line, and has been traced 32 chains north. This goes into the centre section, but has not yet been picked up in the northern block. As concentrating ore, it has been cut in a trench further north on the centre section, and some of the clean galena assayed 64 per cent. lead, and 72 ozs. silver per ton. A couple of feet of what may be described as poor concentrating ore are exposed in a cutting south of the trench, with an equal width of slate, impregnated with some galena. A little pile of nice dressing-ore is stacked outside. There are veins of mineral all up the creek. A tunnel would cut this lode in 200 feet of driving, with 65 feet backs, but work has been stopped here, and transferred to the southern section. There is some uncertainty as to the lode being the continuation of the North Farrell, but the opinion on the ground is that the two are identical. I had no time to verify this.

About 60 feet W. of this line is a copper lode, in a belt of grey talcose schist, which is about 200 feet wide, and bounded E. and W. by slate. This schist is the channel for the copper ore. The copper has not been traced beyond the centre section. This lode is about 30 chains W. of the Metropolitan line. The schist is said to go N., right through to Pearce's. It carries copper pyrites and sulphate, associated with quartz. Its bearing is about N. 5° E., and its dip W. A shaft has been sunk on the lode. At bottom of same the ground is poor, charged with carbonate of iron and splashes of copper ore. This shaft is on the footwall of the lode, which underlies 8 feet to the W. in the 40 feet sunk. A few fathoms further W., another quartz outcrop occurs in the creek, also with copper pyrites and sulphate. The same is cut further north, where it has been uncovered to a width of 14 feet, and consists of fissile quartz, showing a little copper pyrites. Further west is another band of quartz and iron pyrites, but with no copper visible. A specimen of the copper pyrites, assayed by the Government Analyst, returned 15·5 per cent. copper, with traces of gold and silver; and a sample from the galena lode assayed 65 per cent. lead, 39 ozs. 17 dwts. silver per ton.

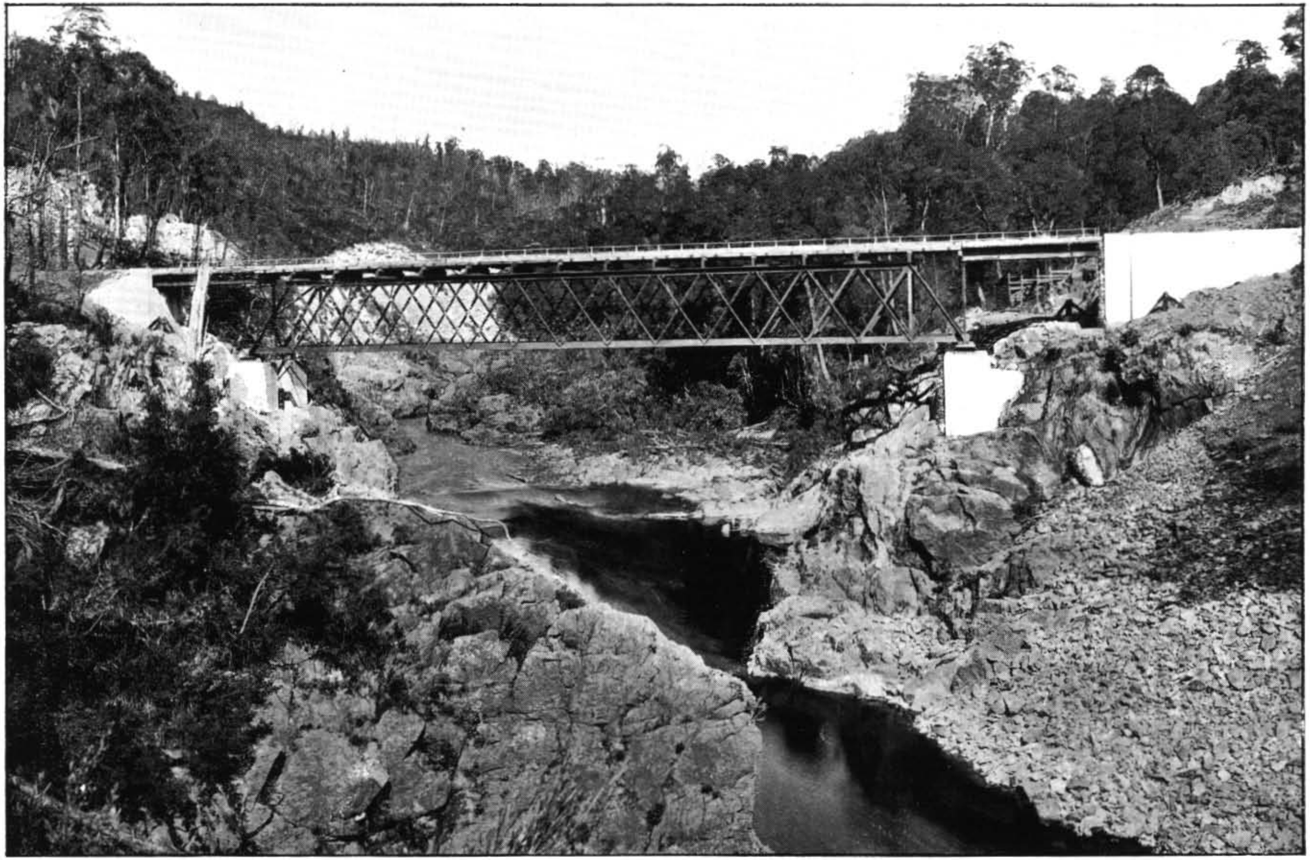
The proper course would be to drive a long tunnel to the shaft, intersecting the different lodes outcropping in this belt of schist. The tunnel would, however, have to be over 400 feet in length, and such a task is probably beyond the resources of the present owners. The nature of the ore is attractive—very clean copper pyrites, associated with quartz, and hardly any iron pyrites. The property needs development, and has fair chances of improving into something valuable. At present, it is being prospected by two men and the manager. Without the infusion of a little more vigour and capital, the undertaking is bound to remain stationary. The property occupies an important position in the northern part of this field, and deserves more serious attention than it has hitherto received.

Metropolitan.

Section 4860-93M, 80 acres, in the name of C. P. Smith. Work has been abandoned here. I found a tunnel driven E. 16° S., near the northern boundary, for about 30 feet, in a light-coloured talcose schist, right under the precipitous western face of the N. end of Mt. Farrell. Just behind the end the tunnel enters conglomerate. The conglomerate is silurian, and has no connection with the younger conglomerate capping of the mountain, of which huge boulders lie over the tunnel higher up the hill. The schist is sometimes silicified with white quartz, and contains a few splashes of copper and iron pyrites. I could see no sign of a lode. A few specks of galena have been found. This tunnel is on the east side of the Barn Bluff track. Westwards from the track, the usual kindly black slates begin, and run down, right across the river, for a width of 20 or 30 chains. These slates require prospecting. There is not much inducement to continue the tunnel. Better results would probably be attained by costeaning across the belt of slate, with a view of locating some of the lodes, which, in all likelihood, are enclosed in it. The slates here run N. 35° E.

Osborne Copper Blocks.

Sections on the Murchison River, 3 miles south-east from Farrell township, 4440-1-2-3-4, 80 acres each. The Melbourne syndicate, represented by Mr. J. P. Madden, is prospecting here. Geo. Harris, the prospector who discovered copper on the blocks in 1898, was at work at one of the shows near the cage over the Murchison, in Section 4442. The river here flows in a gorge between the Farrell and Murchison mountains. On the Farrell side of the river, north of the cage, there is a cupriferous formation of greenish slaty schists, which cross the river-bed, and contain splashes of copper and iron pyrites. On the Mount Murchison side, 100 feet above the river-bed, a short tunnel is being driven into the same country, besprinkled with copper and iron pyrites, under an outcrop of hematite and magnetite showing the same minerals. A sample of fair-looking copper ore, which I took from here, was assayed by the Government Analyst, and returned 1·8 per cent. copper, 1 oz. 9 dwts. 9 grs. silver per ton, 8 dwts. 4 grs. gold per ton; this result is distinctly promising. Work should be persevered with, and systematic sampling adhered to. 50 feet further up the hill to the W., a trench has been cut, disclosing dark chloritic schist, mineralised and associated with reddish quartz-porphyry, similar to that of the Red Hills. This is not the only place here where iron ore is exposed. I was told that outcrops of hematite are to be seen further north on the east slope of Farrell, and further south also, on the east side of Mount Murchison. I was shown some copper ore in chloritic quartz-porphyry from Section 3340-93M (James Spencer), about two miles to the S.W., from which it would appear that the zone is of at least that width. At the Murchison cage is a bluff of coarse reddish quartz-porphyry, descending to the river on its eastern side. Further south, nearly half a mile up the river, on Section 4441, is a galena lode running N.W., rather badly exposed at the water edge. It is in the red quartz-porphyry country, and, as no work had been done on it, and it was partly concealed by the river, I could not ascertain its width, but it seemed a foot or two wide. Arsenical pyrites and a little cubical galena were the minerals observed. The veinstone is quartz, and of an appearance which suggests that it may be gold-bearing.



PIEMAN RIVER BRIDGE, EMU BAY RAILWAY.

This lode should be opened upon higher up the Farrell slope.

On the southern lease, No. 4440, is Harris's copper show, on the eastern side of the Murchison river, in massive chloritic quartz-felsite of green and reddish colour, impregnated with iron and copper pyrites. This belt is the same as that in which the hematite occurrs near the cage further north. Very little work has been done in the way of exploration yet; but the country-rock and the associated minerals are those of the great copper-bearing belt extending southwards through Jukes and Darwin, and the possibilities are those of a large copper field. It is a couple of miles east of the Red Hill line, but the intervening country is of the same description, which makes this belt one of great width. There is only a footpath leading to Harris' show, and prospecting work is consequently attended with difficulties. The sections require systematic exploration, and will absorb any amount of outlay of that kind, as the copper ore is scattered over wide areas of the country-rock, and the localities where it is more or less concentrated have yet to be hunted up and opened out. As a copper field it is the counterpart of those which I have described further south on the same range. From the evidences presented to me at different times during my visit to the West Coast, and in spite of indications which at first sight are not altogether favourable, I have gradually formed the opinion that this copper zone is destined to be of the highest importance to the Colony; but time, capital, and careful attention to the geological relations of the rocks and ore deposits will be found necessary factors of successful work.

From the above, it will be seen that the mineral district of Mount Farrell is roughly susceptible of two divisions, a galena and a copper ore field. The galena deposits give it its immediate value, the copper a prospective one. The slates in which the galena lodes run are of a most favourable character, and the configuration of the ground is well adapted to easy and economical working. The width of the slate belt, as far as proved, is only two or three hundred feet, but there is reason to believe that bands of slate occur again a little further west, under the button-grass. The slate crosses the Murchison in a southerly direction, and its northern extension ought to be prospected. A good extension in either direction would greatly enhance the possibilities of the field. In the nature of things, the field being thus limited, it cannot attain the magnitude of Zeehan as a silver-lead producer, but the fact of a good lead district existing midway between Zeehan and Burnie is in itself important, and every new mineral centre is of distinct advantage to the Colony as a whole. Only one mine of any importance, so far, has been opened up; but I believe exploratory work on the other sections will probably result in equally good discoveries. The country is of a highly promising nature. The lodes do not appear to be in the form of a few main fissures, but occur rather as numerous fractures and infiltrations between the slates, and this fact makes it in the highest degree unlikely that the deposition of galena is confined to one spot.

As regards the copper ore in the quartz-porphyry area, it will take time to prospect the field and develop the exposures. Every reported success at Red Hills, Jukes, and Darwin, will re-act on this field, and stimulate work. If the mining on those mountains attains success, as it promises to do, the copper mining here will receive an impetus.

Kershaw's Blocks.

I left Mt. Farrell on the 13th June, and proceeded to the Pieman, crossing along the track north of the river. Greywacke and quartz-keratophyre are the rocks cut through by this track. I passed by the old Langdon P.A. Mine, the tunnel entrance of which was padlocked. The mine seems to be in keratophyre. Further W. is the Cutty Sark. There is no lode in this mine (C. Sark), but the iron and copper pyrites are disseminated through a dark-green, massive quartz-chloritic rock. The useful mineral is not abundant enough to be payable where the rock has been worked. Though the mine has been abandoned, it may yet be taken up again some day, if payable spots are discovered in it. I could not satisfy myself whether this rock had any connection with the quartz-keratophyre, or not: it is certainly in juxta-position. At the Pieman crossing the same rock is seen under the bridge; also on the north side of the river, where Mr.

Hodge has found some good copper pyrites. Immediately to the west of this exposure is quartz-keratophyre, well seen in the railway cutting south of the bridge. This appears to be on the strike of the soda-felsite, which occurs on Mt. Read.

A little north of the Pieman bridge I climbed up to Kershaw's blocks, four sections, 50 acres each, 3199, 3200, 3201, 3202, which occupy the top of a lofty hill, west of the railway, about 1400 feet above sea-level. The centre peg of the four sections is fairly on the top of the hill. About 150 feet below the crown of the hill a trench has been cut in somewhat calcareous schistose rock, impregnated with iron pyrites. Higher up a 7-feet cut shows this pyrite quite solid, and on the hill-crest a hole has disclosed the same dense pyrites in the same grey schist. On the S.W. section the same formation extends on the southern peak. The outcrop of this ore-body forms a crust of iron oxide. Fifty feet below the trench, a tunnel is being driven N.W. in the schist, which has been strongly mineralised the last 25 feet. The schist planes bear N. 20° W., and the dip is to the N.E. The ore-body may be described as a broad mass of calcareous schist and pyrite, with quartz and a little copper pyrite; it also contains a little galena. The present end of tunnel has about 60 feet backs, which would increase to 200 feet when under the crown of the hill, to be reached after driving further 200 feet.

It is an exceptionally solid body of pyritic ore, but I do not think the present works are anything like deep enough to settle the question whether copper pyrites makes in depth. At the same time, the present owners are not in a position to incur the outlay requisite for a conclusive test. The deposit is of a magnitude which cannot fail to command attention, but its economic value has to be proved. It has, doubtless, been formed metasomatically, and is, apparently, in the zone of the pyritic deposits of Mt. Read. There is no reason for not indulging in the hope that at some point or other the iron may give place to copper pyrites.

On this journey I was accompanied by Mr. James Harrison, Inspector of Mines for the Western Division, and I am also indebted to the mine managers on Mt. Farrell, Messrs. Innes, Maurice Callaghan, Tresize, Petrie, Thornton, etc., for assistance and information. Mr. Con. Madden, of *Mount Farrell Hotel*, and Mr. Hodge, of the *Pieman Hotel*, also took much trouble in guiding me to difficult spots. To all of these I wish to return my thanks.

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 BLYTHE RIVER IRON ORE DEPOSIT.

Government Geologist's Office,
Launceston, 30th January, 1901.

SIR,

I have the honour to report that, according to your instructions, I visited the Blythe River property, near Burnie, on the 15th June last, and again on the 9th and 10th of this month. There is a large deposit of hematite iron ore here, proposed to be worked by the Blythe River Iron Mines, Limited. In the interval between my two visits, the property had been inspected by Mr. John H. Darby, an iron expert from England, and the more particular object of my last visit was to see the result of the test tunnels, which he had recommended to be driven.

At about 6½ miles from the mouth of the Blythe River, the stream cuts through a huge outcrop of hematite iron ore, which runs N. 27° E., and S. 27° W. for an observed distance of over a mile. To the north of the river it extends 65 chains, traversing Quiggin's 78 and 73-acre sections, O'Keefe's 50-acre section, and Quiggin's 40 acres. South of the river it passes through Quiggin's 78 acres, Jones' 20 acres, the company's 12 acres into Atkinson's land. It is said to be traceable still further south. I noticed it strong and good at this end of the line.

It will be convenient to divide my remarks into :—1. The occurrence of the deposit. 2. The quality of the ore. 3. Its probable quantity. 4. Its extraction.

1. GEOLOGICAL AND PHYSICAL OCCURRENCE.

The outcrop runs up the hillside on either side in a series of huge crags. At about 21 chains north of the the river, and at the height of 600 feet above the stream, it passes below a sheet of basalt, which caps the hill. It emerges from below this cap about 26 chains further north. The outcrop is nearly perpendicular, dipping at a high angle to the S.E. It is conformable, both in strike and dip, with sedimentary rocks of the Cambro-Silurian system. Its strike is slightly sinuous, following the direction of the edges of the enclosing beds. These beds are fissile sandstones, with intercalated slates.

The upper crag on the north side appears to be east of the main line of outcrop, and is probably part of a paralled ore-bed, which has been trenched upon lower down, and crosses the river 40 or 50 feet east of the main outcrop.

I should not be surprised if this eastern outcrop is not the continuation of the line upon which the upper eastern siliceous crag is situate on the south side of the river, unless the latter line is a separate one still further east. At any, rate, there seems to be more than one deposit of ore, separated by intervening country. As we are dealing with a sedimentary deposit, and not a lode, the intervening country cannot properly be described as a horse.

The thickness of the bed, as shown by the width of the outcrop, varies in different parts, but it is greater on the south side of the river than on the north. At about 120 feet above the stream, at the base of the lowest crag, $4\frac{1}{2}$ chains S.W. of river, the ore-bed measures 147 feet across. The ore here is good hard hematite, but in the crag there is a considerable quantity of siliceous matter. At the top of the crag, $2\frac{1}{2}$ chains to the S. and 200 feet above the river, the ore has been exposed in a trench to a width of 4 chains. For half this distance there is good ore, the rest is seamy, and, towards the west, is more siliceous. Higher up is what is called "the purple crag," an immense projecting mass of solid ore. Here the ore measures 114 feet in width, as far as I could measure, but it evidently continues to the west, concealed below overburden, getting siliceous also in that direction. The crag itself is dense and crystalline, and the ore equal to the best on the property, This is 9 chains S.W. of river. The ore has a peculiar lumpy structure, the origin of which is rather doubtful, but I am inclined to think the most likely cause is that of meteoritic waters percolating through the ore, and dissolving away the softer parts, leaving the hard ore in lumps. This explanation is preferable to the supposition that shattering has taken place.

Greater widths have been ascribed to the outcrop of the ore-bed on this side of the river, but I think these must have included the interval of iron-stained country between the main outcrop and the paralled eastern line mentioned above. It is difficult to measure the exact width in the absence of more and deeper trenches, and I shall not be surprised if future work shows that my measurements can be extended considerably.

At 8½ chains N. of the river, and 280 feet above river level, is the central tunnel, a crosscut tunnel which has been driven right through the ore-bed 50 feet below its outcrop. The latter is stony to soft, and is rather a poor-looking part of the line, between two large crags of ore, which project from the surface of this side of the hill. The place for the tunnel has been badly chosen. The ground is too shallow, and if the crosscut had been begun further north, increased backs would have been obtained. To get these backs now, the north drive in the tunnel would have to be continued a couple of hundred feet, and crosscuts then put in to prove the ore. The ore deposit in this tunnel measures 54 feet across, and is bounded by sandstone strata on both sides. A drive N. has been put in along the W. side of the deposit for 34 feet, and was then stopped. The ore cut through in the tunnel is of inferior grade. Perhaps, 10 per cent. is good ore, the rest is earthy and siliceous. Going southwards from here the outcrop strengthens, and at a point on surface about 6 chains N. of the river it measures 81 feet wide.

As for the cap of basalt, the exact point where the iron disappears beneath its edge is concealed by the chocolate soil which has tended to fall down the slope; but, as far as I could see, the basalt rock comes in between 20 and 21 chains N. of the river, and continues northward, covering the ore outcrop for a distance of 26 chains, and attaining a maximum thickness above the ore of 120 feet thick. It is a Tertiary basalt, rich in olivine.

At 47 chains N. of the river, and 650 feet above river level, a few chains within the N. boundary of O'Keefe's 50 acres, is an old quarry, which has exposed hard iron ore of splendid grade.

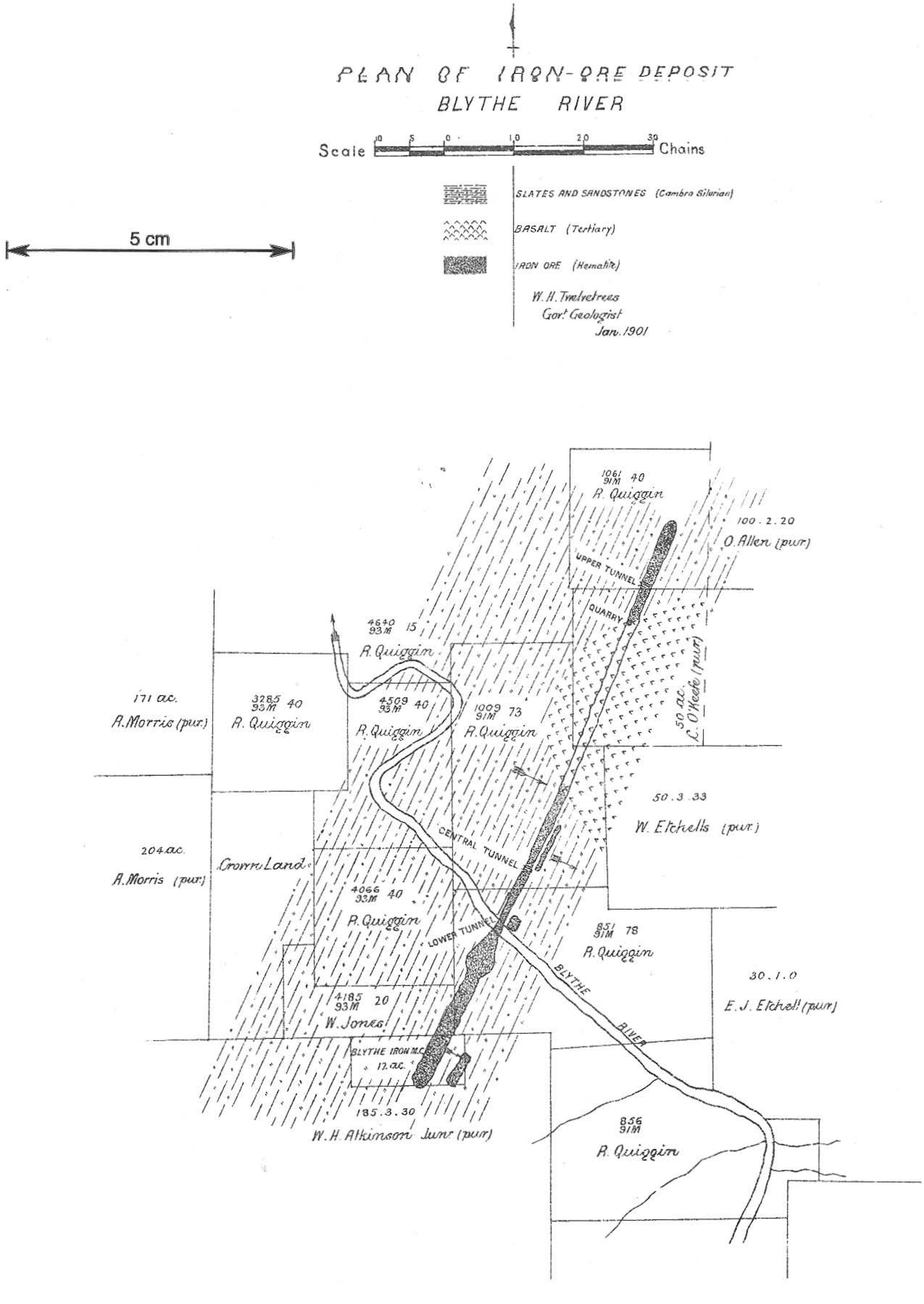
Six chains N. of this is the upper tunnel outcrop, a fine mass of dense hematite. Trenches have been put in on each side of this, defining the solid ore as 94 feet across.

A few chains further north, the outcrop has been trenched upon, showing good dense iron ore, associated with infiltrated silica. It measured here 108 feet across, and appeared to be bearing down the hill still further north.

Mr. Darby's Tunnels.—To test the behaviour of the ore-body in two important parts of its course, Mr. Darby recently recommended two tunnels to be driven, one near the bridge over the Blythe River, and the other 79 feet below one of the northern outcrops on Quiggin's 40 acres. These points are situate 53 chains from one another along the strike, and the vertical difference between the two is 650 feet. They are, consequently, fair tests of the continuity and uniformity of the ore.

At the face on the northern bank of the river, the ore-body is 30 feet wide, bounded on the E. by 40 feet of decomposed sandstone and slate country. Further E. is a jaspery ridge, and 80 feet of siliceous and brecciated iron ore. Much of the latter ore is earthy and stony, though some of it is of fair quality. This I take to be the eastern deposit.

Stacked at this face is a large pile of good hematite, free from visible silica. This ore has been broken from the outcrop. At this place, opposite to and N. of the bridge, a low adit tunnel has been driven into the hill. The result of the work has been to confirm the opinion which I expressed on my first visit, that this is not the oxidised capping of a lode, and, consequently, there is no reason to fear that it will make into sulphide in depth. The ore-body is holding down with undiminished strength and quality. The level has been driven 225 feet into the hill on the western or footwall side of the ore-deposit, which latter has been tapped at frequent intervals by crosscuts. The first crosscut E.


PLAN OF IRON-ORE DEPOSIT
BLYTHE RIVER
Scale 10 5 0 10 20 30 Chains
5 cm
SLATES AND SANDSTONES (Cambro Silurian)
BASALT (Tertiary)
IRON ORE (Hematite)
W. H. Twelvetrees
Govt. Geologist
Jan. 1901
1061 91M 40
R. Quiggin
100 . 2 . 20
O. Allen (pur.)
UPPER TUNNEL
QUARRY
4640 93M 15
R. Quiggin
171 ac.
A. Morris (pur.)
3285 93M 40
R. Quiggin
4509 93M 40
R. Quiggin
1009 91M 73
R. Quiggin
50 ac.
L. O'Keefe (pur.)
50 . 3 . 33
W. Etchells (pur.)
CENTRAL TUNNEL
204 ac.
A. Morris (pur.)
Crown Land
4066 93M 40
R. Quiggin
LOWER TUNNEL
851 91M 78
R. Quiggin
30 . 1 . 0
E. J. Etchell (pur.)
BLYTHE RIVER
4185 93M 20
W. Jones
BLYTHE IRON M.C.
12 ac.
185 . 3 . 30
W. H. Atkinson Junr. (pur.)
856 91M
R. Quiggin

was driven at 30 feet from mouth of tunnel for a distance of 12 feet, the last 6 feet of which are in dense solid ore, free from visible silica. The second crosscut, at 45 feet, was driven E. 6 feet to the ore, and then stopped. The third crosscut, at 66 feet, was driven E. 10 feet, 6 feet of which has been in ore of a somewhat jaspery nature. The fourth crosscut, at 77 feet, has been driven E. for 17 feet, all in ore, hard and solid, the best in the level. This ore is of splendid grade. The fifth crosscut, at 142 feet, has cut into good ore for 6 feet, though not quite so good as in the 77 feet crosscut. At 167 feet, the sixth crosscut has been driven E. 25 feet 6 inches in ore, some of which is good and solid, though rather patchy in places, and in the end of crosscut having a hackly fracture, which points to the development of silica. At 189 feet the ore has been cut into for a foot on the E. side of the level, and is of excellent grade, hard and solid. At 199 feet the ore has also been exposed by a cut into the side of level. Its grade is first-class, though it is slightly siliceous on the western wall. Just behind the end of tunnel, at 225 feet, the seventh crosscut was being driven E. wholly in ore (for 13 feet). The ore is good, pure-looking stuff, mostly lumpy, and with a short fracture. Some of it is rather fine, and would have to be cautiously mixed with the harder ores.

The crosscuts from this tunnel have disclosed good payable ore, though here and there not without siliceous matter. The assays of the samples which I took from the several crosscuts are given lower down. In no instance has a crosscut been driven right across the ore-body, and, therefore, absolute evidence as to the thickness of the ore at that depth is wanting, but I see no reason for questioning that the outcrop thickness is maintained down to the level of the bottom tunnel. At 6 chains north of river the outcrop measures 81 feet across. It contracts to 30 feet at the river. The vertical depth of the crosscut at 30 feet is 36 feet; at 45 feet, 42 feet; at 66 feet, 52 feet; at 77 feet, 57 feet; at 142 feet, 96 feet; at 167 feet, 111 feet; and at the 225-feet, 140 feet. The tunnel works show that the ore is unchanged at these depths, and I do not anticipate that any change takes place below river level. Moreover, any possible deterioration below this level is unimportant, as there is enough ore above river level to occupy the owners for a generation to come.

The second tunnel initiated by Mr. Darby is the upper one, near the northern end of the outcrop, 600 feet above the lower one. It is a crosscut tunnel, being driven E., cutting the ore-body at 79 feet from surface. It has been driven E. through country for 182 feet, and then 84 feet into the ore, which measures 94 feet across at surface. The ore in tunnel is good grade all through, barring a few siliceous and earthy patches. The country strata at the entrance dip W., then E., further in W. again, and are nearly vertical where the ore-bed comes down. Some softer ore is beginning to show at the face.

This tunnel, too, has shown that the promising surface outcrop is not a mere cap, but part of an ore-body, which descends with the enclosing strata. The results of both tunnels are highly satisfactory.

The Silurian or Cambro-Silurian series of strata, which enclose the ore-body, are of undetermined thickness. They have been folded, and the folding has taken place on a large scale. The iron ore was, in all probability, originally deposited as limonite, and may be expected to go down to a depth limited only by the fold of the strata. Although the ore bears a close physical resemblance to the celebrated Cumberland hematite, the geological occurrence differs, as the Cumberland ore fills cavities in carboniferous limestone, and the dissolved iron from superincumbent strata has probably been brought down and substituted for the limestone *in sitû*. The Cleveland iron ore is mostly carbonate in lias shales; and the Staffordshire ironstone belongs to the coal measures, so that the English sources of the metal offer no parallel. The Spanish hematites are largely associated with limestone, but there seems to be no sign of any limestone connected with the Blythe deposit. The explanation of the formation of the iron ores, which are so common in limestone, is that ferruginous carbonate ($Fe\,CO_3$) originally replaced a calcareous sediment, and was afterwards converted into iron oxide by surface water, which brought carbonic acid and oxygen.

As the laminations of the sedimentary beds may be interpreted to be parts of huge folds, it is natural to expect that all along this coast, as far as the same geological series extends, there will be exposures at various points of similar beds of iron ore. Perhaps few deposits of this magnitude may be found, but where the conditions of sedimentation were similar, and the sedimentation was contemporaneous, it is likely enough that other occurrences will be met with.

2. Quality of the Ore.

The Blythe deposit has long been recognised as ore of very superior quality. Mr. J. R. M. Robertson, in 1891, reported :—

"I know of no deposits of iron ore so pure, and, consequently, so admirably fitted for producing the highest and best brands of iron and steel."

Mr. W. F. Ward, Tasmanian Government Analysis, in 1894, reported :—

"This ore is of excellent quality, being practically free from all impurities, with the exception of the silica. It resembles the well-known Cumberland red hematite, so long used for the production of steel by the Bessemer process."

Mr. A. Montgomery, referring to Mr. Ward's analysis, reports :—

"According to this analysis, the Blythe River hematite is one of the finest and purest in the world, ranking with the famous Spanish, Algerian, and Cuban ores, which are now exported in very large quantities to the United Kingdom, United States, France, and Germany, for the manufacture of Bessemer steel."

Mr. Ward's analysis referred to above is as follows:—

Iron peroxide, Fe_2O_3 (=66·4 iron)	95·2 %
Silica	4·8 %
Phosphoric acid	traces

On my recent visit, I took samples from different points, so as to be sure that the deposit is fairly uniform, and does not carry deleterious ingredients at any of the horizons accessible. I believe, too, the samples are fairly representative of the bulk.

The only instance in which I think I may have included too high a proportion of siliceous matter is the stone from the upper tunnel. Siliceous ore is only met with locally in that adit, and has, I think, augmented the average silica contents unduly. The samples have been assayed by Mr. Ward, Government Analyst, with the following results :—

	Iron.	Silica.	Phosphorus.	Copper.	Sulphur.
From Mr. Darby's low tunnel—	%	%	%		
Crosscut at 66 feet ...	46·0	34·2	...	Nil	...
" 77 feet ...	65·0	7·0	...	Nil	...
" 142 feet ...	67·2	3·8	...	Nil	...
" 167 feet ...	68·1	2·4	...	Nil	...
" 199 feet ...	68·5	2·0	...	Nil	...
" 225 feet ...	68·7	1·6	0·04	Nil	Traces
From Mr. Darby's upper tunnel	59·8	14·4	...	...	...
Upper quarry	68·4	2·2	0·04	...	Traces
Central tunnel...............	56·7	18·8	...	...	...
Lower South Crag	61·5	12·0	...	...	...
Purple Cliff...................	68·6	1·8	0·09	...	Traces

The metallic contents are extremely satisfactory, the average iron percentage being 63·9 in the lower tunnel and 64·1 in the upper tunnel and quarry. The silica percentage of the ore in the lower tunnel is 8·5, and for the whole of such ore as would be selected for export, (including the inferior grade ore of the central tunnel), 9 per cent. The high proportion of silica in the samples from the upper tunnel has diminished the iron percentage, which from appearance I should judge to be equal to the average of the whole mine.

From these analyses it is apparent that the ore will suit the smelter. There is no carbonic acid to be expelled, no iron protoxide to be raised to peroxide, hardly any sulphur; consequently, no calcining is necessary. The ore is suited to the acid Bessemer process for steel making, being low in phosphorus and high in silica. The Bessemer process, it will be remembered, consists in blowing compressed air through moulten pig iron, and the air being thus brought into close contact with all the particles of the metal, rapidly causes the combustion and elimination of some of its impurities—carbon, silicon, and manganese. Phosphorous is one of the undesirable elements not eliminated, and, as 0·001 to 0·002 per cent. retained in the steel makes it brittle and cold-short, ores to be treated by the acid process should have as little phosphorus as possible. Copper, too, is not wanted. Only an infinitesimal proportion of phosphorus is removed during the conversion. The Cumberland hematite iron most suitable for the process should not contain more than 0·2 per cent. of phosphorus. Smelters, however, have grown more exacting of late years. In the United States, the presence of 0·01 per cent. phosphorus to 1 unit of iron used to be allowable, but now iron ores there are not accepted as Bessemer if they carry over 0·0075 of phosphorus to the unit of Fe. The phosphorus in the Blythe ore is in about the same proportion as in the Cumberland red hematites, which average 57 per cent. and 58 per cent. iron. The Bilbao ores average from 55 per cent. to 60 per cent. iron, and a few of the ores of the south of Spain go up to 65 per cent. The Lake Superior ores carry mostly about 60 per cent. metallic iron. Few of them contain more, and few are sold leaner, unless they command a sale owing to special qualities, such as manganese contents, freedom fron phosphorus, or fluxing properties.

I believe the shipments of the Blythe ore could easily be made to bulk over 60 per cent. iron. This ore, owing to its high per cent. of iron and its easy smelting qualities, will, without doubt, be acceptable to the smelter.

Sometimes, in a bed of iron ore, the phosphorus contents are far from uniform. The water-level often brings a change, or the marginal parts will merge into non-Bessemer ore. At the Blythe, the ore at the river-level and that at the upper quarry show no difference in phosphorus. The only increase shown is at the Purple Cliff, on the south side of the river, and I should recommend further samples to be taken from there, to see whether the variation is only accidental.

Quantity.

An estimate of the quantities available above river-level can only be made very approximately indeed. If I give figures, it must be understood that they are only intended to furnish a rough idea of the extent of the deposit. I have taken, as carefully as possible, the average width of the ore-body and height above river-level for separate lengths, and base my calculation of the tonnage on a mean specific gravity of 4·75, that being the average of determinations of lean and rich ore.

In order to be well within the mark, I have deducted 50 per cent. for waste rock, taking credit only for the remaining half. The resulting net weight is 17,291,000 tons marketable ore. This, I confidently believe to be an irreducible minimum. As I have taken only unquestionably defined widths of solid outcrop, I think it highly probable that a deduction of only 33 per cent. for waste rock could be safely made, and upon this basis the total tonnage of iron ore from surface down to the level of the river, and for a horizontal length of 5940 feet, would be about 23,000,000 tons.

Extraction.

The quantity and quality of the material being all that can be desired, the cost of extraction has to be considered. Fortunately, unusual facilities exist for breaking the ore. The open cut system can be everywhere followed, which saves timber, lighting and ventilation expenses, reduces surveillance costs, and is best adapted for large outputs. The working cost of quarrying this ore will be about 5*s*. cubic yard; the cost per ton should be within 3*s*. The transport by rail from the mine to Burnie cannot well exceed 1*s*. per ton, and can probably be effected for 9*d*. At any rate, I do not see why the ore could not be put on board ship at Burnie at 4*s*. per ton, which will leave a fair margin for delivery to a New South Wales port.

The daily quantity broken in iron mines depends always on the conditions of ore occurrence. Where much waste stuff has to be excavated, as in some parts of England, a miner does not raise more than $1\frac{1}{4}$ ton a day. But in some of the Lake Superior mines, with underground workings, ore is raised at the rate of 4 or 5 tons per day per man employed, while in others 2 to 4 tons per day per man are broken. At the Blythe Mine, with open works, 6 tons of stuff per man would be possible—3 tons of ore at about 2*s*. 8*d*. per ton—so that I think 3*s*. is a safe estimate; for the series of benches by which the outcrop can be attacked will enable the deposit to be worked very economically. Immense quantities can be brought down by blasting, and these will be easily reduced to suitable sizes by hammers, wedges, and picks.

The basaltic overburden lying on a portion of the deposit will not need to be removed for many years to come, unless it is found that exceptionally pure ore passes beneath the basalt capping. If the ore at the northern end of the outcrop is worked, a short horizontal tramway of a few chains will have to be made, and an inclined line or aerial tram will take that ore down to the river.

A line is being surveyed for a 3 feet 6 inches railway from the mine to the mouth of the Blythe River, about 6½ miles, where it will join the Government line to Burnie, other 5 miles.

There is good reason to believe that the company can undertake profitably the manufacture of steel from this ore by erecting smelting works in New South Wales. They are contracting with the New South Wales Government for the delivery of 100,000 tons steel rails during the next four years at British rates, *plus* freight and import charges. The smelting works will be in New South Wales, and the bulk of the ore will be from the Blythe, as this ore is exceptionally pure, and the New South Wales ore possesses impurities which exclude it from any other use than blending. A suggestion has been made to build works at Burnie for the reduction of part of these ores, bringing coke from New South Wales as back freight for the vessels which carry the ore away. These could only treat moderate quantities. If we look round the world, we shall find the largest iron-making centres are near the sources of fuel, and not near the mines, notwithstanding that the ore is the item which weighs the heaviest. At first sight, we might suppose, and many do urge this, that the works should be close to the mine, even if distant from the fuel, because the ore is heavier than the coke or wood. But it is forgotten that by the time the pig iron is converted into manufactured steel wares, the weight of the fuel has overtaken that of the ore smelted.

If works are erected at Burnie, a supply of limestone for fluxing will have to be sought. That at Gunn's Plains, near Ulverstone, seems to be the nearest deposit, but I cannot speak as to its quantity or purity.

Probably a little less than half a ton of 90 per cent. limestone would be required per ton of pig iron produced. If charcoal fuel were adopted, the consumption of limestone would be less. Charcoal fuel gives high-class pig on account of its freedom from sulphur and other detrimental substances, but owing to the enormous supply of timber required for its constant production, charcoal iron-making cannot result in a large permanent industry. Even if indulged in as a beginning, it could only be on a very small scale. The making of charcoal pig is everywhere diminishing, and is destined to decrease still further. Such iron makes high-class steel for tools, etc., but the first aim of the company should be the manufacture of steel rails, as these can be turned out easily in large quantities, and are not dependent upon minor industries.

I have said enough to show that the deposit is one of immense proportions. Much of it is very pure, and the quality is unsurpassed anywhere. If iron-smelting in New South Wales can be carried on profitably, there is every reason for believing that this mine can supply suitable ore in sufficient quantities. It is not difficult to work out the cost of mining and delivery to a close figure, and if the enterprise is judiciously planned and managed, I anticipate the inauguration of an industry fraught with benefit to all concerned. The iron and steel industry will eventually be in these States what it is in other countries of the civilised world. It must even finally overshadow the other products of our mines, if we are to attain solid and permanent commercial prosperity. I cannot refrain from expressing my conviction that these large iron ore deposits on our N.W. Coast are destined to lay the foundation of this industry.

West Lode.—I looked at an iron outcrop on the 40-acre section, No. 3285-93M, called the west lode. Some surface trenching has been done on it, showing it to have a north and south bearing. Hematite, ferro-manganese ore, and silicate of iron are the minerals of the outcrop. 41 feet below this, a tunnel has been driven west across the Silurian slates for about a chain. It has passed through an 11-foot lode of hematite, with a soft dig on each wall. It is reported as assaying $2\frac{1}{2}$ dwts. gold, 3 ozs. silver, and a trace of copper. 64 feet below this, an adit is being driven N.W. across black slate, dipping S.E. This hematite has different geological relations from those of the large deposit at the river, and partakes of the nature of a lode. I am afraid, however, that the lower tunnel is not deep enough to be below the zone of oxidation. At a greater depth there is likely to be copper sulphide ore.

I beg to return my thanks to Mr. Whitsitt (the Resident Secretary), Mr. Chaplin (the Manager), and to Mr. W. R. Bell, for information and assistance rendered during my examination.

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 MINERAL DISTRICTS OF BELL MOUNT, DOVE RIVER, FIVE-MILE RISE, MOUNT PELION AND BARN BLUFF.

Government Geologist's Office,
Launceston, 3rd April, 1901.

SIR,

ACTING on instructions received from Mr. W. H. Twelvetrees, Government Geologist, I left Launceston on the 18th February to examine and report upon the mining districts in the vicinity of (1) Bell Mount, (2) Dove River, (3) Five-Mile Rise, (4) Mount Pelion, and (5) Barn Bluff.

Throughout the journey I was treated with great kindness and hospitality by the various mine managers and others with whom I came in contact. I am also specially indebted to Messrs. A. Stephenson, John M'Namee, Rudolph Wachsmuth, and C. P. Smith, Mine Managers, and also to Messrs. Chas. Adams, E. Anderson, G. Renison Bell, J. Swallow, and H. Andrews, for much valuable information and assistance.

Mount Roland.

When passing through Sheffield, I took advantage of a spare afternoon to visit Mount Roland. This is a fine bold escarpment, about five miles south of Sheffield, and rising some 2500 feet above the surrounding country. The country around Sheffield is overlaid with Tertiary basalt, and this extends south to the foot of Mount Roland. My track passed up the centre of the northern end of the mountain. The surface is here largely covered with *débris* and conglomerate boulders fallen from the top of the mountain, but every now and then the bed rock is exposed *in situ*. It is composed of syenite, considerably decomposed at the surface. Unfortunately, I was unable to determine the extent of this mass, but it is evidently very considerable. Towards the west a little galena has been known to exist for a great many years, and eastward, at the Minnow River, there are also deposits of silver-lead ores. The syenite extends from the foot of the mountain up to the capping of conglomerate. The latter is the same conglomerate that caps so many of the mountains on the West Coast of Tasmania, and is believed to be of Devonian age, though there has been no evidence of a positive nature in support of this. On Mount Roland the conglomerate is dipping about 20° to 30° to the south, the strike being east and west. Hard red sandstones occur on the top of the mountain, interbedded with finer conglomerates, but at the bottom of the series there is a very thick bed of coarse conglomerate. The southern side of the mountain slopes gradually, and is less steep than the dip of the conglomerates. The mountain is deserving of a more careful examination, and might very possibly yield information concerning these old conglomerates, which would be of much value elsewhere. The same rock is seen two miles north of Sheffield on Badger Hill, and also to the west, on Mount Claude.

The Bell Mount Mining Field.

This field is situated on the divide between the Forth River and one of its western tributaries, the Wilmot River. Bell Mount itself is about seven miles south of the township of Wilmot, and the mining field lies to the south of this again. The total distance by road from Sheffield is 22 miles; of this the first eight, to the Lower Forth Bridge, is in good order, being metalled nearly all the way. The last mile or so passing down to the Forth Bridge was only formed, and not in good condition at the time of my visit, but men were at work putting it in order. From Forth Bridge to Wilmot the distance is three miles—sidecutting and formed—but only about 20 chains metalled. From Wilmot to Shepherd and Murphy, distance eleven miles, formed, and cuttings made twelve feet wide for a distance of four miles, and metalled, perhaps, a hundred chains. The metalling is not continuous, but only here and there, where formerly bad bog-holes existed. From here on to near Bell Mount the road has been only cleared, and the trees grubbed, the worst bogs being roughly corduroyed with slabs and round myrtle spars. Approaching and passing round Bell Mount, the road has been formed and cuttings made fifteen feet in width, and these continue right through to the Shepherd and Murphy Mine. The road was in a very passable condition at the time of my visit, as there had been a long spell of fine weather, but even then there were some nasty bog-holes to be negotiated. In winter the road must get in a very bad state, and would soon become practically impassable were there any quantity of traffic along it.

Plate 1 is a geological sketch map of the field. The sedimentary rocks of the district belong to the Silurian period, and where exposed consist, for the most part, of sandstones, containing "fucoid (kelp) stems" in abundance. This is the most characteristic fossil of the district, locally known as "pipestem," from its resemblance to the stem of a clay pipe. Other fossils are met with, but more rarely; a variety of rhynchonella occurs at Bell Mount diggings, also fenestella; and at the Five-Mile Rise Mr. O'Rourke presented me with a fine specimen of trilobite, from the same rock. These fossils are probably of Upper Silurian age. A collection has been sent to R. Etheridge, jun., Curator of the Australian Museum, Sydney, for determination, but I fear that none of the specimens which I was able to send were sufficiently perfect for exact determination. These same Fucoid sandstones occur southward as far as the Five-Mile Rise, and on the other side of the Forth they are met with on Mount Claude, and south as far as the Lemonthyme Hill. Conglomerates of the same age as the sandstone also occur, generally occupying the more elevated positions. Their superior hardness enables them to withstand the processes of denudation longer than the softer sandstones and slates. The prominent position of the conglomerates, and the presence of numerous boulders of the same rock lying along the slopes of the hills, gives one the impression, at first, that they are much more widespread than subsequent examination proves to be the case. Slates and limestones also occur, probably in greater abundance than the conglomerates, but they are not so easily seen, as they occupy the low-lying parts, and are frequently covered with vegetation or river wash.

To the south-east of the field an extensive belt of quartz porphyry occurs. This rock gradually passes into granite in an easterly direction, and is evidently caused by the marginal cooling of the granite mass. Granite and porphyry are two rocks of the same composition, and differ only in the way in which the mineral constituents have separated and crystallised out. Granite has cooled slowly, and all the mineral constituents of the rock have had ample time to fully crystallise; we find, therefore, no trace of glassy or felsitic matter present. Porphyry, on the other hand, has been cooled comparatively quickly; the quartz and a little of the feldspar have had time to separate themselves from the rest of the magma, but the bulk of the rock has solidified as a micro-crystalline or glassy mass, which latter has subsequently become devitrified. The great width of the porphyry on the surface at the western end of the belt may be explained by assuming that the present surface represents the top of the granite mass, and that the granite itself exists at no great depth from the surface. There is very strong evidence in favour of this view. At the south-east corner of Section 1333-91M, a patch of sandstone still remains overlying the porphyry, and on Section 1420-91M much of the latter contains numerous fragments of sandstone embedded in its mass; so much so, that the weathered surface may readily be mistaken for that of a conglomerate or breccia. This occurrence is at least 25 chains from the nearest sandstone on the present surface, and, therefore, the fragments are evidently derived from overlying sandstone, which has subsequently been removed by denudation. We have further evidence to show that the porphyry extends in a north-westerly direction at no great distance from the surface. The northern contact of the porphyry and sedimentary rocks is just below a long straight ridge of white conglomerate, underneath which the porphyry appears to be passing. On the Shepherd and Murphy Tin Mining Company's Section, 1437-91M, an extremely metamorphic garnet rock is met with, which almost certainly is the result of the metamorphism of limestone through contact with the porphyry.

Although the country about is well exposed, no porphyry has been found on the surface in the vicinity of this rock, and we are, therefore, compelled to assume that the metamorphism has been produced by an underlying mass of porphyry. As will be seen by reference to the geological map, much of the country is overlaid by the Tertiary basalt. This is an unfortunate circumstance from a mining point of view, as it renders prospecting very difficult. Some of the Shepherd and Murphy lodes have been traced under the basalt, and these will, no doubt, be followed. To the west of the basalt there is a large deposit of deep alluvial drift, containing both gold and tin in appreciable quantities. This is said to continue underneath the basalt, though I had no opportunity of verifying the statement. It is, however, very probable that deep leads do exist under the basalt, and their discovery might be of great importance to the prosperity of the field.

About a mile north-west of the Shepherd and Murphy mine, on Crown land, I found a dense green rock, containing a good deal of magnetite, which micro-examination proves to be largely composed of epidote and vesuvianite. This is a metamorphic rock, and is probably also due to the alteration of limestone. It occurs in the sandstone, and is worthy of more thorough examination. Its approximate position will be found on the geological sketch map.

On Bell Mount itself there occurs an extensive belt of schistose porphyrys, chlorite schists, and argillaceous schists. The porphyrys are of a totally different character to those occurring in the south-eastern portion of the field, which constitute the marginal portion of the granite mass. The former, I believe, are interbedded with the clay slates, and represent old rhyolitic lavas of the same age as the argillaceous schists with which they occur. Whether these belong to the same age as the fucoid sandstones (Upper Silurian) or to some older period, I was unable to determine. In any case they are older than the massive porphyry already described. The belt is striking about north-west and south-east. I found a similar schistose porphyry on the Narrawa Section. This may be the western edge of the schistose porphyry belt, but, unfortunately, time did not permit me to decide this point. The country is apparently favourable to the occurrence of ore deposits, but, with the possible exception of the Narrawa lode, so far, nothing has been found in it.

The Shepherd and Murphy Tin Mining Company, No Liability.

A. Stephenson, Mining Manager. This company holds Sections 1968-93M, 1437-91M, 1456-91M, 2326-93M, each of 80 acres, and 2134-91M, of 78 acres. Most of the mine workings are situated on the south-eastern portion of Section 1437, on the slope of the hill to the south of Bismuth Creek. As will be seen by the geological sketch map (Plate I.), a good deal of the country is covered with basalt, but on the greater part of Sections 1437, 2134, and 1968, as well as a small strip on the north of Section 1456, the Silurian sandstones and slates are exposed. Quartz-porphyry exists on the south-eastern angle of Section 2134, and, as has already been explained, there are strong reasons for believing that this extends through the other sections at no very great depth below the surface, though it is nowhere else exposed to view. About the centre of Section 1437, a lenticular mass of garnet rock occurs. In its normal state, this is a hard yellowish-brown rock of resinous lustre, composed principally of garnet, but also containing epidote, pyroxene, magnetite, and probably zoisite, though the latter is decomposed, and could not be identified with certainty. To the west, this rock becomes black and heavy, owing to the presence of much magnetite, and contains numerous veins of flesh-coloured feldspar running through it. The rock is not an uncommon one, being often met with among old sedimentary rocks and crystalline schists. Its presence is attributed to the metamorphism of limestone through contact with an eruptive rock. In this case there can be no doubt that the metamorphism is due to contact with porphyry. Limestone occurs in the bed of Bismuth Creek, about 30 chains north-west of the garnet rock, and, no doubt, were not the intervening country overlaid with basalt, this could be traced much nearer the garnet rock. Slate, a rock which invariably accompanies limestone in these sedimentary rocks, occurs in the creek just below the outcrop of garnet rock. There can, therefore, be no doubt as to its origin. The most northerly of the tin lodes known on the section has been driven on into the garnet rock, and, as far as can be judged by the work done, it appears to have a favourable influence on the mineral contents. Mr. W. F. Petterd has discovered the presence of bismuth sulphide in this rock; this may be regarded as a good indication. It is probably due to impregnation from the lode.

On the surface of the hill on which the lodes occur numerous large boulders have been found composed of a sandstone breccia or conglomerate, the parts being held together by a siliceous cement. These boulders contain coarse crystals of tin oxide and topaz distributed through them. They have been evidently derived from some deposit of old cemented wash, and very possibly come from a deep lead underneath the basalt on Section 1465. Near the edge of this basalt, at the north end of the section, a dish was washed from the sub-soil, which yielded a prospect of very similar tin oxide and topaz to that found in the boulders. If such a lead exists here, it could be found by carefully trenching along the edge of the basalt. The work may well be held in abeyance for the present, as the company will have its hands full for some time to come in exploiting its tin lodes; but the occurrence is worth bearing in mind, and should receive some attention as soon as the more pressing work is completed.

The mine has been very carefully described by Mr. J. Harcourt Smith, late Government Geologist in September, 1898, and as there has been very little exploratory work done since his visit, a detailed description of the workings will not be necessary in the present report. A short account, therefore, of the tin-bearing lodes and the principal work done thereon will be all that is attempted here. In all, seven parallel lodes are known to exist on the property. The strike is approximately east and west, and the dip vertical. The lode-matter consists of quartz with tin oxide in coarse crystals, wolframite, sulphide of bismuth, and, in the upper parts of the lodes, carbonate of bismuth; a little topaz and fluorite are also present. The lodes are small but have proved to be regular in their occurrence, both as to size and mineral contents. They have been numbered from south to north as follows; 1, 2 3, 4, 5A, 5 and 6, number 6 lode being

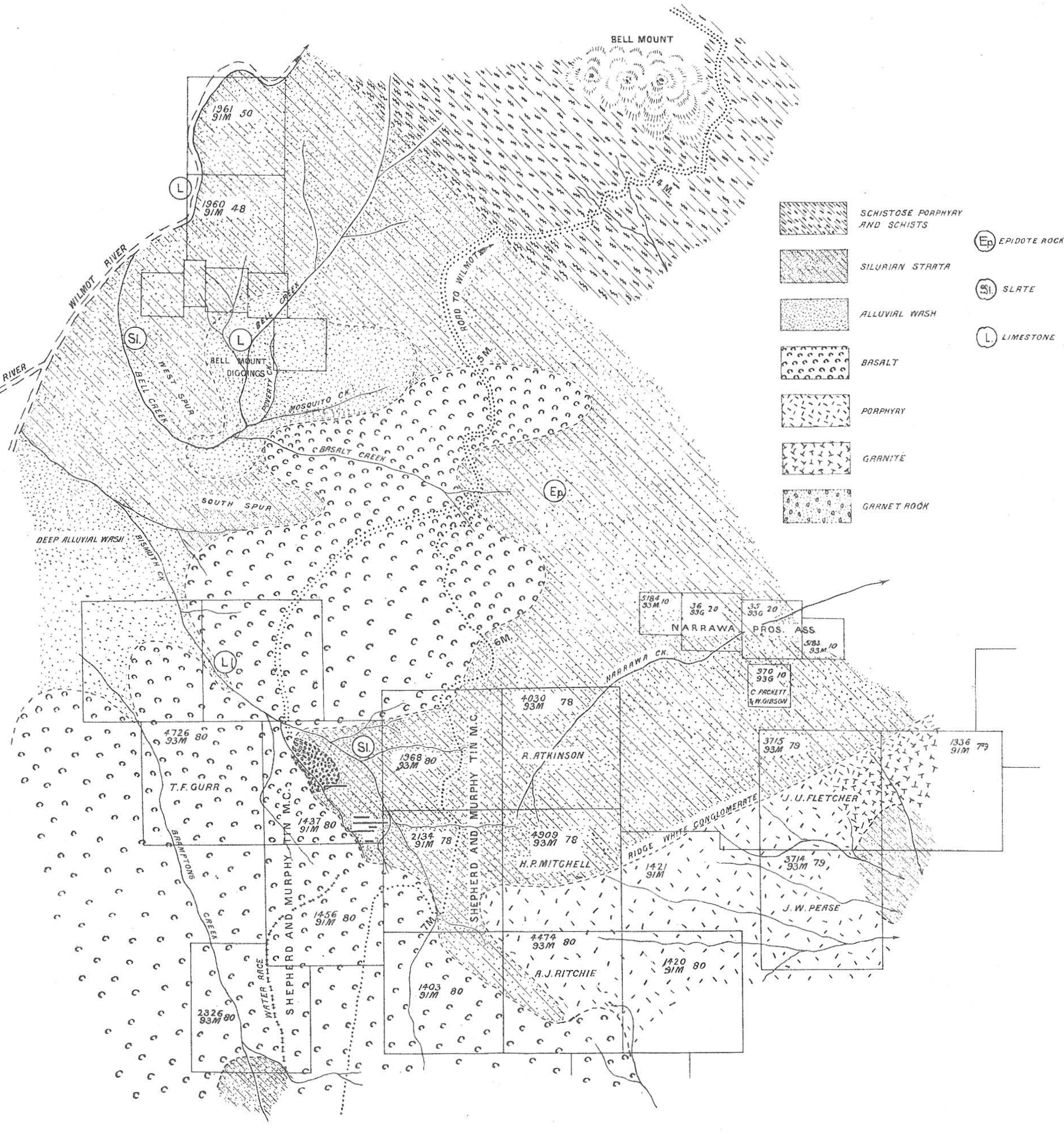
GEOLOGICAL SKETCH PLAN
OF
BELL MOUNT MINING DISTRICT

Scale 10 5 0 10 20 30 40 50 Chains

5 cm

PLATE I

G. A. Waller
Assistant Government Geologist



the furthest north. Between the outcrops of numbers 5 and 6, No. 1 adit has been driven nearly due south, cutting lodes Nos. 5 to 1 ; and 140 feet below this No. 2 adit, was put in, cutting No. 6 lode 50 feet from the entrance. A third tunnel is now being driven about 120 feet below No 2, with which it is intended to cut all the known lodes. This is to be used as a permanent working adit for the mine. At the time of my visit this tunnel had been driven 290 feet, and had still 80 feet to go in order to cut No. 6 lode, provided it preserves its course of east and west. On the surface however, the course appears to be altering a little to the north of west, and in that case the lode may be cut 30 or 40 feet sooner. The other lodes should, if they continue their present course, be cut by this tunnel at approximately the following distances :—No. 5 at 880 feet ; No. 5A, at 892 feet ; No. 4, at 967 feet ; No. 3, at 1060 feet ; No 2, at 1110 feet ; and No. 1, at 1200 feet.

In No. 1 adit, lodes Nos. 2 and 4 are the most promising. No. 2 is about 15 inches wide, and has been driven on for about 25 feet. A rise has been put up to the surface (86 feet), and is said to be in payable ore all the way. This lode is richer in bismuth than the others. A good bunch, from which 15 bags of bismuth sulphide were obtained, was cut in driving from the adit. No. 4 lode has been driven on a total distance of 115 feet, and varies in width from 18 inches to two feet. It carries a fair percentage of tin oxide throughout, as well as a good deal of wolframite, and some bismuth sulphide. No. 6 is also a very promising little lode. From No. 2 adit it has been driven on a total distance of 320 feet, and varies in width from 15 inches up to 2 feet. Towards the west it enters the garnet rock, and the tin appears to show an improvement, which is a most hopeful sign. No. 3 adit will intersect this lode some 620 feet west, and 110 feet below No. 2. The event is looked forward to with some anxiety, as it is of course quite possible that the adit may strike the lode in a poor spot. Should this be the case, there is no need for despondency. There are poor as well as rich patches in every lode, and at that distance the poor patch is as likely to be struck as the rich one. In either case the lode should be driven on both east and west in order to prove it as quickly as possible.

Since Mr. Harcourt Smith's visit to the mine the stamp battery and concentrating mill have been completed, and during the last winter 400 tons of stone were treated. The stone came from the various lodes in the following proportion :—

20 tons from No. 2 lode.
80 tons from No. 4 lode.
300 tons from No. 6 lode.

The parcel yielded 14 tons, or $3\frac{1}{2}$ per. cent of concentrates, as well as about $4\frac{1}{2}$ cwts. of hand-picked bismuth sulphide, but of the 400 tons put through, 90 tons had been previously hand-picked for bismuth, and in the course of mining a patch of bismuth ore was struck which alone yielded 15 bags of sulphide.

The concentrates are not pure tin ore, but contain also wolframite and bismuth sulphide, and are of too complex a nature to be treated at the local smelting works. The parcel has been shipped to Europe, where there are several buyers who profess to pay for all the valuable constituents of the ore. The success of the mine will no doubt largely depend upon the price obtainable for the concentrates; should this prove satisfactory, there is no reason why the mine should not become a very payable concern. It is true the lodes are small, but as far as they have been proved, are consistent, and this is a very important point in mining. The facilities for economically mining and handling the ore are excellent. No pumping or winding machinery will be required for some years, and I do not think the mine will ever be troubled with much water. No. 3 adit is being driven on the same level as the battery hopper, so that the ore can be delivered straight into the mill, without further handling. As soon as the mine has been opened up from this level, the aërial tramway which at present connects No. 1 and No. 2 adits with the mill may be dispensed with, and the sooner the better. It does not work well, and is a constant source of annoyance and delay.

The battery and concentrating mill is a nice compact little plant. The ore is dumped into a hopper, which delivers into a Blake crusher with 9″ by 16″ jaw opening, and crushes to about $1\frac{1}{2}$-inch cube. From the crusher the stone passes to a two-compartment conical trommel, which separates three classes: Class I., above 1 inch diameter; Class II., between 1 inch and ½ inch diameter; and Class III., below ½ inch diameter. Class I. passes directly on to the stamp battery. Classes II. and III. go to two two-compartment plunger jigs, the tailings from these being fed into the battery. The stamp battery is of 10 heads, 950 lbs. stamps, with a 7-inch drop. The battery screens contain 14 holes to the inch. The battery is fed by a pair of Challenge automatic ore feeders. The pulp from each battery of 5 heads passes through a series of two Rittinger Spitzlutten of excellent design, 18 inches in width, giving two sorts or classes of sands. These are treated on two pairs of jigs, the tailings from which go to waste. The overflow from the Spitzlutten passes on to a Spitzkasten, 12 feet long, 2 feet 6 inches wide at small end, and 5 feet wide at large end. This separates two sorts of slimes, which are treated on a couple of Frue Vanners.

The respective specific gravities of the minerals present in the ore as as follow:—

Wolframite (tungstate of iron and manganese) ...	7·2–7·5
Cassiterite (oxide of tin)	6·8–7·1
Bismutite (carbonate of bismuth).....................	6·86–6·9
Bismuthmite (sulphide of bismuth)	6·4–6·5
Iron pyrites	4·95–5·1
Topaz	3·4–3·6
Quartz..	2·65

It will be evident from the above, that it is impossible to separate the first four minerals in the list by mechanical means. The concentrates will, therefore, consist of a mixture of these minerals. The object to be aimed at is, of course, to obtain as pure a tin ore as possible, though the wolframite, and especially the bismuth, are well worth saving, but are much more valuable if they can be separated from the accompanying minerals. The only way in which this can be effected is by hand-picking. This should be practised not only in the mill but in the working places of the mine itself. When the mine has been more fully opened up it will probably be possible to do a good deal of sorting of the ore before it is brought into the battery. Thus it will probably be found that the tin ore, wolfram, and bismuth occur more or less in separate patches. If this is the case it would be a mistake to mix the ores in the battery hopper only to endeavour to separate them again mechanically.

Advantage should, as far as possible, be taken of the natural concentration, and the ore which is rich in wolfram should not be treated with that which is rich in tin. Bags should always be kept handy in the stopes for the reception of any bismuth ore which it may be possible to separate by hand.

The cleavage of minerals is a factor of the greatest importance in ore concentration. Tin oxide has, luckily, no cleavage, and, in consequence, it has very little tendency to form slime. Moreover, in the ore under consideration the tin occurs in coarse crystals, so that there is no necessity for fine crushing. Under these circumstances the loss of tin in concentration should be very small. Wolfram has a perfect cleavage, and, therefore has some tendency to slime. On this account it will be found that the concentrates from the vanners will contain more wolfram than the coarser product from the jigs. There will also be a greater loss of wolfram than tin Sulphide of bismuth, which, next to tin ore, is looked upon as the most valuable component of the ore, has a very perfect cleavage, and, in addition, is a very soft and brittle mineral. For this reason it will slime very much in the battery, and the loss in concentration will be great. The only remedy is careful handpicking. Fortunately, the high price of bismuth will enable handpicking to be carried out to a much greater extent than is the case with a less valuable ore.

The plant is driven by two Pelton wheels, one of which drives the battery, and the other the concentrating plant. Unfortunately, at the time of my visit, and for some time previous thereto, the battery had been at a standstill, owing to want of water. The water supply is at present taken from Brampton's Creek, which is sufficient during the winter months, but during the dry weather does not contain enough water to drive the mill. It is intended to bring in water from the Weaning Paddock Creek, where an ample supply can be obtained, and the survey of the race has been already made.

The Bell Mount Gold Diggings.

This is a small but fairly productive alluvial gold field, from which, during the past nine years some 5000 ounces, of gold have been won. It was originally discovered by

Malcolm Campbell in 1892, and during that and the following year quite a rush set in, upwards of eighty men being at work on the field. Since then the field has been in a semi-abandoned condition, though a few men have always been able to make a living, either by re-washing the ground passed over rapidly in the first instance, or by treating the wash on the terraces, a lot of which has proved to be well worth working. During the last few months the Bell Mount Hydraulic Gold Mining Company, Limited, has started operations, and is bringing in water from the Iris River by means of a race five miles in length. This company proposes to work the deposit on a large scale, taking out all the wash which proved too poor to be worked by hand.

The deposit of alluvial wash is situated directly south of A. J. Lyall's Blocks 1001 and 1002-97G, and will be found marked on the geological chart (Plate I) appended to this report. To the south and west of the field are two narrow spurs of hard sandstone separated by the steep and almost semi-circular gorge through which the Bell Creek flows. To the north the ground rises to the foot of Bell Mount, and to the east is an undulating plain covered for the most part by loose sandy drift, and gently rising till Hall's Track is reached, falls sharply away to the Forth River.

Several creeks flow through the deposit ; the largest of these, Bell Creek, flows through the western portion. To the east of this is Poverty Creek, and still further east, Mosquito Creek, while Basalt Creek flows through the southern end of the deposit. The Bell, Poverty, and Mosquito Creeks are separated by large mounds of wash up to 60 feet in height, and the wash extends at least as high as this up the slopes of the South and West Spurs, and also for a considerable distance in an easterly direction. It appears pretty evident that the wash originally extended across the gullies, and has since been sluiced away by the present creeks, the gold becoming concentrated in their beds.

The western portion of the field proved to be much the richest. In the Bell Creek both the wash and the gold are coarser than elsewhere, and on the terraces on the western spur the gold is mostly coarse, and occurs from the surface down ; indeed, the coarsest and best gold is found within two feet of the surface. In Poverty Creek both gold and wash are finer, and, as one would judge from its name, by no means so rich as in Bell Creek. Mosquito Creek has only been worked within the last couple of years; the gold is of the same nature as that found in Poverty Creek. Speaking generally, the greater part of the gold won has been coarse. The largest nugget found weighed 22 ounces, and was sold for £83. Several nuggets from 10 to 16 ounces, and many others of smaller weights, are recorded; the nuggets are described as being all of the same nature, flat in shape, with one side smooth and the other jagged. Most of the gold is augular, and contains a good deal of quartz, though some water-worn gold has been got from pot-holes. The wash is for the most part composed of angular fragments of sandstone with a little schistose porphyry and schist, the latter generally more or less waterworn. Boulders of conglomerate also occur, especially in the mound between Bell and Poverty Creeks, and on the slope of West Spur. Below the wash, there is often a false bottom consisting of black pug, and containing vegetable remains; this is evidently an old surface soil. It has been bottomed in several places, but no gold has been found underneath it. In Poverty Creek, the wash, which is very fine, has been sunk in for a depth of 35 feet without reaching bottom; it is said to contain fine gold all through. This would bring the bottom at this point below the present outlet of the Bell Creek. I think, however, that this depth is quite local, as in several other places close at hand the sandstone bottom has been reached at much shallower depths.

The source of the gold in the Bell Mount field is a question of considerable importance to prospectors in the district, and some discussion on the question will not be out of place in the present report. It has been suggested that the gold may have come from a deep lead under the basalt, but I think this is very unlikely, because, apart from Basalt Creek, the wash is quite free from particles of this rock. Moreover, the only basalt in the vicinity of the deposit lies at a lower level than the greater part of the payable wash. The angular character of both the wash and gold, and the presence of quartz in the gold, makes it more probable that the gold has been derived from reefs or veins in the country-rock, and in seeking these we must endeavour to find out from which direction the wash has come. The wash is bounded on the south and west by narrow spurs of sandstone too small to afford such a mass of alluvial as we have here, and making it impossible for the wash to have come from either of these directions. To the east the country is low-lying, and is largely covered by basalt. We are, therefore, compelled to assume that the wash has come from the north, and probably followed the general course of the Bell Creek. A somewhat hurried examination of the country went far to confirm this view. In several places along the creeks I noticed deposits of similar wash to that contained in the Bell Mount diggings. The country is composed almost entirely of sandstone, until far up near the source of the creek, where a belt of conglomerate occurs. Beyond this, porphyry and schist country is met with. All these rocks are found in the Bell Mount alluvial, the porphyry, schist, and conglomerate, however, being, as one might expect, greatly subordinate to the sandstone. I think, therefore, that the most probable source of the gold is to be found on the southern and south-western slopes of Bell Mount, more probably in the sandstone than in the schists. When discovered, the reefs or veins will probably be, like others known in the district, small, rich, and patchy, but considering the large amount of gold derived from their disintegration they are surely worth looking for, and when found should be worthy of systematic exploitation.

The Bell Mount Hydraulic Gold Mining Company, Limited.

Rudolph Wachsmuth, manager. This Company has been at work since August, last year, bringing in water from the Iris River with the object of treating the wash in the Bell Mount diggings by the process of hydraulic mining. The race, which is about five miles in length, is nearly completed for the first four miles, but the last mile, which passes through the most difficult country, has yet to be cut. There is still a nasty cliff to be negotiated, but, fortunately, the race comes for the most part just along the base of the cliff, leaving only a chain or so of high fluming, so that the difficulty is not insuperable. The sectional area of the race is $4\frac{1}{2}$ square feet, with a fall of $1\frac{1}{4}$ inches to the chain. This should be capable of delivering 150,000 gallons per hour on to the workings. The fluming is being constructed of greater sectional area and a greater fall than the race, so that the size of the race can be increased, if it is found to be necessary, without very great expense. The pressure-tank is 130 feet above the sluice-box, and considering the loose and sandy nature of the greater part of the wash, should prove to be sufficient. The get-away for the tailings is along the Bell Creek gorge, where there is a good fall for half a mile, until the latter joins the Wilmot River. At the top of the gorge there was a sandstone bar, which had to be shot away in order to enable the whole of the ground to be worked. Thus the first two conditions for successful working, namely, sufficient quantity and pressure of water, and sufficient get-away for the tailings, may be said to be fulfilled; the third and last condition, namely, the presence of a large quantity of gold-bearing wash, will, I think, also prove to be satisfactory. Along West Spur there is a large amount of wash, parts of which have been worked with very good results. The gold here is coarse and patchy, but when worked in bulk should yield a good return. At the north-western end of the field the ground was very difficult to work by hand, owing to the difficulty of draining it, but just here one of the best claims on the field was located. The richest ground has, of course, been worked out, but, owing to the difficulty of draining, it is probable that much good ground still remains. It is very likely that an elevator will have to be used to work this end of the field. The mound between the Bell and Poverty Creeks has never been much prospected It certainly contains some gold, but whether it will prove payable or not is a question which will be best proved by the nozzle. There is always a chance of striking a good lead in places like this. Further east, there is a large quantity of wash, which may also prove to be payable. Mosquito Creek, which has cut its way through this, has managed to collect enough gold in its bed to pay for sluicing, though whether the wash will be payable in bulk is not determined. On the whole there seems to be every prospect of the venture turning out a profitable one.

Section 1960-93M. *W. T. York.*

A little prospecting has been done on this section on some small veins of galena that occur on the side of the gorge to the east of the Iris river. The galena occurs in small veins and stringers running through the country. In one place I noticed a small bunch of mixed ore about 9 inches wide, but this is exceptional. Near the south-west angle of the section a short drive has been put in on the side of the hill, following a vein of galena about 2 inches in width. This, however, soon died away, though other small veins are still showing in the face. The country is not unfavourable for the occurrence of galena lodes, being composed of slates and limestones, but I hardly think it worth while to spend more money in tracing up these small stringers. It is not at all likely that a payable deposit would exist below the surface without giving some more decided evidence of its presence than we have here. The ground is worth further prospecting on the surface, but unless some stronger evidence of a defined formation is met with, it is quite useless to spend money in sinking or driving.

Section 2114-91M.

This section was floated last year under the name of the "Tasmanian United Wolfram Company Limited," with the object of working a run of alluvial ground which passes through the northern portion of the section. When the company was floated the price of wolfram stood at £70 per ton. Since then, it has fallen as low as £30, and at the present time it is worth about £50 per ton. The section, which is one of those formerly held by the Iris Tin Mining Company, is situated to the south-east of the Shepherd and Murphy mine, on a high flat saddle between the watersheds of the Forth and Wilmot rivers. The country is for the most part porphyry, much decomposed on the surface, with a strip of sandstone to the west. The southern portion of the section is overlaid with basalt. Mr. R. Dryden, who has been prospecting the section for the Company, has sunk a number of holes in the wash, and demonstrated that the run goes right through the section, the width varying from one chain up to seven. The metal-bearing wash is shallow, varying from a few inches up to a couple of feet. Mr. Dryden estimates the wash to contain an average of 9 ounces to the dish of mixed tin and wolfram. The deepest ground has been already worked by tributors under the old Iris Company. These workings are situated on the eastern portion of the run. The ground was worked principally for tin, the wolfram being picked out by hand. I understand that most of the latter has since been removed and sold. The rest of the ground was left, principally on account of the difficulty of getting water on to it. This is, I fear, a serious difficulty, on account of the highly elevated position of the section, and will have to be carefully gone into. Mr. Dryden thinks that water can be got from the Bull Plains Creek by means of a race five or six miles in length, but I am told that the Shepherd and Murphy Company failed to get water from this source into its pressure tank, which is 200 feet below the general level of this section. If this is the case, the Wolfram Company will probably encounter the same difficulties in bringing in water on to this ground. It is, however, probable that at least a winter supply can be got by damming small creeks in the vicinity. The whole of the section is covered with heavy timber, which will greatly increase the cost of mining. On the whole, I fear the Company will hardly find it profitable to work the ground themselves. If water can be got on the ground at reasonable cost, it would, probably, pay tributors to work it, and the Company would, besides obtaining a fair royalty, stand a good chance of tin-bearing lodes being discovered. The country is very favourable for tin lodes, the junction of the porphyry and sandstone occurring on the western portion of the section, and it is probably from lodes occurring in this vicinity that the tin and wolfram which is found in the wash has been derived.

The Dove River District.

Leaving the Shepherd and Murphy camp on March 1st, I proceeded to the Devon Mine, where I was most hospitably entertained by Mr. John M'Namee, the mining manager. The first few miles of the track from the Shepherd and Murphy mine is in an extremely bad condition. For some distance after leaving the mine the old track has been abandoned as impassable, owing to fallen timber, and the present one has been merely beaten out of the bush by the mailman's horses, no attempt having been made to cut it out. When the old track is reached it is not in a very much better condition, and frequent detours have to be made into the bush in order to avoid fallen timber. In one place there is a very bad bog-hole, half concealed by floating cords, which is most dangerous to cross on horseback. Considering that the mail and all the supplies for the prospectors and others at the Dove River and the Five-Mile Rise pass along this track, something should be done at once to make it more fit for traffic. If left in its present state it will become quite impassable next winter.

Leaving the old V.D.L. track about half-way down the Five-Mile Rise, the track to the Devon Mine takes a south-westerly course into the Dove River. It was, at the time of my visit, in good order, but would no doubt be very muddy in wet weather. The last mile is very steep, falling an average of 1 in 4 for 70 chains, and in places it must be much steeper than this. When we consider that all the ore from the Devon Mine has to be packed up this track, some idea can be formed of the difficulties with which this pioneer mine has had to contend. The country passed through for the first half-mile after leaving the old V.D.L. track is the same fucoid sandstone already met with at Bell Mount. After this the country is overlaid with basalt for perhaps another mile, and then granite is entered, which continues down to the Dove River, a distance of about another mile and a half. The Dove River is a tributary on the west side of the Forth. It is a fine stream of water flowing through a very steep gorge, at least 1200 feet in depth. The precipitous nature of the country makes a thorough geological examination a lengthy and arduous undertaking, but a general idea of the geological features can be obtained by examining the rocks which outcrop in the bed or on the banks of the river. I followed the latter down for about a mile below the Devon Mine, and went up stream as far as the Sirdar

Prospecting Association's Section, a distance of about five and a half miles, returning over a steep spur, around the northern end of which the Dove River winds. The course of the river is most tortuous, a remarkable feature considering the depth and precipitous nature of the gorge through which it flows. At the Devon Mine a massive belt of granite crosses the country roughly in an east and westerly direction, and from this granite and porphyry dykes break out into the country in many places. The porphyry is often seen to be the margin of the granite, but it also occurs in separate dykes. North of the granite the country is composed chiefly of hard quartzites, probably of the same age as the fucoid sandstones of Bell Mount and the Five-Mile Rise districts, but hardened and altered through contact with the granite. To the south of the granite belt we have finely laminated crystalline mica schists or gneisses of the uniform character characteristic of Archæan rocks. These are met with in the Dove River below (south of) the Devon Mine, and also about four miles higher up stream, about due west from this point. Among these schists I found a fine-grained massive rock, which is probably an old diorite, or some allied rock. This occurs in the Dove River, about half a mile to the south of the Devon Mine.

The Devon Mine.

John McNamee, Mining Manager. This company holds Sections 1831-93M and 1021-93M, each of 40 acres. The contact of the porphyry and the quartzite is seen in the Dove River, a little north of the centre of Section 1831. The porphyry is a marginal portion of the granite, and in it, on the western bank of the river, the Devon silver lode occurs. The course of this lode is a little east of north, whereas that of the river at this point is due north and south; consequently, towards the north the amount of backs decrease, and towards the south they increase. The dip is about 80° to the east. The lode has been opened up by means of an adit, put in about 25 feet above the river. It was cut at 50 feet from the entrance, and the adit continued for another 30 feet with the object of cutting any parallel lodes, but so far, without success. A small parallel vein was, however, cut in the mouth of the adit, carrying three inches of galena. This was dipping to the west, and evidently junctions with the other lode at no great depth. From the adit the lode has been driven on north for a distance of 154 feet, and south for a distance of 83 feet. Both north and south shoots of metal were met with, and these have now been nearly stoped out over the drive. The width of the lode-channel is from two to three feet, and is filled with galena, country-rock, and a little quartz. The upper portion of the lode is much oxidised, and contains a good deal of carbonate of lead. The gossan is of fair quality, but not sufficiently rich to pay for the very high cost of packing to Sheffield, in addition to other freight and smelting charges. The galena is of excellent quality, and occurs in bands, the width varying from a few inches up to over two feet. The Manager informs me that good metal is showing in the floor of the drive for nearly the whole distance driven, and he estimates the average width of galena at 15 inches, though in places it goes up to over two feet. About 100 feet north of No. 1 adit a second is being put in just above the flood-level of the river, with the object of working out this metal. Unfortunately, it will be only about 18 feet below the first adit, but as the distance to be driven is only about 30 feet, this appears to be the best thing to be done under the circumstances. The northern end of the drive, which was not very far from the surface, was principally in oxidised ore, but at the lower level it is probable that the galena will continue further north. The mine has been more than paying its way for some time, but it is very much to be regretted that absolutely no prospecting or development work is being attempted. No. 1 adit should certainly be continued for another 150 feet or so, with the object of finding other parallel lodes, and the drive should be continued south with the object of discovering other shoots of metal, of which there are encouraging indications on the surface. The problem of sinking, too, is one which the company will be forced to face before very long. Pumping machinery will have to be erected, but I am not of opinion that very large quantities of water will have to be dealt with, provided that adequate means are adopted to prevent the surface-water from draining into the mine. There is, of course, a risk of the river giving trouble, but I hardly think that likely. Ample water-power for driving the machinery exists in the Dove River, but that is a question that will have to be very carefully gone into. The sides of the gorge are so steep that the race would have to be flumed through a large part of its course.

The mine has been sending out regular shipments of ore since May, 1899. In all, 172 tons have been shipped, realising the sum of £2153 11*s.* 11*d.*, excluding cost of packing, &c. The average assay value of the ore has been as follows:—Gold, 5 dwts. 4 grs. per ton; silver, 85 ozs. 10 dwts. per ton; lead, 55·9 per cent. This gives an average of 2 grains of gold and 1·53 ounces of silver per unit of lead. The galena is therefore of high grade. The gold contents are exceptional for Tasmanian galenas.

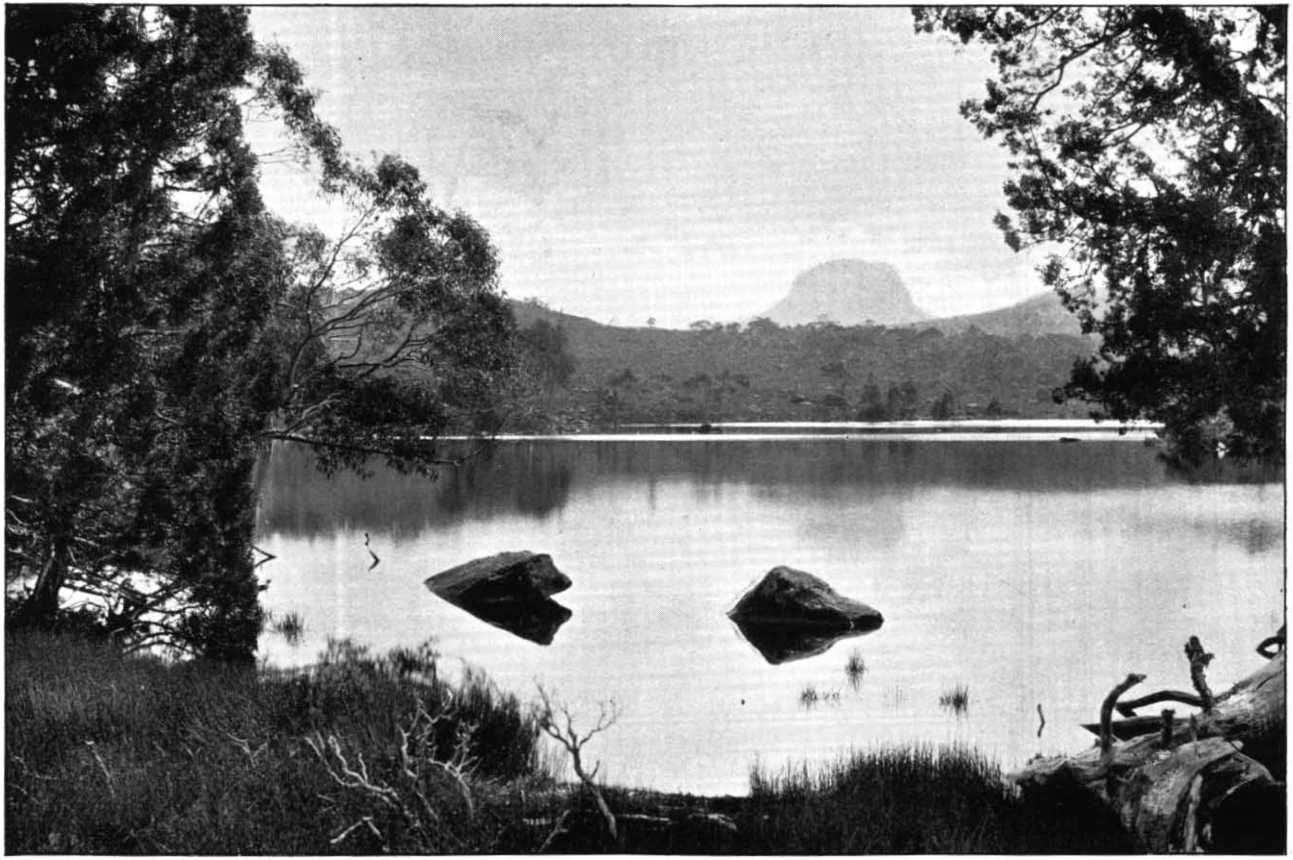
There is a large heap of seconds at the mouth of the tunnel. It consists principally of gossan and country rock, and some of it contains a good deal of carbonate of lead. This ore could not be concentrated mechanically, but might pay to handpick as soon as the means of getting the ore to market are more favourable. Galena seconds have been mixed with the gossan; this is a mistake. They should be kept separate, as the company may erect concentrators later on, when the latter would become valuable.

The mine has been worked under the greatest difficulties. The cost of packing the ore into Sheffield alone is £5 per ton, and all mine supplies have to be obtained at even a higher rate. With the present means of access it would be quite impossible to bring in machinery. That under these circumstances the mine has been able to do a little more than pay its way is most encouraging, but of course the future prospects of the mine depend upon the behaviour of the lode in depth. Should it prove to be as rich or nearly as rich in depth as it has already been shown to be near the surface, there will be no doubt at all about it. I can see little reason for evil forebodings. The valley of the Dove River has been excavated at a comparatively recent period, certainly long after the metal was deposited in the Devon lode. We may regard the valley as a tremendous costean, 1200 feet in depth, in the bottom of which the Devon lode is exposed. It is plain that, unless we have a case of enrichment by surface waters, the present surface of the ground can have had nothing do with the presence of galena in the lode, for when the galena was deposited the surface was many hundreds, and possibly thousands, of feet higher than it is at present. I could see no evidence in favour of surface enrichment. The lode, except quite near the surface, was undecomposed. The gangue is either country-rock or crystalline quartz, and there is no soluble mineral present, the removal of which might have caused an enrichment. There is only one possibility, and that is the re-precipitation and concentration of the galena from down-going solutions carrying sulphate of lead. This is a question which has recently been brought into prominence by several American geologists. From a chemical standpoint the reactions have been proved to be possible; but to how great an extent these reactions take place in nature is a question in which there is room for much further investigation.

Other Sections.

The Devon is the only mine in the district which is at work at the present time. And, indeed, very little work of any kind has been done on any other section. T. Davy has a show about a mile and a half below the Devon, on which he tells me there is a lode carrying galena and carbonate of lead, but as he was not in the district at the time of my visit, I was not able to see it. On Section 4665-93M, south and adjoining the Devon, there is also said to be a lode carrying galena, and it may possibly be a continuation of the Devon lode. I was unable to visit it, and I understand very little has, as yet, been done with it. On my way up the river I noticed a small vein of galena crossing the bed of the stream, on Section 1978–93M. This occurs just to the west of a dyke of porphyry, and, though itself valueless, is an indication of the presence of the metal. The contact of the porphyry and quartzite should be prospected here, as this is the most likely place for payable deposits of ore to occur. But the porphyry itself should not be neglected, for we have already the example of the Devon lode which occurs right in the porphyry, though near its contact with the quartzite. Somewhat similar veins of galena occur on Sections 3287 and 3288–93M, but, as far as I could find out, no defined lode has been discovered. Section 3855–93M, known as the Sirdar Prospecting Association, stands by itself about a mile and a half to the south-west of the Devon mine. The country here appears to be all composed of finely crystalline and laminated mica schist. No eruptive rock occurs on the section: a little work has been done on some small veins of galena, but nothing payable has been discovered. One of these veins has been driven on for about 12 feet, and about 60 lbs. of galena taken out, but it has almost disappeared in the face. I consider it quite useless to spend money in opening up these small veins; they are not the least likely to open up into payable lodes, and are only of value as indicating the presence of the metal. There may be a payable lode in the vicinity or there may not, but certainly where these veins occur is the most likely place to look for lodes. Take the Devon Mine as an example. Here a small vein of metal occurs in the rock, and may very possibly have been the first indication of galena discovered on that property. Had the prospector expended his time and exhausted his resources by sinking or driving on this, it is probable that he would never have discovered the real lode. Fortunately, however, he expended his time on the surface, and uncovered the gossanous capping of the present Devon Mine. Galena lodes of any size are almost always capped with gossan, and the country about is stained with oxide of iron. These are, therefore, the indications which must be looked for, and until they are found the less time and money that is spent in driving or sinking, the better. On the north side of the river, on the Sirdar property, there is a gossan formation which ought to be trenched across, and, if the indications are favourable, should be followed up along its strike. This may possibly be the outcrop of a defined lode, though at present it would be impossible to say.

I consider the field is worthy of much more attention from prospectors than it has yet received. These very old mica schists are mineral-bearing in a great many countries of the world, and in this district there is every reason to believe that good permanent fissure lodes will be discovered. The country is broken through in several



BARN BLUFF, FROM LAKE WINDERMERE.

places by dykes of porphyry and masses of granite, and the tendency of modern geological research is to ascribe more and more importance to these old acid rocks. They are believed to be the principal source of the metals on the West Coast of Tasmania, and that they are metal-bearing in this field is proved by the Devon lode itself, and the numerous veins and stringers of galena which occur in or near them throughout the district.

As regards access to the field, the present track was constructed by the Devon Mining Company (assisted by the Government to the extent of £100) in order to get its ore to market. The grade, as has already been remarked, is very steep, even for a pack-track. A fair grade for a road, or even a tramway, might be got by sidling down the valley of the Dove and Forth Rivers, and this is certainly the only practicable outlet for the Devon Mine and sections in the vicinity. Its construction would stand a good chance of opening up other mines lower down the river. Emerging from the Dove River gorge there are three routes available to obtain railway connection, each of which is strongly advocated by interested parties. The first of these which I will consider is to connect with Mole Creek, *via* Lorinna and Lienna. The distance from the Devon to Lorinna would be about five miles, and, as I have already stated, a good grade is to be had. From Lorinna to Lienna, Gad's Hill has to be crossed. A couple of years back a road was formed between these two townships, but, unfortunately, it was never laid out by a competent surveyor, and it passes over almost the highest point in Gad's Hill. It is useless for cart traffic, the grade being altogether too steep. Mr. Burrows, authorised surveyor, acting on behalf of the Devon Mining Company, has nearly completed a survey of another route. This crosses Gad's Hill about two miles further north at a low saddle, and according to Mr. Burrows report to the Devon Company, besides shortening the distance by half a mile, secures a workable grade all through, the steepest part being 1 in 10, and that only for a few chains. The distance from Lorinna to Lienna would be, by this road, about 7½ miles. From Lienna to Mole Creek the distance is 12 miles over a good macadamised road. It is stated that this road would have the advantage of opening up about a thousand acres of agricultural land on the western fall of Gad's Hill. Mr. J. C. M'Michael, legal manager of the Devon Mining Company, informs me that the company has offered to pay £300 towards the construction of this road.

The second proposed route would be to connect the Devon Mine with the road already formed to the Shepherd and Murphy Mine. The distance would be about 14 miles, and I think a good grade could be obtained. The objections are that it would involve unnecessary climbing. The road from the Devon Mine will start from near the bottom of the Forth gorge, and this route would involve ascending to Shepherd and Murphy's (about 1000 feet), only to come down again on the same side of the river. The other side of the Forth gorge has then to be climbed in order to reach Railton. The total distance to Railton by this route would be 43 miles, as against 25 to Mole Creek.

The third suggested route is to connect with the proposed railway to be constructed from Railton to Wilmot at its crossing of the Forth River. The distance in this case would be only 12 miles from Lorinna, or say 17 miles from the Devon Mine, but considering that this line will probably not be completed for some years, I think it would hardly be fair to the district to postpone almost all means of access for that length of time. Moreover, Mr. W. R. Reynolds, the engineer in charge of the survey of the Railton-Wilmot Railway, tells me that there are engineering difficulties in the way which would make the construction of this road very expensive.

I am, therefore, of opinion that the first route mentioned, namely, that to Mole Creek, *viâ* Lorinna and Lienna would be cheaper, and serve the district better than any other.

Five Mile Rise Gold Field.

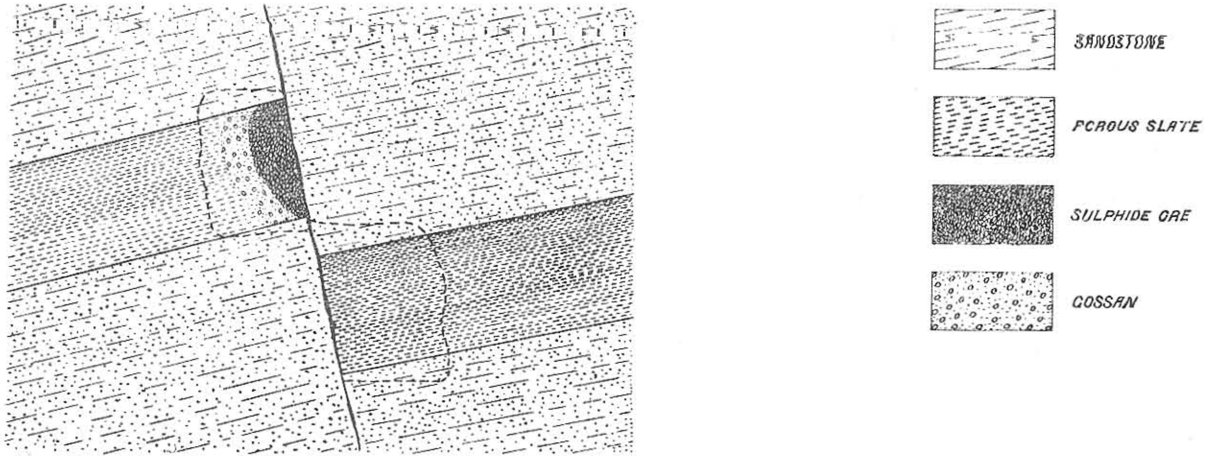
Leaving the Devon Mine on March 4, I made Lorinna my head-quarters for the Five-Mile Rise District. The latter is situated on the western slope of the Forth River Gorge, about 8 miles from Bell Mount. The old V.D.L. track from Sheffield to Surrey Hills passes across the Upper Forth Bridge at Lorinna, and thence up the

Five-Mile Rise to the Caledonian Mine. The geology of the district is very simple. The sedimentary rocks are composed of fucoid sandstone, with thin layers of shale and slate, striking about north-east and south-west, and dipping about 10° to 20° to the north-east. Often the dip of the strata follows the slope of the hill for considerable distances, and, following up some of the creeks, one can trace the same bed of shale for over half a mile, though its thickness does not exceed one or two feet. On the eastern side of the Forth River, we come across limestones and slates conformable with the fucoid sandstones, and overlying them. Above these the sandstones appear again. Granite occurs to the south of the field on the Golden Cliff Mine, this being a portion of the granite belt which runs from the Mersey over Gad's Hill to the Devon Mine. Higher up the Hill the country to the north and south of the rise is overlaid with Tertiary basalt. There has been a considerable quantity of alluvial gold got from the field in past years from the beds of small creeks flowing down into the Forth River; but, at the time of my visit, there was no work going on at all, even O'Rourke's Hydraulic being closed down for want of water. There have been a number of small gold-bearing veins or reefs discovered on the Five-Mile Rise, and many of them contained very rich patches of gold-bearing stone, the richest gold being found in a whitish sandy pug. Some of this is described as being almost yellow with fine gold, but, unfortunately, the amount available has been very small. Quite a number of these reefs have been floated from time to time, and work started with great hopes of success, but not one of them has been able to hold its own. It cannot, however, be said that any of these shows have really had a fair trial. The shoot of gold which was first discovered has been sunk on and soon found to give out, but very little effort has been made to discover others of a similar nature in the same reef. As no one was at work on the field at the time of my visit, I was unable to see as much of the field as I should have liked.

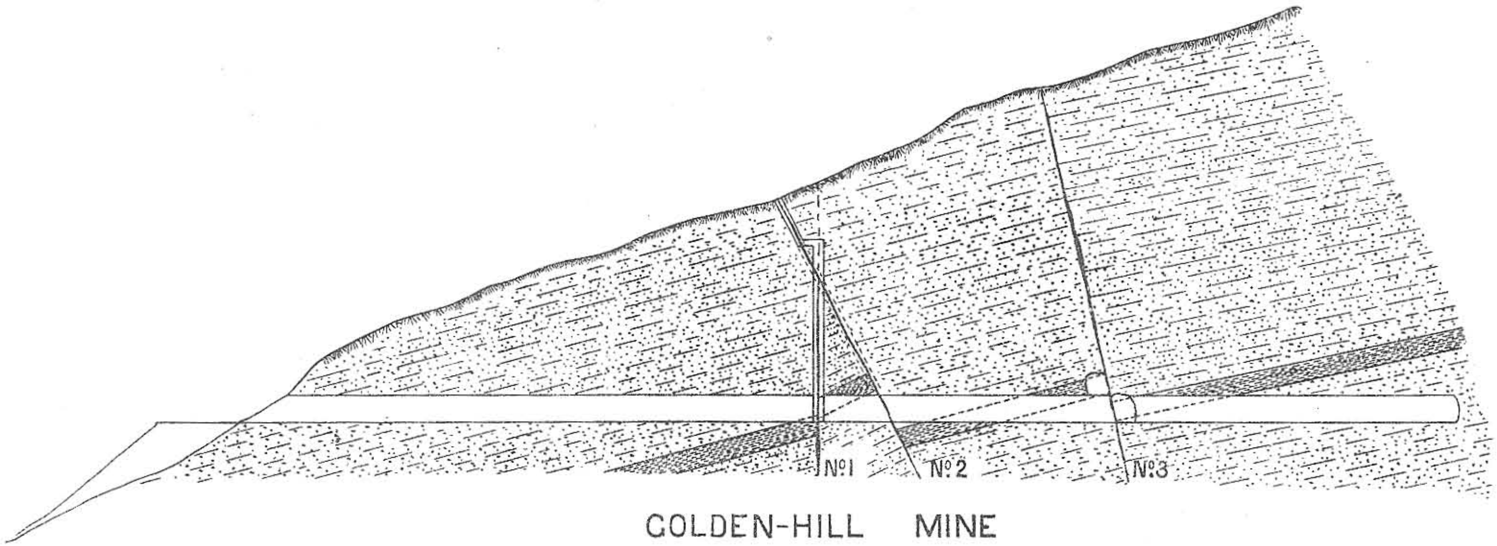
The Golden Hill Mine.

Sections 1476-93G, 1477-93G, 1478-93G, 1475-93G, each of 10 acres, chartered in the name of L. J. Bryant.

This mine is situated about half a mile south-west of the Forth Bridge, and is connected by means of a tramway, with a 15-head stamp battery, erected on a machinery site on the western bank of the Forth River. The battery was formerly driven by steam-power, but the engine and boiler have lately been removed. The country is similar to that occurring elsewhere on the Five-Mile Rise, and consists of flat-lying fucoid sandstones, with thin seams of shale and slate. The latter have evidently played an important part in the deposition of the mineral matter. I walked up a creek to the north of the mine for some distance. The dip of the strata follows the fall of the hill nearly the whole way, and the water in the creek flows over flat smooth slabs formed by the stratification of the sandstone. On the banks of the creek there is a seam of shale about 15 inches in thickness, which can be traced on either bank of the creek for a long distance. In quite a number of places I noticed that a stream of iron-stained water trickled down from this seam, and in several places small cuts had been put in, revealing the presence of pyrites, and in one place I noticed a little yellow pyromorphite. The mineral in each case was confined to the seam of shale, and often occurred on both sides of the creek. It is evident that this mineral is due to small fissures traversing the country. The shale was favourable to the deposition of mineral sulphides, and became impregnated with the latter from mineral-bearing solutions traversing the fissures. This fact throws considerable light upon the occurrence of sulphide ore in the Golden Hill Mine. Plate II. gives a sectional sketch of the formation and mine workings. A tunnel has been put into the side of the hill, cutting three small veins or fault fissures numbered 1, 2, and 3. These fissures are apparently nearly parallel as to strike, the latter being about north-east and south-west, and dip as shown in the sketch. The throw of the faults is very prettily show by tracing out the position of a seam of porous sandy shale, about 4½ feet in thickness, which occurs in the sandstone. Going into the workings, this seam is first seen in the bottom of the tunnel, dipping underfoot, and striking at right angles to the course of the tunnel. It is faulted upwards by No. 1, and on the other side of the fissure appears in the roof. Going on to No.



ENLARGED SECTION ON FORMATION No3
NOT TO SCALE



GOLDEN-HILL MINE

SECTIONAL SKETCH OF COUNTRY AND MINE-WORKINGS

PLATE 2.

Scale 10 5 0 10 20 30 40 50 60 70 80 90 Feet

G. A. Waller
Assistant Government Geologist.

5 cm

2, the shale gradually disappears overhead, but reappears in the floor of the tunnel as soon as the fissure is passed. No. 2 is, therefore, a down-throw fault. The seam again gradually rises in the tunnel until No. 3 is reached, when it is again faulted downwards; after this it finally disappears overhead. All this may be readily seen by consulting the sectional sketch on Plate II. Where cut in the tunnel, these three veins or fissures are very small, not more than two or three inches in width, and filled with sandy pug and a little reef quartz. No. 1 has been risen on for about 40 feet, but no further work has been done upon it. No. 2 vein has widened out very considerably towards the surface, and has been underhand stoped for, perhaps, 150 feet. The stopes are now mostly full of water, and I could form very little idea of the nature of the reef; there are apparently two well defined walls about 18 inches apart. Mr. L. J. Bryant tells me that two crushings were taken out, which gave an average return of 7 dwts. of gold per ton. An underlay shaft was also put down on the vein, but as this was full of water, I could not examine it. A sample of gossan from the end of the stopes, assayed by Mr. W. F. Ward, Government Analyst, gave a return of 18 dwts. 19 grs. of gold and 1 oz. 19 dwts. 5 grs. silver per ton. The vein was about six inches in width at this point.

No. 3 vein has been driven on for a distance of 75 feet from the tunnel, the drive following the seam of sandy shale all the way. The latter has been faulted by the vein, and appears again on the left-hand side just above the drive. One stope has been taken out along this seam, and in the end of the stope about 2 feet of solid sulphide ore, composed of zincblende and iron pyrites, is showing. An enlarged section of the formation at this point is given in Plate II. The sulphide ore is confined to the seam of porous shale which runs horizontally with the stope, and, therefore, forms a horizonal shoot. To the left of the sulphide body there is a foot or so of nice-looking gossan, and for 10 or 15 feet further the shale is much iron-stained. The gossan is evidently caused by the oxidation of the sulphide body by surface waters travelling along the bed of shale.

Four samples were taken from this formation, and were assayed by Mr. W. F. Ward, Government Analyst, with the following results :—

	Gold per ton.		Silver per ton.		
	dwts.	grs.	ozs.	dwts.	grs.
No. 1.—Bulk sample of sulphide ore	4	2	1	4	2
No. 2.—Bulk sample gossan from end of stope next sulphide ore	1	6	0	19	15
No. 3.—Bulk sample gossan and iron-stained shale from side of stope...	Trace		0	2	11
No. 4.—Bulk sample quartz and pug from No. 3 vein	15	12	5	19	5

The results are disappointing, and not as high as the whole of the ore token out of the stope is said to have bulked when treated in the battery. Mr. L. J. Bryant tells me that two crushings were made, the first of which yielded 12 dwts. per ton, and the second 7 dwts. The difference may probably be accounted for by the presence of rich patches, which have raised the average contents of the ore to the figures stated The gossan is said to have been extremely rich in places,

The occurrence of the sulphide ore in the bed of shale is an interesting case of the influence of the country-rock in the deposition of minerals in lodes. It is evident that the fissure vein has acted as the channel through which mineral-bearing solutions circulated. The shale was of a favourable nature, and became replaced by mineral sulphides, which, probably owing to the insoluble and dense character of the sandstone, and also possibly to the absence of a precipitating agent, were not precipitated in this rock. It need hardly be said that the sulphide body cannot be expected to live down; its presence in the vein is entirely dependent on the seam of shale whose strike is approximately the same as that of the fissure vein; but it is quite possible for other similar shoots to be met with in depth. In all probability, other parallel seams of shale occur which have a similarly favourable influence on the mineral contents, but I cannot regard the prospects of the mine as at all encouraging. Were such seams abundant, they would be more noticeable on the surface than is the case, and unless they are abundant the shoots of ore would never pay to mine. It is true free gold occurs in the veins where the shale is absent, but, as far as I have seen them, they are too small to work. The rich gold is described as occurring in soft sandy pug, and we do not know how much this has been enriched by mechanical concentration. Where the gold occurs in the quartz it is not very rich, and the veins are very small.

The Golden Cliff Mine.

This mine is now held under prospecting licence by Mr. E. O'Rourke. It is situated about a mile south of Lorinna. A cliff of hard sandstone rises from the valley of a small creek, and forms the northern wall of the granite belt which crosses the country from the Mersey to the Devon Mine. In this cliff a small reef or vein of quartz occurs, carrying very fair gold. The width of the vein, where exposed, is only 2 or 3 inches. Mr. O'Rourke is putting in a tunnel below the cliff in broken country, in which he finds fragmentary pieces of quartz, carrying gold. A sample from these pieces, assayed by Mr. Ward, gave a return of 1 oz. 7 dwts. 11 grs. gold per ton. The tunnel is being driven, approximately, on the course of the reef, and when the unsettled country has been passed through there should not be much difficulty in finding it. The country, where settled, is very hard, and I doubt very much if the reef will be found to be payable.

The Glynn Mine.

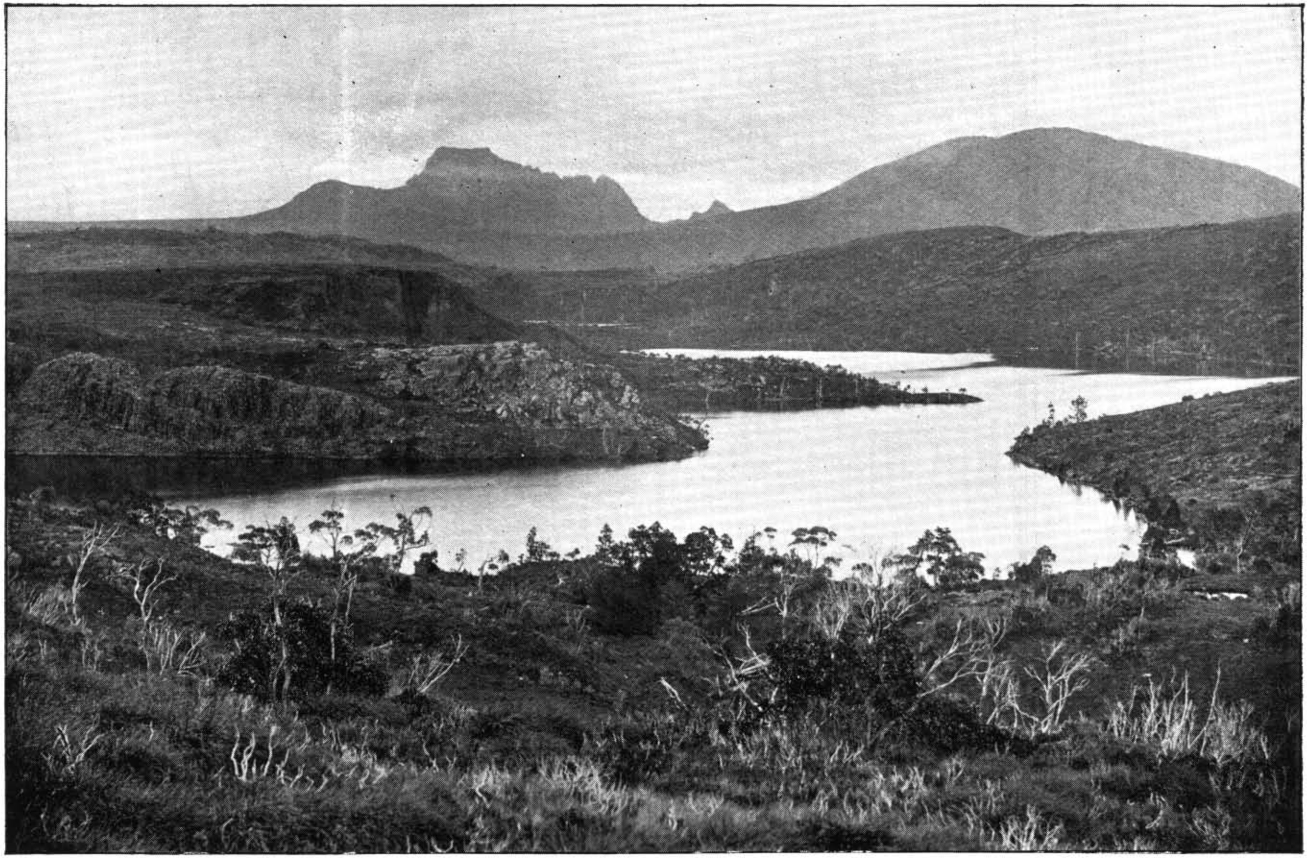
This mine was deserted at the time of my visit, and I could obtain no information as to the results obtained. The mine workings were left in a very bad state, a lot of the ground having fallen in, making a thorough examination impossible. A five-stamp battery has been erected, and, apparently, several crushings made. The stopes have been taken out very wide—over six feet in places—and the western wall is well defined, but at the ends of the stope the reef appeared to be only about six inches wide. It was filled with a sandy pug, containing some quartz. The country is composed of a soft, shaly sandstone, rather more favourable, I should say, than that which I have observed elsewhere in this district.

O'Rourke's Hydraulic.

This is a small mine which has been successfully worked by the owner for the last six or seven years, whenever the water supply permitted. The mine is situated to the north of the V.D.L. track, just opposite the turn-off to the Devon Mine, on what is known as Sunday Creek. The water supply, which is only available in wet weather, is taken from another creek to the north. A small dam has been constructed just above the run of wash, and from this the pressure main comes down along the deposit. The run of wash is, perhaps, 500ft. in length by two or three chains in width, and up to 10 or 12 feet in depth. It is composed, for the most part, of angular sandstone wash, the bottom portion of which is firmly cemented together, and has to be shot out. The gold is generally coarser than that found elsewhere on the Five-Mile Rise. It often contains quartz, and is quite angular, and sometimes flaky. Angular pieces of lode quartz are also met with in the wash, in some of which visible gold is present. The central gutter has been worked up to within a chain or so of the dam, but Mr. O'Rourke tells me that the greater part of the remaining wash is payable, his object in working up the gutter being to locate the source of the gold, which he thinks will prove to be a payable quartz reef. In this there should be no great difficulty, as the gold has, evidently, not travelled far.

Other Sections.

There have been several other mines in the district, all possessing essentially the same general characters as those already described. The Caledonian Mine is situated at the top of the Five-Mile Rise. This mine started on a rich vein of gold-bearing pug, which soon changed into a small quartz reef. A fifteen-head battery was erected (subsequently removed to the Golden Hill Mine), and a crushing of 200 tons put through. This is said to have yielded 12 dwts. to the ton, but, on account of the narrowness of the reef, it did not pay for the mining. The old Union Mine, a little west of the Golden Hill, and Campbell's Reward, about three miles north of Lorinna, were of the same character. On the whole, I cannot think the country is likely to contain any large and payable reefs. The creeks have all been well prospected for alluvial, and although this is widely distributed, it occurs nowhere in very large quantities. Where it has been worked it has



LAKE AGNEW AND CRADLE MOUNTAIN.

usually led up to some small reef similar to those which have been described, and I think it is probable that these will account for all the gold that has been shed.

Forth Bridge to Barn Bluff, via Mount Pelion.

On March 6th, I left the Forth Bridge for the Barn Bluff. The only route at present available is along Innes' Track from Lienna to Rosebery. The track is most circuitous. From Lienna it ascends on to the divide between the Mersey and the Forth rivers, and follows this in a southerly direction for about 20 miles, until the eastern end of Mount Oakley is crossed. Then it descends in a westerly direction to Lake Ayr, at the foot of East Pelion, passes round north end of West Pelion, and then runs in a north-westerly direction to the Barn Bluff. Along the track, the distance from Lienna to the Barn Bluff Copper Mine is about 46 miles, but as the crow flies it is not more than 16 or 17. Besides being very circuitous, the track has many other disadvantages. The divide between the Mersey and Forth rivers is at an elevation of from 2500 to 3250 feet above sea-level, and in winter a large part of this is covered with snow, absolutely prohibiting all traffic. Much of the track is also very boggy, and, after Mount Pelion is passed, traverses button-grass swamps for several miles. Very little traffic passed along this track until the Barn Bluff Company started operations, some four months ago, and even now the pack-horses only go along the track about once a week; but this has been sufficient to make the track quite dangerous in parts. The greater portion of the track has only been pegged out, and much of it passes over swampy ground, which is only covered by a thin crust of vegetable matter. This soon becomes broken through, and a dangerous bog-hole is produced.

The northern end of the divide between the Mersey and the Forth is known as Gad's Hill. Here the country is all overlaid with basalt, with the exception of a belt of granite passing across the northern end of the hill, and which has already been referred to. Gad's Hill is about ten miles in length. South of this, the track enters fucoid sandstone country for about four miles (Lemonthyme Hill), until the Berriedale Plains are reached, when the country is again overlaid with basalt. This continues for, perhaps, another couple of miles, and for the remainder of the divide, a distance of 12 miles, the country is composed of dolerite. This rock is also a capping, the Forth and Mersey gorges on either side being cut into sandstone or schist. Descending from the plateau to Lake Ayr, we enter the horizontal strata of the lower coal measures.

The geology of the country in the vicinity of Lake Ayr and Mount Pelion is very interesting. Plate III. gives a sketch map (for which I am indebted to the kindness of Mr. G. R. Bell) with a rough geological section of the Pelion Group of Mountains. As will be seen, there are in this group six good-sized mountains, separated by high saddles, only two of which have received separate names. The un-named mountains I have numbered 1 to 4, in order to facilitate reference. The geology of all the mountains in this part of the State presents essentially the same features. The lowest rocks are highly-inclined schists of, probably, Archæan age. Above these come horizontally-stratified conglomerates, sandstones, and shales belonging to the Lower Carboniferous period. The thickness of these strata at Mount Pelion I estimate at from 1200 to 1500 feet. Above these again, and forming the capping of all the mountains in the district, is a layer of columnar greenstone (dolerite) from 500 to over 1000 feet in thickness. In the Pelion group, the saddles between the separate mountains are in carboniferous strata. Mount Pillinger and Ragged Mountain, to the east of Mount Pelion, The Du Cane and Eldon Ranges to the south, Mount Oakley, Barn Bluff, Brown Mountain, and Cradle Mountain, to the north, all present essentially the same geological features. Viewing the country from the top of one of these mountains, the deduction is almost irresistible that these now isolated masses of dolerite once formed part of an enormous sheet covering the country in all directions. If this view is correct, the area of the sheet must have measured at least some hundreds of square miles, and its depth from 800 to over 1000 feet. According to the latest theory as to the origin of the dolerite, it is supposed to have been inserted between horizontal layers of sedimentary rocks in the form of great laccolites, or sills. However well this theory may hold for other parts of the State, I am not of opinion that it is tenable in this. A laccolite having an area of hundreds of square miles is, of course, impossible, and I cannot believe that each of these mountains represents a separate sill, connected with an internal reservoir by means of a separate volcanic neck. Were such the case, dykes, or fissures, or some decided evidence of disturbance, would be noticeable along the well-exposed slopes of the Pelion Group; but such is not the case. The coal measures are singularly undisturbed, and are not broken through by any eruptive rocks. Wherever the eruption of dolerite took place, it must have been at some distance from any of the Pelion group of mountains. I shall not discuss this question further in the present report. It is to be brought forward at the next meeting of the Australasian Association for the Advancement of Science, to be held in Hobart in January next, and then, no doubt, many more facts concerning this interesting rock will be brought to light.

Coal at Mount Pelion.

Two seams of coal have been discovered in the Pelion Group of Mountains. The first one which I examined was exposed in several trenches on the eastern slope of West Pelion, and in one place a tunnel, 20 feet in length, has been put in on the seam. The latter is, apparently, horizontal, and about 17 inches in thickness. It is composed of a bright firm black coal, containing, unfortunately, considerable quantities of pyrites. A bulk sample taken down the face of the seam, and analysed by Mr. W. F. Ward, Government Analyst, gave the following result:—

Fixed Carbon	Coke	52·0	per cent.
Ash		17·1	”
Gases, &c., lost at red heat		19·6	”
Sulphur		10·5	”
Moisture lost at 212° F.		0·8	”
		100·0	

The unusually high percentage of sulphur would probably render the coal useless for economic purposes.

The second seam has been found outcropping on the northern slope of No. 3, Mount Pelion. On the north-western end of this mountain a tunnel has been put in on the seam for a distance of 50 feet. The seam is split into two parts at this point, separated by about 4 inches of carbonaceous shale, the upper portion being about 5 inches in thickness, and that of the lower 21 inches, excluding a few inches of very poor coal on the floor of the seam. This makes a total of 26 inches of coal. A bulk sample taken at this point gave, on analysis, the following result :—

Fixed Carbon } Coke	54·6	per cent.
Ash }	20·2	"
Gases, &c., lost at red heat	22·5	"
Sulphur	0·6	"
Moisture lost at 212° F.	2·1	"
	100·0	

I was surprised at the large percentage of ash present, as the coal had the appearance of being singularly pure and homogeneous. I am inclined to think it must be in part due to the accidental inclusion of some of the carbonaceous shale in the sample. This, of course, might be eliminated during the process of mining. In other respects the result is very satisfactory. About 20 chains to the east of the above tunnel another opening has been made 20 feet in length into the same seam. It is not split into two parts at this point, one seam 22 inches in thickness being seen. The floor of the seam is composed of shale, and the roof of firm sandstone. The same seam has been traced, by means of small trenches, round the slope of the mountain to the west side of East Pelion. Here it is said to be about 18 inches in thickness, though I did not examine it at that point. The seam is 900 feet above the one found on West Pelion, and, in all probability, might also be picked up on that mountain. The seam is too small to be payable at present, even if the ash contents proved to be satisfactory, but if a local demand sprang up through the development of metal-mining in the district or at Barn Bluff, it is probable that the seam would then become payable.

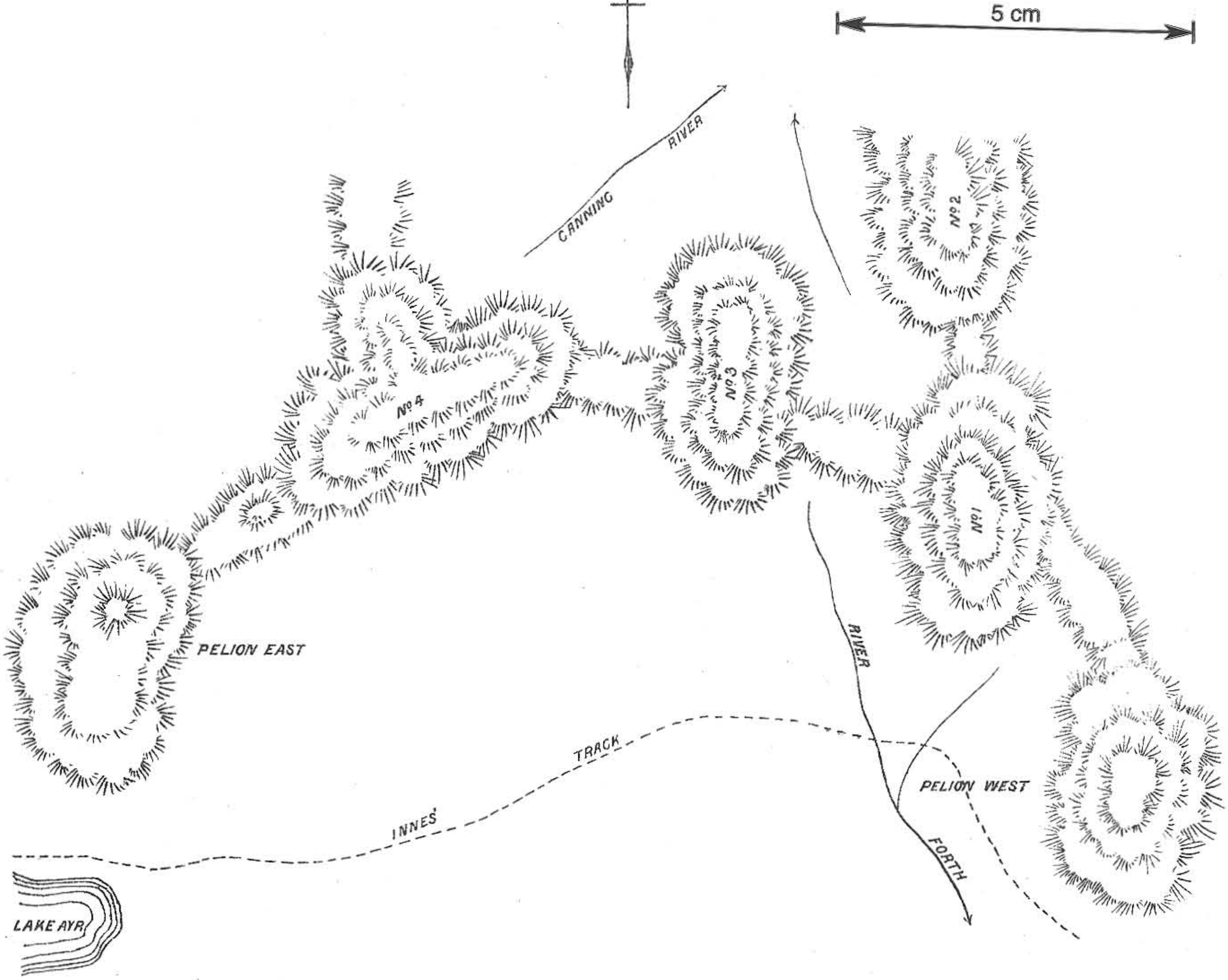
Mount Pelion Copper Mines.

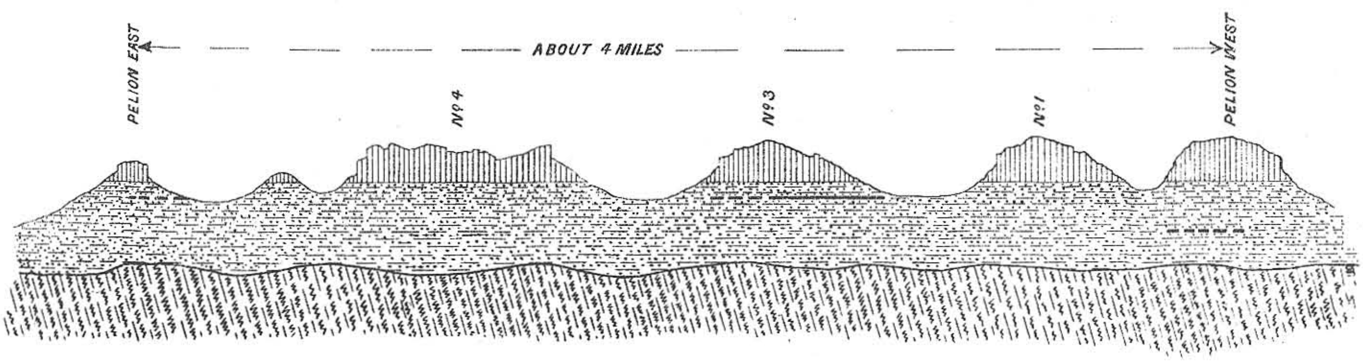
These mines, which I believe have been shut down for some years, are situated in a belt of schist country between East Pelion and Mount Oakley. Time did not permit me to locate the shows on the different sections. Several veins, carrying copper pyrites, were examined on the south

GENERAL SKETCH OF THE PELION GROUP OF MOUNTAINS

PLATE 3

G. A. Waller
Assistant Government Geologist.





IDEAL SECTION PELION GROUP OF MOUNTAINS

COLUMNAR GREENSTONE (DOLERITE)

CARBONIFEROUS STRATA CONGLOMERATES SHALES & SANDSTONES

SCHISTS

COAL SEAMS

side of the creek which flows from Lake Ayr into the Forth River. These have been trenched across, and sunk on for short distances in several places, but as the holes were all full of water at the time of my visit, I could only examine their outcrops on the surface. They seem all to consist of small veins and bunches of iron and copper pyrites, pyrrhotite, zinc blende, and quartz. The most easterly of these veins is the largest. On this a shaft has been sunk, from which a good many tons of ore have been obtained. It consists mainly of iron pyrites, zinc blende and hematite, with a little copper pyrites. The strike is north and south, and on the surface the vein is from 1 to 2½ feet in width. The eastern wall of the vein is well defined, but I could see no western wall, and think the metal is due to the replacement of the country-rock on this side. About 30 chains north of these veins another lode, or probably, a continuation of one of those already described, has been discovered. The formation has more of the appearance of a true lode than any of the others. It also strikes north and south, the dip being 60° to the west. A small open cut has been made upon it, and in the centre of this a shaft (now full of water) has been sunk. On the surface the lode is about 5 feet wide, and consists, for the most part, of quartz, with bands of zinc blende and iron pyrites up to 18 inches in thickness. The country is low-lying, and could only be tested by sinking. Under these circumstances, and considering the by no means encouraging results which have so far been obtained, I doubt if it will be worth while to spend more money upon it. There is, however, every possibility of payable lodes existing in the locality, as the country is of a favourable nature, and the failure of these should not be allowed to discourage prospecting in the locality.

The Barn Bluff Mining Field.

This field has been brought under prominent notice during the last few months by the discovery of several large deposits of copper-bearing pyrites. The field is situated to the east of the Barn Bluff, between that mountain and the Forth River. The country consists mainly of finely laminated schists, striking for the most part about 80° west of north, and sometimes due east and west. The dip is variable, and it is probable that a careful survey would disclose a series of anticlines and synclines. The whole country shows very marked evidence of prolonged glacial action, large areas being covered with glacial *débris* and erratic boulders of greenstone (dolerite) being met in all directions. *Roches moutonnèes* are not uncommon, and lakes varying in size from an acre or two to several hundred acres are very abundant. Superficially the country strongly resembles the Lake Dora district.

The rock most frequently met with is a strongly foliated quartz schist. This consists principally of quartz, but contains a good deal of hydro-mica, the flat particles of which are arranged in parallel layers, giving to the rock its foliated structure. The fine laminæ are very prominent on the weathered surface of the rock, but are by no means so distinct on the fresh fracture. I think that quartz schist is a more appropriate name for the rock than quartzite, the term by which the rock is locally known, as it lays more emphasis on the schistose character. The rock occurs in long bare ridges all over the country, the intervening flats and hollows being covered with button-grass or scrub, or being occupied by small lakes. This causes the rock to appear in greater abundance than is really the case. I think it will be found that the softer schists are really in greater abundance than the quartz schists, but these being softer have been worn away by the erosive action of the glaciers, and, therefore, are now hidden from view beneath the button grass and glacial *débris* of the low-lying ground. Crystalline mica schists, hydro-mica schists, and argillaceous schists are all represented. I also noticed a nodular schist containing very numerous siliceous nodules about the size of a walnut. The latter stand out on the weathered surface of the rock, giving it a very striking appearance.

I believe these schists are of archæan age, and that the same line of country extends in a northerly direction as far as the Devon Mine. The Mount Pelion schists are also of the same age. It may be worth recording, in this place, that at the 29-mile peg on Innes' Track, a boulder is to be seen consisting of coarsely crystalline gneiss. The latter has evidently been transported by ice, but must have come from somewhere in the district. Its occurrence may be an additional proof of the ancient character of the rocks in the district.

The Barn Bluff Gold, Silver, and Copper Mining Company, No Liability.

C. P. Smith, Mining Manager. This company holds Sections 4920-93M and 4921-93M, each of 80 acres. They are situated about 4½ miles south-east of Barn Bluff, and the mine workings are in the valley of Commonwealth Creek, a tributary on the west side of the Forth River. The mine was discovered by H. Andrews and J. Swallow about two years ago, but, with the exception of some surface trenching, no work was done until the present company took over the property.

Plate IV. gives a geological sketch map of Section 4920. I wish to lay particular stress on the fact that this is only a *sketch* map as far as the geological features are concerned. The mine workings are plotted approximately correctly, but it was impossible for me to locate, with much accuracy, the lines of contact of the different rocks. The ground is largely covered with button-grass, scrub, and detrital matter, and often it happens that where one most wishes to find an exposure, there the rock is most effectually concealed. The strike of the country is approximately shown by the lines or dots representing the various rocks. But as this varies considerably, especially in that belt of country which is shown running diagonally across the section, an accurate representation could not be made by this means. In all essential particulars, however, as far as the present report goes, the chart will be found to represent the geological features of the mine with sufficient accuracy. It will be seen that two creeks flow through the section—Cook's Creek flowing along the northern boundary, and Commonwealth Creek about 10 chains to the south. It is on the spur between these creeks that the mine workings are situated. To the south of Commonwealth Creek the ground rises steeply for over 500 feet, the highest point being known as the Big Knob. The greater part of the section is composed of quartz and other schists, striking from 80° to 90° to the west, and dipping either vertically or steeply to the north. The rock is frequently traversed by veins of white quartz striking north-east and south-west, and a few chains north of the section a small dyke of basalt, 4 feet in width, is beautifully exposed in the bottom of a creek, striking in the same direction as the quartz veins. A microscopical examination of this basalt proves it to be very fresh olivine basalt, and evidently of Tertiary age. Crossing the section diagonally from the north-west corner to the south-east, is a very remarkable belt of country striking approximately 45° west of north. Along the south-western wall or boundary of this formation there is a band of chlorite schist, perhaps two chains in width, which can be traced in a straight line right across the section. To the north-east of this band, in the vicinity of the mine workings, a hard, dense, dark green rock occurs, also containing chlorite, and strongly impregnated with crystalline iron pyrites, and also containing copper pyrites. This occurs in bands running parallel to the chlorite schist. North-west of this again we find a greyish-green rock, easily scratched with the knife, and probably containing both chlorite and stealite. I think that both these rocks are of the same nature, and propose the provisional name of chlorite rock until their precise character has been determined. Actinolite rock also occurs in some of the trenches in this belt. Further south along the belt I did not notice the chlorite rock, though it is quite possibly present. The Big Knob is composed of highly foliated quartz schist, very strongly crumpled, and striking in all directions. On four different places along the south-western wall of the chlorite belt, outcrops of white quartz are noticed. They consist of a mass of thick veins of quartz, containing numerous druses of crystals. They are approximately in a straight line, and occupy the same geological position in relation to the chlorite belt, and are evidently connected therewith. As will be seen by the chart, more than half of the mine openings have been made to the east of this chloritic belt. Here the country is composed of alternate bands of quartzite, or quartz schist and actinolite rock. The latter, when free from the presence of pyrites, is composed of fine fibres of actinolite, malted and felted together in a very compact manner, making the rock extremely tough and difficult to break with the hammer, though it is easily scratched with the knife. Both these rocks are often very heavily charged with mineral, dense bands of pyrrhotite, iron pyrites, or micaceous iron and iron pyrites, all containing a little copper pyrites, and sometimes the latter in considerable quantities, occur over the whole area which has been opened up. The dense pyrrhotite occurs more frequently in the quartzite than in the actinolite, and has the appearance of having replaced the latter metasomatically, there being no definite line of contact between them, but rather a gradual passing over from the quartzite into pyrrhotite, the intervening rock being composed of quartzite, more or less heavily charged with pyrrhotite. The pyrrhotite generally contains a little copper pyrites distributed through it in fine strings, and sometimes in considerable quantities. The actinolite rock appears to be richer in copper than the quartzite, and to be more generally associated with iron pyrites than with pyrrhotite though bands of the latter also occur in the actinolite rock. In several places I thought I detected the fine fibres of actinolite all through the otherwise dense whitish iron pyrites, or mixture of iron pyrites and micaceous iron. This might be taken as pointing to the replacement of actinolite rock with pyrites. This also contains a little copper.

The eastern portion of the chloritic belt is also very heavily charged with pyrites and micaceous iron, and usually, though not always, the dense metal is associated with actinolite, the latter often occurring in long bundles of radiating fibres. Altogether, the deposit exhibits some novel and most interesting phenomena, and it will not be till much more work has been done that any adequate theory of its origin can be put forward.

The Barn Bluff Company started work on the formation on the 12th of January last, and immediately commenced vigorously opening it up by means of a series of open cuts and trenches, with the object of ascertaining the nature and extent of the formation. Considering the very short time that the company has been at work (at the time of my visit, a little over 2½ months), the amount of work done is most creditable, but, as yet, the extent of the formation is merely a matter of conjecture. The open cuts and trenches extend over an area, the extreme dimensions of which are 9 chains long by 7 chains wide. In all of these the country is more or less mineralised. There has, however, been nothing done, as yet, to show how far the deposit extends to the south and west of these workings. In both these directions the metal appears to be going just as strong and massive as anywhere else. The principal openings are charted on the map, and, to facilitate reference, I have lettered them with capitals. Openings A to L are situated east of the chloritic belt, whereas M to T are situated either in this belt, or near its margin.

Open cut A discloses a seam of pyrrhotite, containing a good deal of copper pyrites and some arsenical pyrites, about 2 feet wide. Copper contents improve in the bottom of the cut, which is about 7 feet in depth. Strike is east and west, and dip vertical; north and south walls are quartzite. The Manager tells me that a sample from this cut, assayed by Mr. Ward, Government Analyst, yielded 9½ per cent. of copper, as well as some gold and silver.

Open cut B.—About 12 feet wide. The face is mostly composed of solid pyrrhotite, with copper and arsenical pyrites distributed through it, also a good deal of quartzite and actinolite rock, the latter containing copper pyrites in bunches. Strike of formation east and west.

Open Cut C.—About 10 feet wide in solid actinolite rock, with iron and copper pyrites in bunches. A little talc and stealite also present.

Open Cut D.—Very solid metal is exposed here. It consists of whitish iron pyrites apparently replacing actinolite. It is poor in copper.

Open Cut E.—Subsoil is deep here; from the bottom of the cut a good deal of solid iron pyrites and a little copper pyrites has been obtained.

Open Cut F.—This cut exposes a solid mass of pyrrhotite and copper pyrites about 4 feet in thickness. The country is much disturbed here, and it is probable that this, as well as Cuts D. and E., are very near the eastern margin of the chloritic belt. In none of them could the strike be determined with certainty.

Open Cut G.—About 23 feet wide. Face up to 10 feet high. The centre of the face is taken up with a band of quartzite about 12 feet wide, running east and west. To the north of this there is a band of good copper-bearing rock 2 to 4 feet wide, and consisting of decomposed actinolite rock, with a good deal of micaceous iron and copper pyrites. The copper appears to be improving in the bottom of the cut. To the south of the band of quartzite there is another band of mineral-bearing rock of similar nature to the other, but not so rich in copper. A few tons of good oxidised copper ore has also been got from the cut. It consists of malachite, azurite, micaceous iron, and limonite, with, probably, some cuprite distributed through the decomposed actinolite rock.

Open Cut H.—About 20 feet wide. Depth of face 15 feet. In the centre of the face there is a band of very dense pyrrhotite, with a little copper. Also contains whitish iron pyrites which tarnishes yellow. This appears to be due to the replacement of quartzite. Its width is about 4 feet. To the north of this is a finely malted actinolite rock, carrying small bunches of copper pyrites and micaceous iron. The two minerals appear to be closely associated, the latter forming the margin, and the former the centre, of the bunch. This band extends into cut G., making the total width about 20 feet; but the copper contents decrease towards the northern wall. Here also the copper contents improve in the bottom of the cut.

Open Cut K.—This is a small cut about 4ft. in width, and exposes a band of whitish pyrites the full width of the cut. The mineral here appears to be replacing actinolite rock.

Open Cut L.—Seven feet wide; subsoil deep. In bottom of cut, quartzite and greenish black rock carrying nice copper pyrites, showing.

Open Cut M.—Exposes actinolite rock heavily charged with iron pyrites. The strike is 40° west of north.

Open Cut N.—Country consists of a hard dark green rock (chlorite rock), with a little actinolite, carrying a good deal of iron pyrites and micaceous iron, with a little copper. The strike is probably west of north.

Open Cut O.—In dark greenish black rock (chlorite rock), a good deal iron-stained, much of it being strongly impregnated with micaceous iron and a little iron and copper pyrites.

Open Cut P.—Trench on top of hill in dark green rock, a good deal decomposed, and exposing in the bottom a good deal of iron and a little copper pyrites.

Open Cut Q.—Hard greenish black rock (chlorite rock), carrying pyrites distributed through it freely in cubical crystals. A lot of dense, whitish iron pyrites is also present, but very little copper; also, dense pyrrhotite and micaceous iron.

Open Cut R.—A shot or two has been put in here, exposing dense whitish iron pyrites and micaceous iron, accompanied by a little decomposed actinolite rock ; there is very little, if any, copper present, but the cut is quite superficial.

Open Cut S.—A couple of shots have been put into the edge of the creek at this point, and expose a massive body of stone, consisting of whitish iron pyrites and micaceous iron, replacing actinolite or chlorite rock. A little copper is also present.

Open Cut T.—Here a few shots have been put in, in the bottom of the creek, exposing similar stone to that found in S. The pyrites occurs in strings and bunches all through the rock. The groundmass appears to be composed of actinolite fibres and chlorite, there is also some micaceous iron present, and a little copper.

The above description includes all the most important openings which have been made in the deposit, but between these there have been a number of smaller openings made, and with results similar to those described. Speaking of the deposit as a whole, it may be described as an immense deposit of pyrrhotite, iron pyrites, and micaceous iron, occurring in massive bands in the country rock, all containing a little copper pyrites, and in places the latter mineral is exposed in payable quantities. The bulk of the deposit, however, as far as the present very shallow openings have shown, is very poor. In many of the cuts the copper contents are better in the bottom of the cut than on the surface, and I hold the opinion that there will be a further improvement as greater depth is gained. The mine is well worth vigorous prospecting. This can only be done effectually by tunnelling. The spur on which the present cuts are located should be driven under at as great a depth as possible, and another tunnel should be put into the hill to the south of Commonwealth Creek. The deposit is shown to be crossing the creek strongly in cuts S. and T. How far it extends cannot at present be estimated, and it cannot be economically ascertained by trenching, owing to the heavy overburden of detrital matter that has fallen from the "Big Knob." More trenching, however, is required to the east of the present cuts to determine how far the deposit extends down the spur between Commonwealth and Cook's creeks.

As far as the chloritic belt running diagonally across the strata of the country, and the actinolite rock occurring in this belt, and also apparently forming spurs from it parallel to the strata are concerned, I have endeavoured to describe their occurrence as accurately as possible. It is probable that before their geological relations can be determined we must wait until the processes of mining enable us to examine their occurrence more fully, and until a more accurate and complete survey is made than was possible during my visit. I cannot, however, refrain from expressing the opinion that both these rocks are derived from some old eruptive rock. There appears to me to be no other explanation of the comparatively narrow band of chlorite schist running across the general strike of the country. The rock has, of course, undergone intense alteration. Chlorite is a secondary mineral derived from other ferro-magnesian minerals such as actinolite, hornblende, olivine, &c., of which many basic eruptives are almost entirely composed. Rosenbusch, the great authority on petrology, ascribes the origin of chlorite schist and actinolite rock to the alteration of such eruptives. The position of the actinolite rock apparently forming spurs from the chlorite belt as well as occurring in that belt itself is very difficult to explain, and, certainly, it would be premature to enter into any speculative details as to how it came into the position it now occupies.

Whatever may have been the origin of the chlorite and actinolite rocks, one thing is certain, namely, that the deposit of copper-bearing minerals is intimately connected with them. This is proved by the fact that on the only two other mines which I was able to visit in the district on which copper ores had been discovered, the same rocks were associated with the same minerals, and in each case the occurrence is of a very similar character. In the whole of the district the direction of fissuring is consistently north-west and south-east. This is not only shown by the belts of chloritic rock, but is also evidenced by the occurrence of very numerous veins of white quartz crossing the strata in the same direction, and also by the small dyke of Tertiary basalt, whose strike is approximately the same as that of the chlorite belt. Both the white quartz and the Tertiary basalt occur as the filling of fissures, and the latter goes to show that the direction of fissuring was preserved until a comparatively recent geological period.

The North Barn Bluff Mine.

T. Cook, Mining Manager. This company holds Section 4954-93M, north-west and adjoining the Barn Bluff Mine. The belt of chloritic rock which crosses the Barn Bluff Company's northern section, continues into this section, and the quartz formation, already alluded to as being connected with the chloritic belt, also occurs here, as shown on the sketch map (*Plate IV.*). I could not, however, find the continuation of the band of chloritic schist which runs so continuously through the section to the south, though it may quite possibly be here, as much of the rock is covered with button-grass. The chloritic rock is hard, and dark green in colour, similar to that found in open cut 2 in the Barn Bluff Mine. It is strongly impregnated with iron pyrites, and a little copper pyrites also occurs. Several cuts have been put in to the sides of the hill to the east of Cook's Creek, cutting bands of iron pyrites in this rock. Quartzite is also met with in this creek. It is now proposed to test the formation at a greater depth by means of a tunnel from the creek.

Section 4669-93M.

Charted in the name of Lord, Swallow, and Erickson. This section is situated about a mile and a half south-west of the Barn Bluff Mine. The general geological features are essentially the same as the latter, the general strike of the country being 80° east of north. On the eastern side of a good-sized creek flowing through the section a small vein of copper pyrites has been discovered, and traced by means of trenches for five or six chains along its course. The width of the vein varies from three inches up to about nine inches, and the strike is about north-east and south-west. The western wall of this vein is composed of a chloritic rock of a similar nature to that found on the Barn Bluff Mine, and striking in the same direction. On the hillside to the east of the vein of copper pyrites there are numerous boulders of porous limonite, or bog-iron, and a few shallow trenches have been sunk with the object of testing the ground, but none of these have bottomed the subsoil, which in this place is rather deep. The section is well worth prospecting, as we have here evidently another belt of chloritic rock of the same nature as that occurring on the Barn Bluft Mine. That it is also associated with copper is shown by the vein of copper pyrites already found. It is very probable that the boulders of bog-iron on the hill above may have been formed by the decomposition of a body of pyrites. The hill should be well trenched, and if the results are favourable a tunnel should be put in from the creek. About 200 feet of backs are readily obtainable.

North of this section, on the other side of the creek, I was very pleased to see the actinolite rock occurring. It is exposed in a small open cut, but the country is so disturbed that I could not determine the strike at this point. Since my visit the ground has been taken up. It is well worth prospecting.

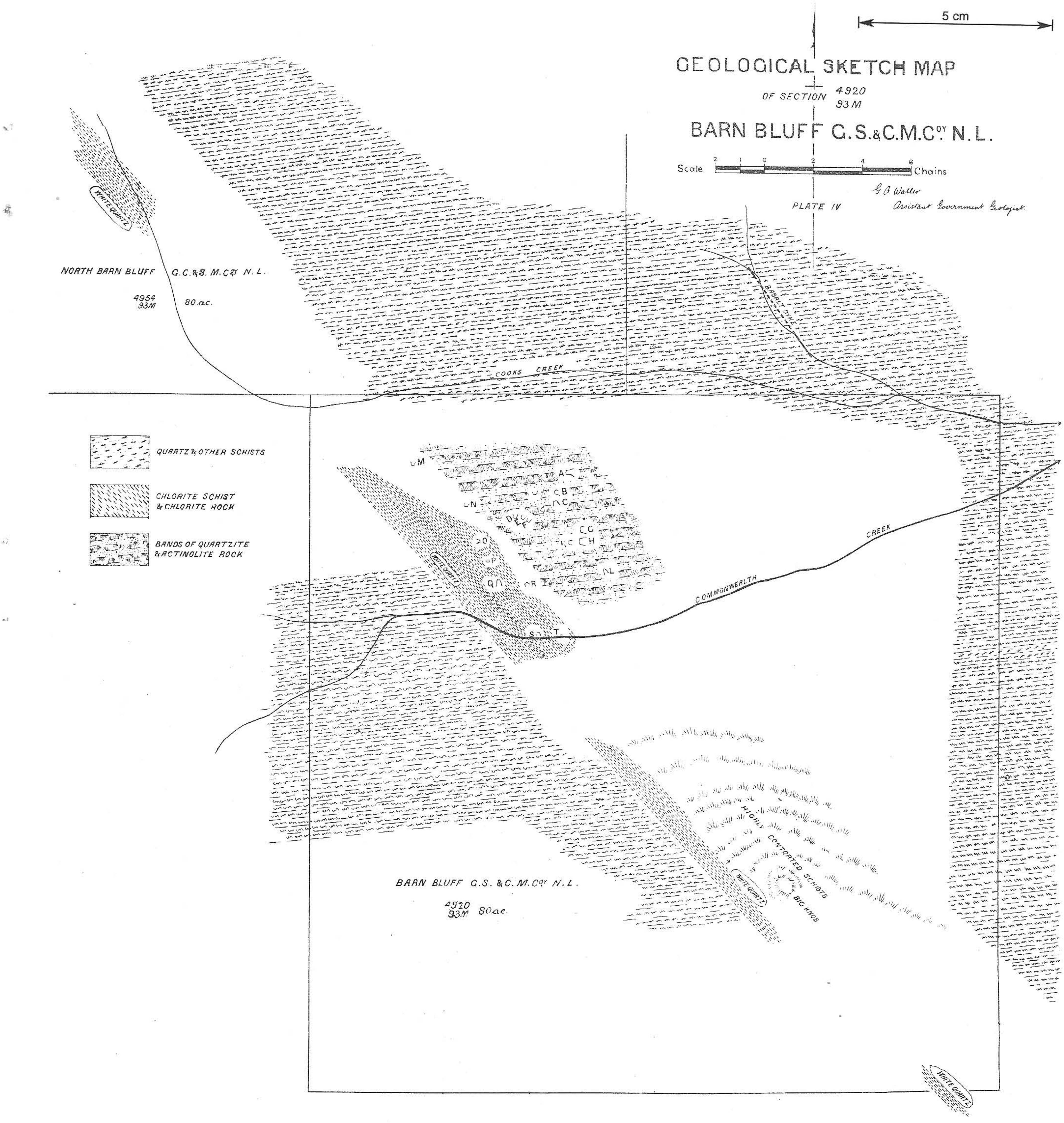
Sections 4818–93M *and* 4819–93M. *Swallow and Madden.*

These sections are situated a little over a mile to the west of Lord, Swallow, and Erickson's Section. Several shallow trenches and open cuts have been made, exposing a very similar formation to that already described on the Barn Bluff Company's property.

In the first trench examined, which was situated to the west of a small lake, the country was much broken up, making it impossible to determine the strike. Dense pyrrhotite occurred here, associated with actinolite rock, and containing copper pyrites. About six chains to the south of this a trench has exposed a good section of the country. This consists of quartz schist and finely-laminated crystalline mica schists, highly inclined, and striking 80° east of north. In the northern end of the trench a dense body of pyrrhotite has been uncovered: this carries copper pyrites all through it, and in places it is fairly rich: the width of the band is 10 or 12 feet. About 30 feet south of this another band occurs in the same trench. This has not been broken into, but is evidently of the same nature as the other. Passing up the hill to the west several other bands are exposed. All these are striking with the country. The trenches are all quite shallow, and it is probable that the copper contents will be found to increase in depth. I think it very probable that here also the copper will be found to be associated with a band of chloritic rock. In prospecting the section this should first be located and followed up. Actinolite rock occurs in the northern trench, though here its position could not be determined, owing to the disturbed nature of the country. The show is a very promising one.

Proposed Track to the Barn Bluff District.

It has been already pointed out that the present track to the Barn Bluff, *viâ* Mount Pelion, is not only extremely circuitous, but passes for nearly 20 miles over high-lying ground which, in winter, is covered with snow, and becomes impassable. A great part of the rest passes over swampy ground which certainly could not be made fit for constant traffic without a large amount of expenditure in cording. The question of another route is, therefore, of great importance to the district. After very careful inquiry into this question from a number of prospectors and others who are well acquainted with the country, and after examining the lay of the country as carefully as possible without actually going over the ground, I am quite satisfied that a route can be got which, while avoiding all the worst of the high ground on the divide between the Mersey and the Forth, would shorten the journey from Lienna to the Barn Bluff Copper Mine by from 15 to 20 miles, and the journey from Lienna to Rosebery by from 10 to 15 miles. The proposed route would leave Innes' track at the south end of Gad's Hill, pass for a few miles along the top end of the Forth Valley, and thence gradually descend to the Forth River. There are then two routes possible, and it will require a survey to be made in order to determine which would be most advantageous. One route would bring the track up through the Barn Bluff Company's Section. The Forth gorge would, in this case, have to be climbed by a zig-zag up the spur to the south of the Commonwealth Creek. The second route would join Innes' track in the vicinity of Swallow's Section, and would come a good deal further south than the first, but could probably be made with a better grade. It would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GEOLOGICAL SKETCH MAP
OF SECTION 4920 93M
BARN BLUFF G.S.&C.M.Coy N.L.
Scale 2 1 0 2 4 6 Chains
G. A. Waller
Assistant Government Geologist
PLATE IV
NORTH BARN BLUFF G.C.&S.M.Coy N.L.
4954 93M 80 ac.
WHITE QUARTZ
BASALT DYKE
COOKS CREEK
QUARTZ & OTHER SCHISTS
CHLORITE SCHIST & CHLORITE ROCK
BANDS OF QUARTZITE & ACTINOLITE ROCK
WHITE QUARTZ
COMMONWEALTH CREEK
HIGHLY CONTORTED SCHISTS
BIG KNOB
WHITE QUARTZ
BARN BLUFF G.S.&C.M.Coy N.L.
4920 93M 80 ac.
WHITE QUARTZ

follow the Forth River up to nearly opposite Mount Oakley, and then turn to the west along the northern side of Swallow's Creek. Either of these routes would be in solid country nearly the whole way, and, passing up the schist country in the Forth Valley, would be opening up a possible mineral country which the old track, by passing along the greenstone capping of the divide, avoids. I am of opinion that the prospects of the district fully warrant the construction of this track.

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-BEARING CAPABILITIES OF THE GLADSTONE DISTRICT.

Government Geologist's Office,
Launceston, 11th May, 1901.

SIR,

I HAVE the honour to report that, in pursuance of your instructions, I have visited and examined the stanniferous ground at Gladstone. My visits extended from 28th January to 8th February, and again from 28th March to 13th April.

The primary object of my examination was to ascertain the capabilities, from a tin-mining point of view, of the country commanded by the Mt. Cameron Water Race. Mr. Rahbek, the hydraulic engineer recently appointed by the Government to report upon the cost of renewals and repairs of the water-race, having estimated the cost of restoration of the six syphons, and of a proposed reservoir on Old Chum Creek, as £22,000, or using perishable materials only, and without the reservoir, as £15,225; the question whether the tin deposits are such as to warrant the outlay has suddenly become of practical and pressing importance.

I may at once say that to form an estimate of the value of these deposits is no easy matter, and it cannot be even attempted without first systematically testing the ground by a series of trial bores.

The reason of the difficulty is that the bulk of the concentrations of tin ore is in gravels spread far and wide over the surface of the country. The configuration of the land was different in Tertiary times from what it is now, consequently, the rivers flowed in other channels, which were subsequently obliterated by being filled with marine wash, as this part of Tasmania sank slowly beneath the waves of the ocean. It has been shown by the diamond-drill bore at Belmont, near Longford, which went to a depth of 894 feet without bottoming in Tertiary lacustrine strata, that the subsidence of the land was considerable. While the country remained at sea-level the wash was, doubtless, carried hither and thither and redistributed by the sea, in which process river gravels and beach shingle got mixed and scattered over a wide area. On its emergence, the rivers, diverted higher up towards the south by extensive outpourings of basalt, assumed channels different from their former ones, and the old watercourses, choked with the stanniferous waste of the Blue Tier, remained thenceforward hidden below the superincumbent later marine and estuarine deposits. Streams of basaltic lava extended further north than Gladstone, for basalt is seen on Foster's blocks and on the N.W. corner of A. Parker's lot, No. 142., between Gladstone and Cape Portland, at the Mussel Roe Marsh. The intervening part of the sheet has evidently been denuded.

In consequence of the commingling of the deposits which has thus been brought about, it is difficult, and often impossible, to separate purely marine drift from purely river wash. The marine or mixed terraces are only locally rich, hence it is, above all, desirable to discover the deep undisturbed river courses, which may be expected to contain the richest drift. Apart from the greisenised granite porphyry formations, the future of the district may be said to depend upon the old beach terraces, and still more upon the uncovering of the more ancient river courses, now lost to sight beneath the pretty uniform covering of drift left by the sea and its littoral lagoons before the land rose to its present level.

A depression of the land, 300 feet below its present level, would bring the highest terraces down to sea-level again, and, accordingly, it seems as if the buried leads of the ancient rivers in this part of the country would terminate by running out to sea below sea-level.

From Mount Cameron northwards the surface of the land is a gently undulating or nearly level plain of marine denudation, sloping gently towards the sea. This gentle slope of the surface may probably be taken as a guide to the slope of the bedrock. Deep leads may, therefore, be within practicable reach, but they are certain to be wet, as they will collect the drainage from the granite slopes.

From a geological point of view, it would be of interest if the Government were to arrange for ascertaining the yearly or quinquennial rate of elevation or subsidence of the coast-line by means of fixed permanent marks at sea-level, such as have been made under the direction of the Swedish Government in the Scandinavian Peninsula, where observations are made and recorded annually.

The rivers which now run through the field are the Ringarooma and the Great Mussel Roe. It is well known that in early Tertiary (palæogene) times the Ringarooma flowed to the west of Mount Cameron. In like manner, it seems as if the palæogene Mussel Roe also ran west of its present course, though its ancient line is now difficult to trace, owing to erosion, earth movements, and the deposition of later sediment. As a starting point, we may take the channel of drift on the east side of the river on the late Mussel Roe Proprietary's section 3467, six miles S.E. of Gladstone. There is here a north and south run of drift, which is separated from the river by a low ridge of granite, shelving away from the present stream eastwards beneath the lead. The granite, as seen in the tail-race, is thoroughly soft and disintegrated, almost like a body of wash, nevertheless recognisable as a rock-mass and intersected by quartz veins. It plunges beneath the drift at an angle of 40°, bearing upon its floor a bed of dark silt, charged with pieces of lignite and comminuted carbonaceous material, accompanied by pyrites. This silt is essentially a fine sand, composed of quartz, muscovite, and clay, the result of the disintegration of granite. It at first dips down in layers, parallel with the granite rim-rock, but soon flattens out horizontally, and fades away into the eastern part of the workings, where the sand still contains traces of the carbonaceous matter. The rapidity with which the silt assumes the horizontal form suggests that the gutter is not very deep. The full depth of the floor from surface cannot be seen now, as some of it is filled up with run ground, but I am told a depth of 40 or 50 feet was attained. The workings extend eastward across the drift channel for about 150 yards, and the drift still continues in that direction in horizontal layers. In one part of the face there is a reverse shallow dip of the beds to the west, but this is merely local, and probably only a case of false bedding, resulting from a deviation in the current. The drift is a coarse granitic sand, composed of even-sized grains of rounded to sub-angular quartz, with felspathic material in the interstices, and small flakes of mica. It has evidently been derived from stanniferous granite rock in the immediate neighbourhood, and is a purely river formation. The seams of tin-wash are a little coarser than the rest of the drift, and contain round and sub-angular stones of vein quartz. These seams are from 10 to 12 feet from surface and show fair tin, sometimes 1 lb. to the dish, for about a foot thick. The ore which I found at one place in one of these seams was clean and good-looking, without any iron, but I was told that there had been pyrites associated with some of the tin. The carbonaceous silt mentioned above is full of pyrites. The tin has not been got deeper than 12 feet, but no bottom has been reached in these workings. The Proprietary Company abandoned work last year. After that Mr. Ogilvie tried it, and won a little tin, but at present the claim is idle.

A few yards east from the face there is a shallow pit, 10 feet deep, in similar drift, and then a flat for 500 yards eastwards, bordered by a granite hill range, which bounds the old drift channel on that side.

This Proprietary run of ground is one of the best-defined channels to be seen in the district, and an effort ought to be made to trace the position of the gutter by means of boring. A bore or two in the face, and a line of bores eastwards across the plain between the face and the granite range just mentioned, would throw light on the old channel outline, and there is a good chance of tin ore being struck. The country to the south is all granitic, and the old stream flowing all its way over stanniferous rock, and receiving the waste of the country on each side, must have collected a fair quantity of ore. No attempt seems to have been made to get down to the bed-rock, but if there is tin anywhere in this neighbourhood, the lower part of this channel is the place to search for it. The silt proves that the conditions of sedimentation were tranquil, and I think it very likely that tin will be found to have settled in the deeper part of the lead. Of course it will have to be elevated, as the lead bottom is below the level of the present river. The shallow work which has been carried on hitherto is absolutely useless as a criterion of the value of the deposit; nothing of any importance will ever be known about it, unless bores are put down as I have suggested above.

As far as can be judged from appearances, the old channel runs from the face north through Ogilvie's (or Carroll's) flat, still separated from the modern river by granite rock. North of the flat is a low E. and W. ridge covered with white quartz drift. If this ridge is granite, the lead bends round its eastern end, but its form suggests that it is made ground, and if so, it is the lead itself. On its northern brow a 5-feet hole has been excavated in granitic drift similar to that of the Proprietary. Further north, on the northern section, is another flat, with a shallow prospecting hole in similar drift. The next hill to the north of this is red granite, which continues northward. This blocks the lead on this side of the river (the eastern), and the old channel must then cross the modern stream in a north-westerly direction to Curtin's blocks (North Mussel Roe). Before it takes this turn the arrested flow very possibly gave rise to a deposition of tin, hence, the flat on the east side of the river is a likely place for prospecting.

On the western side numerous holes have been sunk in wash somewhat like that of the Proprietary, though often rather clayey and ferruginous. Some of these have shown a little tin. One of the holes, 15 feet, appeared to have bottomed on the granite, but in a northerly direction along the river a 30 feet borehole had not reached bedrock. No tin was shown in the northern bores.

The North Mussel Roe faces are two in number, the most southerly being the principal one. This is on granite bed-rock about 20 feet from grass, rather flat, but, on the whole, with a westerly dip. The wash is a granitic sand with a good deal of yellow clay. On the high reef the tin was pretty fair, but little, if any, was found in the deeper ground. The northern face is also in coarse granite sand on the solid granite, falling away to the west, though the uneven floor rises locally.

The sand is composed of subangular quartz, felspar, and a little white mica, and contains a little coarse tin. There are more stones in this wash than in the Proprietary, and the gravel is ferruginous in places. The face is about 12 feet high.

The ground immediately to the west of this appears to be granite covered with a partly consolidated cement formation, which continues to the Edina Sugar Loaf and further north, back west (at the Amber bridge) and S.W. by the ordinary porphyritic biotite granite. This cement contains sporadic tin, but nothing payable. Mr. Jas. Ogilvie showed me some tin in it at the base of the Sugar Loaf, south of the Edina flat. Somewhere below this cement covering the old lead lies concealed between the Edina Sugar Loaf and the Great Mussel Roe River.

Ground between Brown's Camp and Watts'.

North of Brown's house at the No. 4 Syphon is the Edina Sugar Loaf; a sub-conical hill rising to 300 feet above the sea-level. The hill is composed of cemented quartz drift, and the country northwards between here and Watts' is of the same description, covered with partially consolidated cement.

I may here digress to say a word about this cement. It is composed of water-worn grains of quartz, sometimes either loosely aggregated or bound and stained by red iron oxide. It is occasionally excessively hard and sonorous under the hammer, the binding material being then a secondary infiltration of silica uniting the component grains. It then looks more like a solid rock, distinct from the alluvial quartz drift.

In Ogilvie's Edina workings immense blocks of hard siliceous cement, several tons in weight, lie in the wash, generally resting upon the granite bedrock. They usually occur as tabular masses which do not appear to have travelled, though some of the smaller pieces have been moved and rounded by water. The tabular form of the huge blocks in itself shows that they have not been carried to their present positions by running water, though the stream has played upon their surface. Some of them contain quartz pebbles of fair size, but none belonging to the shingle of the modern Ringarooma. I imagine the blocks to be the result of the breaking up of cemented layers of drift *in sitû*; and they are still *in sitû*, or nearly so, as may be inferred from the fact that all along the Edina workings from the Sugar Loaf to the Ringarooma they may be seen lying nearly continuously at one horizon. They are seen at intervals all over the country: in Ogilvie's workings north of Ogilvie's bridge, and in the Scotia workings N.W. of Gladstone; in Moore's workings south of Watts', &c. Cement rock *in sitû* is seen further north, outcropping on the button-grass plains N. of No. 1 reservoir. A ridge of cement also runs E. and W. to the north-west of Matthewson's Lagoon. Brown's Hill, further west of this, is a hill composed of the same cement.

It is not easy to decide whether it is of marine or fluviatile origin. The widely separated localities where it occurs suggest that it was once more widely spread, and that the existing exposures are surviving remnants of a sheet of marine wash, unconnected with river deposits. The sugar-loaves and hill ridges are in favour of wider portions of it having disappeared by denudation. I saw some of it near Cape Portland, to the N.W. of Tregaron. In fact, I am inclined to think that the cementation of the wash may not have been co-extensive with the wash itself, but took place locally. All degrees of silicification may be observed, the drift being sometimes only loosely aggregated, the extreme being reached when the infiltrated silica has bound the component grains of quartz into a hard compact rock, liable to be mistaken for a quartzose modification of granite. Occasionally, I have found a little Kaolin coating the quartz grains. The upper surface of the blocks is worn frequently into hollows and potholes; and this, to my mind, is another evidence of water acting on an unbroken horizontal surface, and not on isolated boulders, which would have been worn into more rounded shapes: this has occurred in the case of detached fragments found in various workings.

Although pebbles are found here and there in this rock, I prefer the descriptive term "cement" to that of conglomerate, even on scientific grounds, for cementation implies definitely a subsequent binding action, which has taken place in the interstices of a loosely aggregated substance. We do not know at present how siliceous waters came to play upon this ancient wash, or whether the process is still going on. A possible explanation is that it was started in connection with the sheets of basalt lava which flowed over the country in middle Tertiary times. It is just possible that alkaline waters descending from the lava acted as a solvent on the quartz of the drift below, or that the descending water set free the silica in the basalt (basalt contains 40 to 50 per cent. silica), and carried it down to the wash. The silicification of tree trunks entangled in basaltic lava, and noticed in many parts of the world, is significant in this direction. This happens in the auriferous deep leads of California. Prof. Le Conte says*: "The deep placers of California are gravel-drifts in ancient river-beds, covered up by lava-flows 100 to 200 feet thick. These placers are worked by running tunnels beneath the basaltic lava until the river gravel is reached. Now, the waters percolating these lava-flows, and reaching the subjacent gravels, are charged with alkali from the lava. These alkaline waters are also charged with silica from the same source. Hence the driftwood of these ancient rivers has all been silicified by these siliceous waters. The gravels are also in many places cemented by the same material."

But this process is not always dependent upon the existence of a lava sheet. Tertiary sand and hard siliceous cement at the base of the Urals in Russia present the same phenomenon. Lava is altogether absent, and yet precisely similar action has taken place: one and the same deposit being in part loose sand, and in part siliceous rock as hard as any of the Edina cement.

The low country between the No. 5 syphon and the Mussel Roe River to the east is swampy, and shows signs of cement or quartz drift, but though I broke through the scrub to the river, I could not see any granite. To the west of this are the Edina flats worked by C. A. Ogilvie, yielding about 1½ tons tin ore per month. This run of ground extends westwards across the Ringarooma and the old Moorina Road, and connects with the Enterprise, though the wash changes its character towards the latter claim, becoming more like

* Elements of Geology. 1899. Page 258.

a river drift. The Edina workings show an abundance of slate, sandstone, quartz and quartzite shingle, alternating with pipe-clay and granular quartz drift, with the tabular blocks of cement described above. The channel is 40 feet higher than the present Ringarooma, and though it does resemble an old stream-bed debouching into the Mussel Roe basin, I cannot bring myself to believe that it ever had anything to do with the Mussel Roe lead, and for this reason: the shingle which surmounts the cement layer was naturally deposited subsequently to the latter. But the Mussel Roe deep lead received its deposits of tin prior to the depression of the land which admitted the sea and built up all this cement country. When the Edina waters deposited their shingle the Mussel Roe lead was already buried beneath the cement drift. On the other hand, it is difficult to connect the shingle with the Ringarooma, for that river never had an outlet to the east. Besides, whence could the modern Ringarooma, traversing granite country all the way from Derby (excepting only a small bar of slate at Derby itself), have derived the wealth of slate, sandstone, and quartzite pebbles which we find so profusely scattered through these terraces. Such stones must have come from the north, and the only agency which can have brought them from that quarter is the sea. Similar shingle occurs also in Moore's old workings to the north, and there, too, in connection with cement. We cannot suppose the Ringarooma to have twisted all about the country within comparatively recent times. These widely distributed areas of shingle can be more easily understood on the supposition that they are remnants of sea beaches. In this connection, I attach more importance to the abundance of sandstone, slate, and quartzite than to the shape of the stones. Even on a sea beach stones of slate assume a flattened form. A massive rock often forms flat stones. At Cape Portland the beach is loaded with flattened stones of the diabase (dolerite), which forms the promontory there. On the cement hill south-west of Watt's, and west of the Government race, are Moore's old workings, some 20 feet deep. The floor looks like soft semi-consolidated cement, which might very easily be mistaken for granite.

Large smoothed tabular blocks of hard cement lie about the workings. In section the face exhibits, in its upper part, 8 feet of clayey ferruginous pan resting on 5 feet of granular quartz drift, passing downwards into 4 feet exposed of large slate and quartz shingle, with an abundance of micaceous sandstone pebbles. The hill both east and west of this is cement, and higher up on the eastern brow boulders of hard siliceous cement lie strewn on the surface, resembling pieces of bed-rock granite.

North-east of this is George Watt's face (Black Boy Syndicate), where about 18 tons of tin-ore have been won during the past year. This is being worked on a false clayey bottom charged with imperfect leaf impressions, timber, vegetable pitch, and pyrites. This brown pug, exposed for about 10 feet in thickness, is covered with about 20 feet of sand, seamed with layers of small white quartz pebbles. The upper part is yellow gravel and white stanniferous wash. Good tin was found on the false bottom of the creek. Drift sand has been found below the clay, but the ground has not been bottomed. In the creek workings, a little to the N.W. of this, both sandstone and granite were touched. Just north of the main face, and at the base of the hill, soft granite comes up near the surface under a foot or two of quartz drift. This is about a mile west of the Mussel Roe River, and, in a broad sense, is the eastern granite bank of that basin.

Further east down the tail-race, near where it empties into the Mussel Roe, Tracey has a face on the south side of the tailings creek. This is on a tourmaline-granite bottom, which slopes down to the creek. This granite ridge is the immediate bank of the river, and the old lead must, necessarily, lie west of it. The presence of tourmaline-quartz rock indicates that tin-lodes may exist in the neighbourhood. This claim has returned about five tons of tin-ore.

Now, having traced the deep ground as far north as Watt's, one of two things may be conceived as possible—

(1.) The lead may continue still further north, and either (*a*) recross the modern river and find an outlet to the sea on the East Coast; or, (*b*) after proceeding a mile or two northwards, bend round to the north-west, passing betwen the Mount Cameron Water-race deep-cutting and the Portland Mine.

(2.) The alternative is to turn rather sharply a little north of west and continue on the Garfield-Tamar line. I think it has done this.

The crucial part of the problem lies here, because the adoption of one view will take us away to the east, altogether outside the sphere of action of the Mount Cameron Water-race; while the other view will confine us strictly to the country with which the race has more or less to do, though, perhaps, not commanding every part of it.

An inspection of the country lying south-west of the Portland Mine shows a continuation of Silurian slates and sandstones from the mine south-west to the deep-cutting, and, further south, to the 5-mile cutting across the eastern end of the Empress Dam Plain. Not far south of the Portland there is a narrow, treeless flat, on the watershed between the Great Mussel Roe and the Ringarooma, which might possibly be a channel through which a lead could pass. No wash, however, is discernible in the soil, and I doubt whether any exists. Still, to set the matter at rest and remove all doubts, a few prospecting pits should be sunk across it, and if no bottom is found, some bores would then be advisable. I anticipate, however, that the pits will be shallow, and bottom on hard ground (slate).

Instead of passing through this gap to the west, does the deep ground cross again over the Mussel Roe to the eastern bank? If it does, the crossing has to be looked for north of Watt's tail-race and south of Brown's Bridge. I heard that tin has been found to the east of the river, and a respected dweller in the district imparted to me his decided opinion that the lead, if there is one at all, does find its way to the sea in that direction. But the existence of alluvial ground on that side is not sufficient proof. A definite crossing-point must be found. At Brown's Bridge the river runs in granite. At Tracey's, on the tail-race, it does the same. A walk north from the tail-race shows that the hills skirting the west of the river are granite, overlaid with cemented drift and quartz and granitic sand. The white quartz sand is subangular, not so well rounded as the ancient wash. It is most likely that the modern Mussel Roe has cut its way down from here to its present channel. Tin-ore is present all through this drift. At one place dish prospects showed fine tin, with a little iron oxide, zircon grains, &c. Ruby and resin tin were proportionately plentiful. At this spot, opened out by Tracey, soft granite was found four or five feet from surface, and the wash was angular, showing flat pieces of felspar crystals, evidently from the adjacent bed-rock. Further north Watt has put down five bores for 25 feet, in sand with rotten timber, finding a little tin.

This is plainly a granite range running parallel with the western bank of the Great Mussel Roe, and forming a barrier to the passage of a lead across it. The tin found in the drift on the slope of the range has apparently been deposited by the modern river system, and, from appearances, I should think this ground is worth prospecting. There may be no great depth of wash, but a good extent of ground could be worked rather easily. The Mt. Cameron Water Race water could be brought on to it, and the fall to the Mussel Roe River gives grand facilities for tail-races. In any other part of the Island it would have been well prospected long ago, but Gladstone is afflicted with the disease of apathy.

The slates come down into this country, or, rather, at the back of it, from the 5-mile cutting, so that the only remaining course for the lead is through the run of ground between Watt's and the Tamar claim, *viâ* the Garfield. If it passes through the channel defined by the two exposures of granite at Watt's, it is rather narrow, in fact, narrower than might be expected. The only other direction for it to take from Watt's is nearly due west. There is hardly any other course for it, if it is to be brought into relation with the Garfield run. Bores in a north and south direction outside the west boundary of Watt's section will intersect the lead if it goes that way: and if these fail, bores in an east and west line north of Watt's eastward, down to the Mussel Roe, will intercept any northerly extension.

In the direction of the Garfield there is deep ground all along, and, strangely enough, it occupies the high hill country which slopes down northwards to the

Empress Plain. The Garfield workings yielded fairly good tin years ago, but the output had to bear pumping cost. Towards the west the face is 15 or 20 feet high, in loose sand, with alternating layers of quartz gravel. There is some slate in the eastern side of the Garfield workings, and Mr. Montgomery refers to Silurian bed-rock in a cutting at the back of the Eureka dam. This rock, therefore, would seem here to be the southern rim-rock of lead. North of this rim there is a continuous line of deep wash on the ridge. A good many small prospecting shafts have been sunk in ferruginous clayey and quartz sand, containing small white quartz pebbles. These are mostly on the northern brow of the hill, but are not more than 20 or 30 feet deep. Towards the east is a face some 18 feet, formerly worked by Chinese. It shows yellow and white sea-sand, with cakes and nodules of iron oxide. The pebbles are rounded white quartz; the sand is occasionally kaolinic, as if it had been derived from granite. Along the road also, on this ridge, towards the Tamar claim, is an old face cut about 12 feet through loose sand with horizontal layers of quartz pebbles. The drift has not been bottomed. The deep ground can be followed N.W. from the Garfield about three-quarters of a mile, as far as the Tamar, where the granite of the the Empress Hill blocks it on the west.

The bed-rock at the N. end of the Tamar face is silurian slate, which is, doubtless, underlaid by the western granite. Eastwards the drift is not bottomed, and nothing is known of what the ground is towards the north-east. There is a steep descent northwards and N.E. to the valley bottom occupied by Silurian slates, which rise again on the north side of the plain into a parallel ridge of hard country, hemming in any lead in that direction.

The Tamar wash is mostly a clayey, often iron-stained, and compacted sand, such as is often found in quiet marine backwaters. Plenty of grey sandstone pebbles occur in it. The bed-rock south and west is the dark mica granite of the Empress ridge, and pieces of granite are in the wash. In the north-eastern unbottomed part of the deposit pieces of drift-wood have collected in the loose sand-drift. I have had some of this sliced, and Mr. H. H. Scott, Curator of the Victoria Museum, Launceston, has furnished me with the following note on its microscopical examination :—

"With the exception of a faintly-indicated banding, and one well-marked area of perfectly evident structure, the specimen was so thinly ground as to leave little or no material to work upon. It was apparent that all ordinary methods of working would fail, and, therefore, the following method was adopted :— Wedge-shaped chips of various woods from many sources were examined, also shavings, polished woods, smoothly-planed woods, cut with and across the grain; also solid woody surfaces covered with Canada balsam and glass, and, as the woods included specimens from Australia, New Zealand, Tasmania, North and South America, Japan, Ceylon, and Northern Europe, the evidence was, at least, culled from a fairly-wide field. During this study over 80 distinct woods were examined. Coming back to the specimen with the evidence thus collected, it could be seen that the section had been cut at exactly right angles to the medullary rays, which, by compression and other external agencies, had been almost obliterated. A few broken scraps of the section removed from the main portion was a little thicker than the rest, and these aided largely in proving that the matter abraded during the grinding of the section had something to do with the filling up of the medullary rays in addition to the results of time. The wood would seem to have been that of some species of cedar, from which the whole of the true wood-cells have collapsed, and the hard bast has been compressed into solid straps."

We know that coniferous trees were very common in the early or Middle Tertiary prior to the basaltic eruptions, and, thus, the timber preserved in the Tamar claim harmonises with a reference of the deposit to the palæogene division of the Tertiary. The deepest part of the old channel will lie towards the N.E., and in that direction a few bores would ascertain the actual depth of the lead. The necessary water for this claim cannot be drawn from the Mount Cameron Race, but can only be got by pumping it up from the Ringarooma River. But if the bottom of the gutter could be reached and tested, it would be a guide to the possible value of the lead, and, as the upper sands yielded a little tin, there is a likelihood that the confined gutter will be much better. The sands which we see in this claim are the upper capping of the old river-wash below, and show that tin-ore was being distributed here by the agency of water in those days. Two chains west of the Tamar a shaft has been sunk by Mr. Galloway 20 to 30 feet in sand, with loose quartz pebbles. This drift is the old marine capping which extended to this height.

We have now reached the end of a more or less continuous line of old drift from the Mussel Roe Proprietary northwards. This line can, with some confidence, be called the Mussel Roe Deep Lead, though the gutter has not been reached at any point along its course; but, in attempting to trace the line from the Tamar further towards the sea, the appearances leave room for a good deal of conjecture, for, with this claim, we are brought to a full stop. However, by a process of exclusion, we are led to assume a likely course for the old river. We have seen that hard slate country bars egress to the N. and E., hence, the only possible cutlet remaining is in a N.W. direction. In that direction, across the Pig and Whistle Creek, deep ground exists from the old Lochaber workings right into the Aberfoyle country, and to try and turn the lead into any other direction is simply to refuse to recognise the facts presented to us. I admit that there is a difficulty in the way in the shape of an unbridged gap between the Tamar and the Lochaber, for there is no vestige of a lead in the slate valley below the Tamar, or crossing the Cape Portland road and the Pig and Whistle Creek, except, perhaps, at the Martha claim. Those who believe this difficulty to be insuperable are apt to lose faith in the very existence of a deep lead, and are driven to assume that the deep country north of the Ringarooma does not cover up any lead, but consists merely of terraces of wash forming the ancient beach when the sea laved the base of Mount Cameron. Consequently, they are shut up to a gloomy view of the future of the district, for, in sea-sand distributed over such a large area, the concentrations of ore would not be likely to be very payable, except in little gutters running down from the mount.

But I do not think the difficulty a fatal one. Once we have convinced ourselves that there was a Mussel Roe lead, it follows, necessarily, that it found its way to the sea in some way or another. A mere gap in its observed course does not remove that necessity, and can be understood by supposing the effacement of the lead by denudation and elevation of the land. In this connection it is advisable to prove the ground N. and E. from the Tamar claims by means of a few bores.

That great denudation has taken place just in this very valley is shown strikingly by the Empress workings $\frac{3}{4}$-mile to the west on the same granite range as the Tamar. This deposit is in a north and south gutter crossing the ridge, but denuded at each end, so that each extremity is open to and above the east and west valleys at each side of the ridge. In this way only a section of the former gutter is preserved. It may have emptied itself to the north into the old Mussel Roe lead, now denuded, or, on the other hand, it may be of later date. In any case, it affords an idea of the enormous amount of denudation which has taken place in comparatively recent times, and we may cease to wonder at the complete removal of all traces of the old lead in this valley.

The Empress claim has yielded excellent tin, coarse in character, up to nuggets weighing one ounce. The worked channel is upwards of three chains in width, but the unworked ground is much wider. The length extant is 15 or 16 chains. The bed-rock is coarse biotite granite merging into stanniferous quartz-mica rock. The drift consists of coarse granular quartz released from the granite. A feature is the abundance of large stones of reef quartz, some of them 2ft. in diameter. A few stones of black quartz are present. No tin has been noticed in the veins of quartz which intersect the granite. The gutter must originally have come across from the south.

The Bridge and Mary claims are north of Bell's Bridge. Both of them are on a slate bottom, and the drift, 15 to 20ft. deep, contains a good deal of flat shingle, but no granite stones. The Mary is S.E. from the Lochaber, but has nothing to do with that deposit, neither is it related to the Empress. It is not being worked now, but it has been above the average for tin, though nothing like the Empress in that respect. I noticed several water-worn pieces of cement in the workings. The Bridge claim belongs to the same class as the Mary. A Chinaman there is getting 1dwt. gold to every hundredweight of tin.

On the east side of the Pig and Whistle Creek, opposite the Lochaber, is the old Martha face, with some 30ft. of small gravel and sub-angular stones of reef quartz resting on a slate bottom, dipping away north and north-west. Small gravel and loose sea-sand alternate. The drift is essentially the same as that in the Tamar and Lochaber, and is in the line connecting the two. It is, however, a good deal lower than the Tamar.

Crossing the Pig and Whistle about $\frac{3}{4}$-mile north of Bell's Bridge we come to the Lochaber claim north of the Ringarooma. The workings are about 40ft. deep in quartz drift, resting on soft, pale-coloured slate, with sometimes a bed of pipeclay. The gutter here is deep, coming in from the S.E., and going out unbottomed N.W. The strike of the bed-rock slate is N. 10° W., and dip E. The slate contains quartz leaders. The drift consists of layers of sand and small rounded stones of quartz, and contains water-worn stones of cement. Some timber has been found in the gutter. There is a noticeable absence of shingle. The claim has yielded fair tin, and the lessees tried hard to make it pay. About half a ton per month was produced formerly, and a little gold was saved; but a drawback is that there is not a good get-away for the tailings. It has lately been started again. I have not much hesitation in co-relating the Lochaber with the Tamar drip; and if this is correct, then the deposit is the marine filling in of the old lead. Deep country exists W. and N.W. from here for two or three miles. It has been tested imperfectly in a desultory way by shallow prospecting holes and bores, which have not reached bottom. All round the intake of No. 6 syphon the country is overlaid with gravel said to be 12 or 15 feet deep, carrying a little tin. The large broad plain traversed by the northern extension of the Mt. Cameron Water Race is covered with wash, but it would be a mistake to bore promiscuously all over this wide area. The bed rock probably slopes very gently towards the sea, for if it did not, the present shore-line would be nearer. This being the case, there is a chance of the lead having been destroyed, and its material distributed in the terraces all over the plain. It is this element of uncertainty which forbids anything like a confident forecast of the future of this district.

The deepest shaft which has been sunk in the ground is the 56-feet one, between the Scotia and the water-race, in a sub-angular quartz drift, which, from the nature of the quartz, I should judge was derived from Mt. Cameron. The drift, however, in its upper part, is a ferruginous quartz pebble. About 700 yards S.W. is a line of shallow holes sunk in the top drift in a north-westerly direction from the Scotia, but without finding any good wash. Such, indeed, need not be expected in the superficial drift. I recommend a line of bores right across this ground in a N.E. direction as far as the bog at Stinking Creek. If the ground is found deepening steadily to the N. we shall know that the lead has been levelled to the sea, and that the deep ground rests upon the sea bottom sloping to the N. There is a further chance that the lead widened out as it approached the sea, and merged into deposits on the ocean floor, forming a wide flat delta, devoid of any defined channel. Whether a defined gutter or not passes this way can only be decided by the bores suggested, which will cross its presumed direction at right angles. The northern bank of the Ringarooma is slate, and its ridge of slate possibly forms the southern rim-rock of the lead.

Cutting across the slate country here is the Scotia lead I call it a lead, though it is hardly possible, as yet, to say positively whether it is a lead or a terrace. From the irregular form of the old workings, it might be considered the latter, but having in view the fact that they are bounded on each side by hard slate country, I am inclined to think that the run of drift occupies the bed of an old creek descending from a high ground south of the river. The sapphires, topaz, and smoky quartz, so abundant in the drift, support this view, for these minerals are eminently characteristic of Mt. Cameron, and are not features of the Mussel Roe lead. The numerous water-worn boulders of reef quartz lying on the slate bottom, and the subangular quartz stones in the wash, have undoubtedly been derived from the Mt. Cameron side of the Ringarooma. Such stones may be seen in abundance in the terraces on the northern side of the mount, and the denudations of large reefs like that of the Royal Standard would furnish large quantities of quartz. Here, too, water-worn stones of cement occur, also large tabular pieces with depressions worn into their upper surfaces. One large piece looked as if it were almost *in sitû*, but I could not see any adjacent mass from which it had been detached.

The claim has been known for many years, and in the old times a fair quantity of tin was extracted, but the production then fell off, and has only been revived lately by Mr. Jas. Galloway, who, by dint of perseverance, has brought the output up to about 5 tons per month. As far as he has stripped to date, the ground, including his previous clean-up, ought not to yield far short of 30 tons ore. There is not much tin in the upper part of the drift. Payable ground began about 10 feet below surface along a horizontal seam of yellow irony gravel, and good tin-wash has been found on the slate bedrock, nice coarse black and amber tin being plentifully disseminated. Rich, shotty tin crystals are studded in the soft clay slate. The drift is quartz, with pebbles of quartz and sandstone. Near the bottom little patches of clayey deposit occur where the current had slowed, and slow sedimentation took place. At the south end of the claim the alluvial is stated to have yielded sometimes as much as 1oz. of gold to the ton of tin, but the yield falls off going north.

The bedrock runs up to surface southward, and has been touched by Mr. Galloway's bores ahead of the face northwards, at a depth of 60 feet. It is safe to assume that the northern extension of the workings will lead into deeper ground. It will be gratifying if the boreholes now being made show tin in the deep ground. If, however, they do not, the lessee need not despair, for the ore in these deposits is inclined to be patchy. At the same time I think the chances are in favour of the drift getting less rich as it extends north. No gutter has been reached yet, as the workings are still going down on the slope of what may be the western rim-rock if it is not the mere configuration of an uneven bottom.

The old Scotia workings a little further N.W. are said to have still unexhausted tin-wash. Mr. Galloway got five tons of tin out of these, and the wash has not been bottomed at 35 feet. To the north, the pits which have been put down in the drift have disclosed poor ground on the whole; but they are not deep, the water generally coming in and causing suspension of sinking. Just N. of the Scotia race a shaft was sunk 20 feet in (it is alleged) payable wash. Three chains further N.W. a shaft was put down 16 years ago in wash to 30 feet without bottom. The wash looks favourable. A little tin is said to have been met with in seams. This wash carries stones of cement, which, moreover, is scattered all along the ridge. Some distance north of the present Scotia face a shaft 45 feet deep was sunk in nice-looking quartz wash, not bottomed. Seams of tin said to have been found.

Besides the Scotia shafts just mentioned, I was shown three others: one sunk in the old workings in clayey and sandy ground, with shingle, &c.; another, further north, in nice-looking wash, not bottomed on account of water; and another, higher up, about 20 feet deep in tin-bearing drift.

Mr. Galloway has commenced an improved race to the river, less circuitous than the old one; but the great drawback to this tract of country is that the Mount Cameron Water-race has not been brought across from the Sugar Loaf through Gladstone. In that case, instead of arriving at the Scotia by a detour of 15 miles, it would come in six miles, and give that claim 50-head more water. It would, further, command the terrace on the 2nd Sugar Loaf and the Fly-by-Night ground. Coming in at the top of the township it would command the Gladstone gravels, and the lessees of the Mount Cameron terraces, which still carry good tin, would almost certainly pump another hundred feet to get the water on to their claims. The manager of the water-race estimates that the renewals of syphons Nos. 5 and 6 will cost £5000. If that outlay is avoided, and the race diverted as aforesaid, the cost would be very little more than that amount. If it is decided to keep up the supply of water for the mines I am in favour of this diversion. Below No. 5 syphon there is no fluming to decay, and the race could be used afterwards, if necessary. If the Mussel Roe lead is tapped near Watt's, small tubes could be used in place of the No. 5 syphon.

West of the Scotia are the old workings of the Doone, on an uneven slate bottom, rising to surface N.W. The deposit is a granular quartz drift, with irregular layers of medium-sized quartz, slate, and sandstone pebbles. Micaceous quartz, porphyry, stones from the granite area, are mingled with pebbles of quartzite and metamorphic slate. There are occasional water-worn stones of cement. From the nature of the drift, I regard the deposit as a marine terrace. At one time good tin came from the Doone, scarcely so good, perhaps, as the Scotia mineral, but the next best along these terraces; and a good area of ground was worked eight years ago, when the syndicate carried on active operations. Work was abandoned about three years back.

Near the Doone is the Newhaven, on the north bank of the Ringarooma. It has less sand and more shingle, and no cement stones. It is difficult to say whether it is an old terrace or connected with the modern Ringarooma River.

A mile further N.W., on the same side of the river, is the Black Duck claim, in about 20 feet of pebbly river-drift of quartz, sandstone, and slate. The bottom is slate and sandstone, and, I should say, the deposit is related to the modern river system. This bank of the Ringarooma is slate and sandstone all the way up to Gladstone. Work on this claim has been stopped for two years. Men made wages here before, and would most likely do better now with the higher price of tin.

Half a mile still further north, on the north bank of a northerly loop of the Ringarooma, is the Canary claim, where the drift has been worked on a soft, decomposed, granite bottom, rising towards the river and shelving towards the sea. This is close to the contacts of the slate and granite, and is either the south rim of the basin of the Mussel Roe lead or the sea-floor of a granite terrace, for we see no more granite to the north of it. A little fine tin associated with iron came from this claim, but work was unremunerative.

Half a mile further west are M'Gregor's workings in the Aberfoyle country. This claim is the only one which has not bottomed, but it is only 20 feet deep, and on the tailings area, perhaps, another 20 feet. This depth is only what might be expected, for it is north of the granite outcrop. The drift is clayey sand with quartz pebbles, both large and small, jasper and quartzite, and concretionary iron in cemented layers. Pebbles of cement are seen, as well as some flat shingle. It is probably a mixed river and beach deposit. A few bores should be put across the face to reach the bottom, and test nature of the channel, if there be one. Work has been pursued irregularly by Chinese labour, till recently, but the three men used to get only about 2 cwt. of tin a week, which is somewhat below the standard, as a bag of tin per man per week is considered a fair average at Gladstone.

South of M'Gregor's is the old Aberfoyle Company's claim, which has a bed of small gravelly wash from 3 to 15 feet in places, resting on granite bottom, and carrying fairly good tin in places, not rich, but paying chinese to work. Water from Browns' Hill commands the claims. I should place this ground in the class of beach terraces, and the tin, consequently, is liable to be concentrated in patches, irregularly. This class of deposit is often very disappointing, for though, in the aggregate, the quantity of ore may be considerable, payable patches are discontinuous and met with only accidentally.

Being so near the slopes of Mt. Cameron, it might be thought that streams would run down from the Mount into this country, forming gutters lined with tin drift. But the presence of fine sand, and the absence of stones characteristic of the Mount (granite and black quartz) seems to be against this supposition. The quartz grains composing the sand of the drift on these flats are well worn and of even size, implying long and continuous battering and tossing, such as would take place on the sea-shore. On the other hand, the large stones and black quartz crystals prevalent in the Scotia claim, rather point to that deposit having taken place in a confined channel, such as the bed of a stream descending from Mount Cameron.

You Hen's claim is further south, abutting on the north bank of the Ringarooma. A deposit of 3 feet quartz sand, passing down into river pebble wash with stones of cement and quartz, rests upon the granite in which the Ringarooma has carved its bed here. Very little tin is being produced by these workings, only 1½ cwt. a month. The water difficulty impedes work in the Aberfoyle. If a higher pressure were obtainable, some of these claims might pay for working. Terrace ground is widely spread, and I do not think it is likely to furnish very brilliant returns. The deeper ground may be expected to lie a little further to the north-east, but whether it will pay to work at this distance down the lead, is, to say the least, problematical. Other things being equal, the *lead* will be richer in its higher reaches, and poorer as it approaches the sea, except where tributaries empty into it. The *terraces* will be richer the nearer they are to Mt. Cameron, and poor and patchy as they advance on the Great Northern Plain.

I have now carried conjecture and probabilities respecting the deep lead of the Great Mussel Roe as far as is warranted by appearances. The lower part of its course is not altogether free from doubt, as the land has suffered movement and denudation, in consequence of which bits of the land have been eaten away, leaving isolated fragments, which, unless we grasp the true position of the case, may be mistaken for mere potholes in the old sea-floor. More reliable information can only be obtained by means of boring.

The same uncertainty which attends the existence of the lead also exists with respect to its value from a tin-miner's point of view. There, too, the boring results may possibly give some encouragement. The only claim along its course which is paying at present is Watts', returning about 1½ ton per month; but it must be borne in mind that no claim has bottomed to the gutter; and until the gutter is found, no satisfactory test can be said to have been applied. Under these circumstances, it is impossible for me to predict what the lead will or will not produce. In its favour we have the fact that at intervals along its assumed course tin ore is present in the upper gravels, and, accordingly, an increased richness is probable in its lower beds. On the other hand, the distance of this part of the lead from the Tier is against continuous runs of ore. The ore concentrations are likely to be in patches, and have been governed by factors now unknown to us, such as gradient of river bed, obstructions to current, &c.

Apart from the deep lead, the alluvial terraces of Gladstone deserve consideration, for, in their time, they have contributed a good deal to the tin output of the district. Many of them are by no means exhausted yet, and, with a more reliable water supply, could be put upon the producing list.

South of the Lochaber the northern bank of the Ringarooma is covered with wash of a shingly nature 8 to 10ft. deep in places. A little ore is disseminated throughout, perhaps just payable at the present price of tin. On the southern side of the river at Gladstone Point, wash has been sunk in for 40 feet. On that side, and east of Bell's Bridge, are Morrissey's old workings in about 18 feet of drift, consisting of 12 feet of shingle covered by 6 feet of clay. The bedrock is Silurian slate, and a quartz reef 2ft. wide and vertical traverses it in a direction N. 55° E. Angular and water-worn boulders of reef quartz occur, and there are some rounded stones of quartzose granite. The tin has been irregular here.

A little further south is the gravel terrace called the Syndicate's Claim, which has returned a fair quantity of tin. It is composed of 6 to 10 feet of quartz drift, with pebbles of quartz and sandstone on the Silurian bed-rock. This terrace, too, has stones of reef quartz and some jasper pebbles. There is no really deep ground here. The ground becomes clayey towards the N.E. and falls off towards the valley of Coarse Gold Creek. These deposits do not seem to have been laid down in any definite channel, but rather to be the result of sluicing by the sea waves. Gladstone itself is on a similar terrace. A shaft behind Galloway's Hotel is sunk about 80 feet in wash, which has shown some good tin. Further N.W. towards the river is a large face, exposing about 20 feet of granular quartz drift bottomed on slate. When the Esk Company stopped pumping from the Ringarooma, this face stopped, too; but it is not worked out yet. At the bottom of the drift is a remarkable rubble of angular blocks of slate and sandstone. Pebbles of quartzite and jasper occur, but most of the large stones are only a little water-worn. Reef quartz boulders are present. Nearly all this material has come from adjacent rock.

Higher up, nearer the mountain, are the North Mt. Cameron terraces, which would yield good returns of tin if they could be supplied with water. These terraces are characterised by coarse tin, abundance of smoky quartz crystals, and large stones of reef quartz, all derived from the mountain. It is generally believed that tin ore exists in small quantities in the granite itself, and this is possible enough in the neighbourhood of tin-bearing veins. I have not seen such an occurrence, but I noticed fine crystals of tin in quartz veins traversing the granite at the Star Mine. The works there are in simple granite detritus, no pebbles, but angular fragments of white quartz from veins in granite. The granite is a coarse red variety, containing dark mica with accessory white mica. The quartz veins contain tin ore and mica, and are from 2 inches to 4 inches thick. The claim is strewn with lumps of tin-bearing greisen (quartz-mica rock) detached from higher up the mountain. There is no sign of alluvial drift in the little creek or ravine, and the ore must be patchy.

East of the Star is the Enterprise, which formerly returned good quantities of tin. It is still worked by Chinamen in the winter, when there is water. It is a wide body of drift, at the N.W. end, purely granitic in character, with quartz pebbles. Further east a few sandstone pebbles creep in, but all small, and mostly rounded, and then the deposit becomes clayey. A descending section would present 4 feet of clay, 3 feet of granular quartz drift, 6 inches layer of quartz pebbles, 3 feet large angular stones of quartz, resting on the granite bed-rock. There is no large shingle, and the drift appears to have come mainly from the mount. Going east, the run of ground leads to Ogilvie's workings, south of second Sugar Loaf. Here cement comes in, and pebbles of quartzite and slate are abundant. In this face the decomposed granite bed-rock rises to within 3 or 4 feet of the surface, and sinks in the bottom of the claim to 25 or 30 feet. The outlet creek from the claim goes east into Jewel's Flats, and the ground seems to be connected with Mr. Ogilvie's Edina workings. There is a continuous run from the Enterprise, although the nature of the drift varies so much from that nearest the mountain. It cuts the modern river system at right angles, and I am inclined to think it is late marine terrace ground. This claim is now abandoned and nearly worked out, but has yielded a good average for tin. The sand is very granitic; in the drift are ovoid, flattened and cylindrical pebbles of quartz, quartzite, slate and jasper, and frequently large worn and subangular stones of reef quartz. Water-worn and tabular blocks and stones of hard Edina cement are frequent, containing quartz pebbles. Gold, one ounce to the ton of tin, has been obtained from here. Round the eastern side of the Sugar Loaf are some shallow tin terraces.

An old claim, known as Brown's Face, is situate north of Ogilvie's Bridge. The deposit is coarse river-shingle, resting on the bed-rock of coarse porphyritic granite. The shingle is composed of quartz, quartzite, and sandstone. False bedding is prevalent, and the sand is apt to cake and be carbonaceous. This is, evidently, a river shingle-bed, the stream having redistributed marine material.

Lode-mining.—Tin-mining in the bedrock has not been carried on to any great extent. The greisen or quartz-porphyry rock on Harden's ravine and the Fly-by-Night Creek, forms a stanniferous zone between the unaltered granite and the Silurian slate. It has been cut into and worked a little, and some rich tin extracted. It merits attention, and, possibly, might be found to offer a payable proposition. The occurrence resembles the contact formation on Roy's Hill, in the St. Paul's valley.

The Royal Standard and Tasman quartz reefs behind the township were opened upon for gold, but appear to be closely associated with a tin-bearing granite source. In the fine-looking massive reef of the Royal Standard I found tin crystals, and a good deal of white or lithia mica. The reef is in slate country, bears N.W., and attains a width of 20 feet. Several shafts have been sunk on it, the deepest one being over 100 feet in depth. No great depth can be attained without sinking, as the ground falls away very gently to the N. and W. This reef is not far from the surface contact of granite with slate, only about half a mile, but, from the angle at which I observed the granite sloping below the slate in a deep cutting on the Mount Cameron Company's ground, the granite may be calculated as lying not less than 2000 feet below the surface at the township, unless, of course, there is some variation in its underground dip, which would affect the calculation.

Three-quarters of a mile north of the main race, crossing on the road to Cape Portland, a white barren quartz reef, in soft yellow slate, has been exposed in a prospecting hole.

N.E. of Gladstone, and west of the Mussel Roe River, is the old Blue Bell Mine, in slate country, where a shaft 200 feet deep has been sunk to exploit a white hungry-looking quartz reef. The mine had one crushing.

At the deep-cutting N.E. of Gladstone, I visited M'Donald's Gold Mine, which was started about three or four years ago. The shaft is abandoned. The lode is an east and west one. There was never any crushing, but a couple of tons of stone were washed, and are reported to have returned 6 dwts. gold.

The old Portland Mine has a 200-feet shaft in connection with an east and west lode, varying from 6 inches to 14 inches in width, but the stone pinched both east and west. The ore is a mixture of argentiferous galena and arsenical pyrites, in a quartz gangue, carrying gold. A lot was sent to New South Wales for treatment, and some of the stone is reported to have gone 6 ozs. gold per ton.

It is apparent that the slate country is traversed by numerous reefs, and some of these may be expected to contain gold in payable quantities. The precious metal in this field is apt to be alloyed with silver.

Gem-stones, &c.

Mount Cameron has long been known as the source of crystals of topaz, apparently released from coarse pegmatitic veins in the granite. Mr. Wintle was the possessor of a fine crystal from the Mount. This was eventually, sold in London to Bryce Wright for £60. There is also a very large one, eight inches long, in Mr. W. F. Petterd's collection. They are usually found rounded and waterworn in the stanniferous drift, where they suffer numerous fractures. The tint is generally slightly bluish and pale-green ; but colourless stones are also met with. When properly cut they exhibit a fine lustre. In lustre, after the diamond, come the colourless zircon, the white sapphire, the colourless topaz. But to bring out the full beauty and brilliancy of the stone it is essential that it be cut properly, that is, that the facets and angles be cut in accordance with the optical constants of the mineral. When Mount Cameron stones have been sent to England for cutting, it has been found that ready-cut stones can be bought there for the price of cutting the Tasmanian ones. There seems to be no market in Tasmania for these stones, except among the Chinese miners, who collect them and send them to China. In hardness (8) topaz is next to the ruby (8·8), sapphire (9), and diamond (10). Though so hard, in nature it is not a very stable mineral, but readily turns to kaolinite and mica minerals when in veins.* This instability is illustrated by the ease with which coloured topazes change colour when heated, or even when kept exposed to sunlight. This is, probably, a chemical change. At Mount Cameron only crystals of the rhombic prism and its sections occur, never the partially crystallised and radiating form of topaz called pyenite, which is found at Mount Bischoff.

The Mt. Cameron drift also contains sapphires, also certainly released from the granite, but more frequently, I think, from the Blue Tier than from Mt. Cameron. I saw some small stones of various shades of blue, but none of the genuine "royal" blue, which is the colour of the blue cornflower. Most of them were of a darker, more intense blue, which is apt to show rather black when cut, and has lost favour in the eyes of connoisseurs. One or two parti-coloured gems were shown to me: these colour patches are also often detrimental in the set gem. The hardness of the blue sapphire exceeds that of the ruby, being generally 9. There is, consequently, nothing surprising in the occurrence of these small stones at such a distance from the Tier. They are always well worn—more so than if they had been derived from the neighbouring mountain, though some of them may possibly have come from there also.

The brown and black crystals of smoky quartz, so abundant in the terrace ground, have, most of them, come from veins in the granite of Mt. Cameron. We

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* Lindgren, Metasomatic Process in Fissure Veins, p. 37.

have in some of these the morion tint of the Scottish cairngorm. The colouring matter is mostly diffused carbon. Where a tendency to violet is present it is probably due to titanic acid. Large water-worn prisms, 8 and 10 inches long, are common, sometimes slightly yellowish, or even colourless. Quartz crystals are collected by the Chinese workmen, who send them home to China to be used in making spectacles or crystal spheres.

I was told of the recent discovery of an "obsidian button" in a creek on the south slope of Mt. Cameron. It is uncertain as yet whether these pieces of lava emanated from terrestrial volcanoes or are to be considered as fragments of acid meteorites falling to the earth from stellar space.

Granite.

The granite of Mt. Cameron and the Gladstone district is part of the granite mass which occupies the country as far south as George's River. It is usually composed of quartz, dark mica (biotite), orthoclase, and oligoclase felspars, but where it is tin-bearing, white mica is developed in it. It is generally course in texture, and contains large crystals of felspar, which decays readily under atmospheric influences. Still, there is a good deal of a more even-grained variety, which would lend itself to structural and monumental purposes. For the latter purpose, once the rock were polished the surface would resist disintegration more successfully than in its natural state. Imported granite comes from Victoria and Scotland: the latter country yields a superior stone to ours. The foreign rock can be imported ready polished at a less cost than Mt. Cameron stone could be delivered and polished in Launceston. In Britain, the polishing work is done by machinery, and incidental labour is cheaper there than here. Mr. Dunn, of Launceston, assures me that there is not the outlet here for granite which would warrant the importation of plant, and even then the imported stone would compete successfully with the Tasmanian. Under any circumstances the dressing and cutting of granite is not easy, and it is unlikely that the near future will see any demand for locally-hewn stone, but there is no doubt that eventually some of our granites will be utilised.

Conclusion and Recommendations.

Viewed as a whole, the district surrounding Gladstone is endowed with three classes of potential resources: (1) auriferous reefs; (2) stanniferous lodes or formations; (3) alluvial tin-bearing terraces and leads.

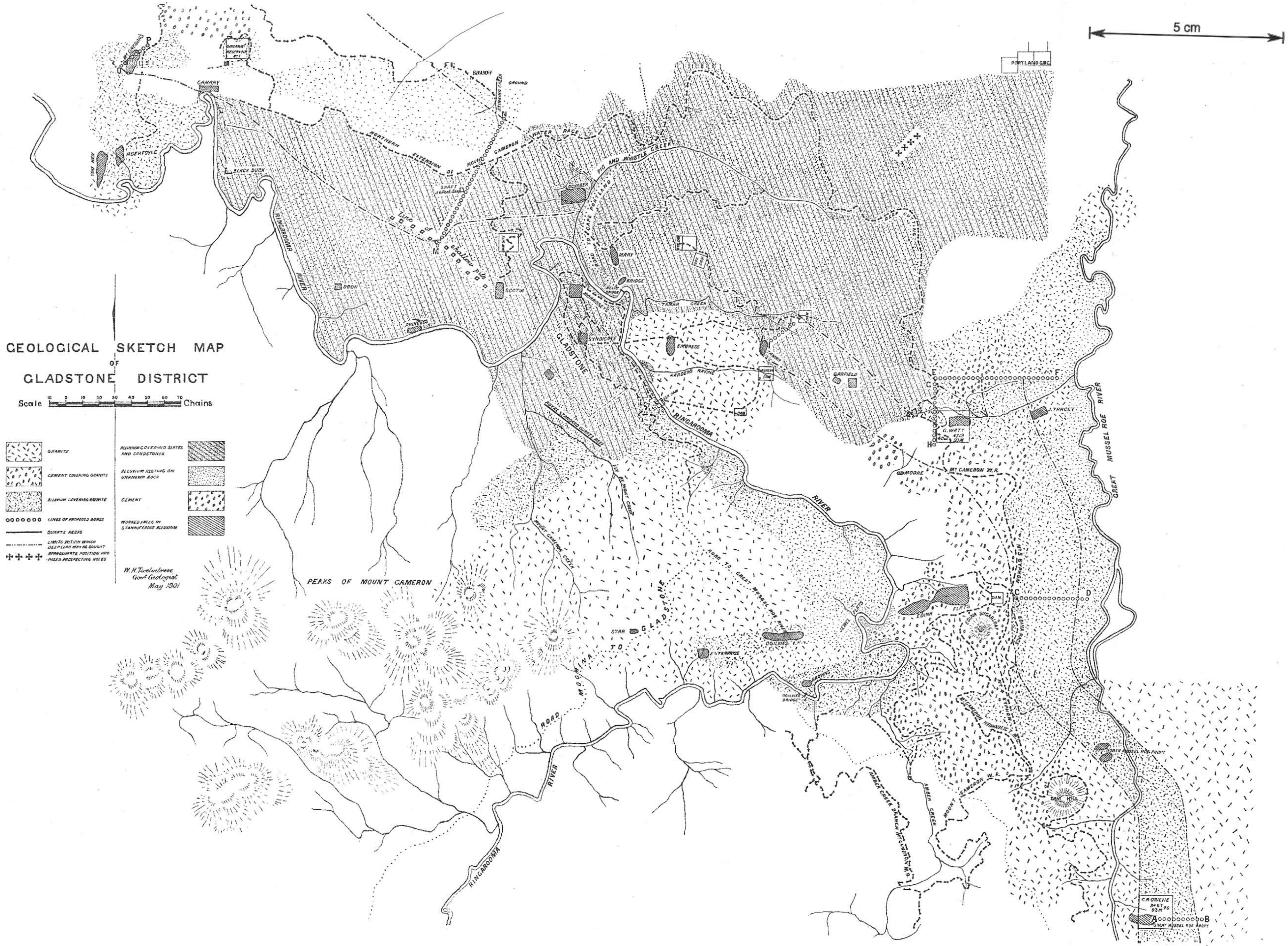
1. Quartz reefs have been opened upon at the Portland, Blue Bell, Royal Standard, Royal Tasman, and a few other points with no great success. But these failures are not sufficient to deter renewed search for better reefs. Those which I have seen certainly have unpromising-looking stone. The Portland reef forms an exception to this statement, and I understand that mine is likely to be started again. But the country all round has numerous reefs in slate-rock, and it is unreasonable to suppose that every reef is certain to be barren. There are likely to be scores of reefs, also, which are concealed by the wide-spread alluvial. The alluvial tin workings which bottom on the slate country nearly always return gold with their tin, and this can only have been derived from denuded reefs traversing the slate. The suspicions of salting in the case of some of the reefs worked has rested upon Gladstone like a cloud, and effectually crushed gold-mining there for a long time past; but I believe its time will come again. There is no warrant for concluding beforehand that the reefs now visible are all which exist there, or that the Silurian slates are less likely to carry gold-bearing quartz than elsewhere. On the contrary, the prevalence of gold in the tin drifts points strongly to sources of the precious metal still undiscovered.
2. There is a belt of stanniferous rock forming the margin of the granite along its contact with the slates from near the Empress to the old Mt. Cameron Company's ground, west of the Fly-by-Night. This rock (known

> locally as quartz-porphry) is essentially greisenised granite, and is a home of tin ore. The small veins of tin in it are individually insignificant, and not worth working by themselves, but selected parts of the formation itself may be remunerative, and a constant supply of water could be furnished to the ground by re-arranging the course of the Government race. The testing of the formation on any considerable scale would, of course, have a certain element of risk, but not greater than usual mining risks. The problem requires carefully looking into by investors.

Mt. Cameron itself has not revealed yet any substantial tin lodes, though undoubtedly it is traversed by veins of tin-bearing quartz, as seen at the Star. I should think it probable that it has not been prospected all over thoroughly, for there is a good deal of Mt. Cameron tin to account for in the high terraces on the slopes of the mountain. The veins are responsible for much of this; disseminated tin, too, may have been released from the granite itself; but these sources hardly seem adequate for the quantities formed. Against this idea of undiscovered tin lodes existing on the mountain is a noticeable absence of tourmaline courses, such as are prevalent at Ben Lomond and Mt. Heemskirk. On the other hand, as tourmaline quartz rock occurs at Tracey's on the Mussel Roe, that neighbourhood might well be prospected for tin lodes.

The alluvial terraces and leads are the mainstay of Gladstone, though from the very nature of the case, alluvial tin-mining, here as elsewhere, must eventually decrease in importance as the deposits become worked out. The deposits in this district are far from being exhausted. The question resolves itself into one of economical mining. The payable parts of the stanniferous drift require locating; and the supply of water is a *sine qua non*. This, in a nutshell, describes the conditions of remunerative mining at Gladstone.

The local output of tin has fluctuated in sympathy with the price of metal, and with the seasonal stores of water. Many claims can only be worked in winter, and are absolutely idle during the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GEOLOGICAL SKETCH MAP
OF
GLADSTONE DISTRICT
Scale 10 0 10 20 30 40 50 60 70 Chains
GRANITE
CEMENT COVERING GRANITE
ALLUVIUM COVERING GRANITE
LINES OF PROPOSED BORES
QUARTZ REEFS
LIMITS WITHIN WHICH DEEP LEAD MAY BE SOUGHT
APPROXIMATE POSITION PROPOSED PROSPECTING HOLES
ALLUVIUM COVERING SLATES AND SANDSTONES
ALLUVIUM RESTING ON UNKNOWN ROCK
CEMENT
WORKED FACES IN STANNIFEROUS ALLUVIUM
W. H. Twelvetrees
Govt. Geologist
May 1901
PEAKS OF MOUNT CAMERON
RINGAROOMA RIVER
GREAT MUSSEL ROE RIVER
GLADSTONE
CANARY
ABERFOYLE
BLACK DUCK
PORTLAND G.R.C.
MT CAMERON W.R.
TRACEY
GARFIELD
EMPRESS
SYNDICATE
BRIDGE
MARY
SCOTIA
DOON
ENTERPRISE
STAR
OGILVIES
EDINA
C. R. OGILVIE
GREAT MUSSEL ROE PROPY
NORTH MUSSEL ROE PROPY
MOORE
PIG AND WHISTLE CREEK
ROAD TO GREAT MUSSEL ROE RIVER
MOORINA TO GLADSTONE ROAD
SWAMPY GROUND

summer drought. I may mention parenthetically, that there is no means of ascertaining the rainfall at Gladstone. If the Meteorological Department would supply the manager of the Government race with the necessary instruments for daily observations, a record would be available where it is more needed, and of greater use than at many other stations. Also certain claims can only be worked at a profit when the market price of tin keeps up to about £80 a ton. Hence, a not unimportant consideration in connection with putting capital into the district, or incurring heavy expense for renewals of existing races, is what the market price of tin is likely to be in the near future. The outlook seems satisfactory in this respect. Looking back upon the last ten years, the first quinquennial period showed a production of tin throughout the world in excess of consumption. During those five years the output exceeded the demand by 20,000 tons, while for the last five years' period the demand has outstripped the output by 15,000 tons. To exhibit the position clearly, I reproduce the following tabular statement from the *Australian Mining Standard* of 14th March, as extracted from a review by the *Financial Times* :—

Year.	Production.	Consumption.	Stocks.	Average price.		
	Tons.	Tons.	Tons.	£	*s.*	*d.*
1891......	59,463	57,095	18,709	91	3	0
1892......	64,569	60,842	19,065	93	6	8
1893......	67,701	67,066	20,082	85	1	2
1894......	73,634	66,817	29,220	68	14	2
1895......	74,981	68,522	35,704	63	7	1
1896......	74,867	71,949	40,101	59	9	11
1897......	69,924	71,284	34,937	61	8	0
1898......	69,262	80,436	23,353	71	4	1
1899......	70,707	74,216	20,681	122	8	7
1900......	77,925	79,869	20,377	133	11	6

The Straits were responsible for nearly 50,000 tons of the 1900 output (an increase of 2000 tons over 1899), and Cornwall for 4000 tons, a 50 per cent. decrease, as against that county's production for the last few years. The output of the Straits is, in many quarters, looked upon as a dark horse, but from what I am able to gather from published reports and private advices, I am lead to believe that fears of any immediate leap in the production are groundless. Now, given a nearly stationary output, or, at any rate, only moderate fluctuations, no new sources of supply in sight, and a steadily increasing consumption of the metal, I do not see how we can do otherwise than look forward to the future of the tin market with confidence. It has taken three or four years for the world to wake up to the state of the case, for though the consumption began to increase in 1896, the market price did not become appreciably affected till 1899. Of course, last year's quotations were too unsteady to last, but an ordinary business view of the situation is sufficient to tell us that present prices are likely to be fully maintained.

The annual output of tin ore in the Gladstone district from claims supplied by the Mt. Cameron Water Race, according to statistics furnished by Mr. M. J. Griffin, the manager of the race, is about 80 tons. The last six months 53 men were employed on 15 claims, though shortage of water at the end of the dry season has reduced the number of workers to 25. The last six months' production of tin has been 38 tons; with an average year's water supply, the annual output might be raised to 100 tons. This industry supports a population of about 150 souls. The water-race has so far paid its way and returned £6262 3*s.* 6*d.* surplus revenue into the Public Debts Sinking Fund. Its annual revenue is about £1500, and annual costs about half that sum. The output of the principal claims drawing water from the race is as follows:—

Scotia claim	About	5	tons	per	month	
Edina claim	,,	1½	ton	,,	,,	
Watts' claim	,,	1½	,,	,,	,,	
Tracey and Daws......	Nearly	1	,,	,,	,,	
Moore's claim	About	¼	,,	,,	,,	
He Sung's claim	,,	1½	cwt	,,	,,	
M'Gregor's claim.....	,,	½	ton	,,	,,	
Lochaber—restarted ..	,,	½	,,	,,	,,	formerly
Bridge claim...........	Nearly	¼	,,	,,	,,	

The above figures are per working month, but shortage of water interrupts work.

It seems to me that it would be a fatal blow to the whole field to pass death sentence on these claims, as would be done if their water supply were allowed to cease. The result would be the immediate and almost entire abandonment of the Gladstone district and the stoppage of all revenue from mining leases therein. And resuscitation at any future time would be a matter of enormous difficulty.

In order to acquire additional and necessary information respecting the Mussel Roe deep lead, and the possibilities of the field generally, before committing the Government to a serious outlay for the renewals of the race, I would recommend a series of bores being put down in the drift at the places marked on the chart which accompanies this Report. Something more will then be known about the direction and nature of the ancient channels in which it is believed accumulations of tin ore may have been collected. These places are as follows :—

1. Five or six bores at the Great Mussel Roe Proprietary, on Section 3467–93M. These bores would be about two chains apart, if necessary. Their object is to cross and define the channel of the Great Mussel Roe lead from west to east, eastwards of the present unbottomed workings of the Proprietary. In this case, as in all others, before boring is started, care will have to be taken that the land is in the possession of the Crown. Marked A—B on the annexed chart.
2. Nine or ten bores, four chains apart, on Crown land, between the No. 5 Syphon at the Edina dam, and the Great Mussel Roe River. The object of these is to cross the Mussel Roe deep lead and also prove the ground east of the Edina run of tin-bearing wash, which has been worked more or less continuously from the Enterprise on the west, to the Edina Sugarloaf on the east, a distance of nearly two miles. Marked C—D on the chart.
3. Four or five bores, four or five chains apart in a north and south line a few chains west of Section 4219-91M (Watt), south into 3566, and north into 2143, to intercept possible channel of lead in this direction. Marked G—H on chart. If the channel is not found here, then bores to be started at the north end of the line and at right angles to it in an east line to the Mussel Roe River. The bores would be twelve

in number, about five chains apart on Crown land. This would settle once for all whether the lead goes out to the north. Marked E—F on chart.

4. Four or five bores, about two chains apart, northward and eastward from the deep ground in the Tamar workings on Section 2011-91M, proceeding towards the Empress dam. This ground has not been bottomed, and, as the lead ahead of it is surmised to have been denuded, it is important to settle the point. Marked I—J on the chart.
5. Twenty-two bores, five chains apart, from the north-west angle of Section 1857-87M to the south-east corner of 172-87W, Stinking Springs, and further north-east, if found necessary. This line will cross north of the Scotia claim, and is designed to prove the lower portion of a heavy bed of stanniferous drift. The line passes at right angles across the presumed direction of the Mussel Roe lead, and the bores will prove, firstly, whether there is any such channel at all, or only a sloping sea-bottom, and secondly, whether the bottom part of the drift is encouraging for tin. Marked M—N on the chart.
6. Three bores in the floor of the M'Gregor workings, Section 2089, in the Aberfoyle country, to find the bottom, and prove whether the deposit is in a confined channel, or consists simply of marine terrace ground. Marked O—P on chart.

The above work comprises 50 or 60 bores, and these, with a few shallow pits south of the Portland Mine, referred to previously, marked K—L on chart, would certainly throw light on much that is now obscure. The work would take about four months, and would cost about £200, in addition to the cost of delivery of the boring apparatus on the field. If the rods could be borrowed or hired, the total cost of the undertaking ought not to exceed £250. Three men would be required, and rods to go down to 200 feet if necessary, though I think the bottom will be reached generally at a much less depth.

In fact I doubt whether the extreme depth will exceed 100 feet. Still, it is well to be prepared. Needless to say, exact registers of the borings must be kept. The ground is loose or partially consolidated quartz drift, here and there only hardened to a kind of cement.

With the additional information obtained by this means, the inferences indulged in in my Report may be fortified, and useful and necessary hints secured for future work: or, on the other hand, eventual loss may be saved by doing away with baseless hopes. In any case I think it would be unwise to abandon the field without a final test.

I have to tender my thanks to Mr. M. J. Griffin, Manager of the Government race, Mr. James Galloway, Messrs J. and C. Ogilvie and others in the district, for information and help received.

The chart herewith shows the bed-rock which underlies the superficial covering of drift. This drift, while deep wherever terraces and leads have survived, is shallow on the higher ground, where the granite or slate bed-rock becomes visible.

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 MINING DISTRICTS OF THE SCAMANDER RIVER AND ST. HELENS.

Government Geologist's Office,
Launceston, 4th June, 1901.

SIR,

ACTING on instructions received from Mr. W. H. Twelvetrees, Government Geologist, I left Launceston on the 22nd of April last to examine and report upon the mining districts in the vicinity of the Scamander River and St. Helens. I am indebted to the kindness of a number of gentlemen whom I met on my journey for information concerning the districts visited, especially to Mr. Paul Beahr, who accompanied me throughout the Scamander River Copper Field, and also to Messrs. H. Grant, T. Haley, Geo. Briggs, B. H. Whittle, and others, who supplied me with much information concerning mining at St. Helen's.

The metals found in the Scamander River and St. Helens districts consist principally of copper, tungsten, and tin. I deem it advisable to divide my report into three parts, the first dealing with the deposits of copper ores north of the Scamander River, and including one deposit (the Silver Echo Mine) near St. Helens, but in the same line of country as the Scamander deposits; the second describing the deposits of wolframite south-west of St. Helens; and the third part dealing with the alluvial deposits of tin at the Scamander River and in the vicinity of St. Helens.

COPPER DEPOSITS IN THE DISTRICT NORTH OF THE SCAMANDER RIVER.

The area in which the deposits of copper-ore about to be described occur is situated to the north of the Scamander River, and extends to within a few miles of the Town of St. Helens. The rocks consist, for the most part, of shales or slates, sandstone, and quartzite, striking from 15° to 30° west of north, and dipping, for the most part, at high angles to the west. Granite has evidently played a most important part in the geology of the district. A massive belt of this rock runs parallel to the coast line from St. Marys to St. Helens, forming the core of the Scamander range of hills, and, according to the observations of Messrs. Montgomery and Harcourt Smith, forms the axis of a large anticlinal fold, the strata dipping away from the granite on either side. To the north of the area is the great mass of granite of which the Blue Tier and Mount Cameron form a part, and from this mass other dykes and tongues of granite or granite porphyry protrude into the sedimentary rocks for long distances. Contact metamorphism is distinctly noticeable in many places, and often extends for considerable distances away from any observed line of contact. This is especially noticeable in the northern portion of the district, where we find sandstones altered to quartzites, and shales and slates indurated and changed into a hard compact rock of the nature of hornstone. Many of these indurated slates contain numerous small concretions of a faintly glimmering substance, probably representing the incipient stage in the formation of crystals of such minerals as chiastolite. No fossils have as yet been found in these rocks, notwithstanding the fact that they have been diligently searched for by several gentlemen who interest themselves in the geology of the district. The only clue, therefore, that we have as to their age is the presence of the granite. The sedimentary rocks are evidently older than the latter, for they have suffered metamorphism at their contact with it. Granite in Tasmania is believed to be of Devonian age, and consequently we may assume that the sedimentary rocks are of the Silurian, or possibly of some still older, period.

The area is traversed by numerous small streams, mostly affluents of the Scamander River, running in steep gullies, separated by bold ridges, and making the country very rugged. The surface is, for the most part, devoid of undergrowth, though covered with a fine forest of ironbark timber, which would become very valuable if mining in the district became prosperous. The absence of undergrowth makes most of the country easily accessible to the prospector, and it is to be regretted that up to the present the district has not received the attention it undoubtedly deserves.

The Eastern Proprietary Silver and Copper Mining Company, No Liability.

This company holds Sections 56-93M and 57-93M, each of 80 acres. The mine is situated about 3½ miles to the north-east of the Township of Yarmouth. It is the only copper mine in the district on which any considerable amount of work has been done. The lode on which the company has been working is a very strong one, and may be traced by means of its gossanous outcrop, running diagonally through the two sections held by the company, and for considerable distances both north and south of them. In all, the lode is traceable for close on two miles. The strike is as nearly as possible N.W. and S.E., and the dip is to the west at a steep angle. A long tunnel has been driven on the course of the lode, commencing in the valley of a creek which crosses the lode in the southern portion of Section 56-93M. North of this creek the outcrop follows the crest of a high narrow ridge, which in places rises more than 500 feet above the tunnel level. I think it probable that this ridge owes its existence to the presence of the lode. The shales and sandstones on either side have been permeated by silicious solutions from the lode, and becoming hardened, have offered greater resistance to the agents of denudation. On the surface the lode-matter consists of brown oxide of iron, iron-stained kaolin, ferruginous cherty matter, and occasionally veins of quartz, but no copper minerals. Chloritised slate generally accompanies the outcrop, and from this a reaction for copper may often be obtained with the blowpipe. The tunnel has been driven along the western wall of the lode, and follows a seam of kaolin and decayed lode-matter almost the whole distance. In a number of places short cross-cuts have been put in in a north-easterly direction from the drive to prove the width of the lode. These have shown that the total width of the formation is not less than 20 feet, but it is very questionable if all this can be classed as lode-matter ; it consists principally of partially decayed slate, much jointed and shattered in a direction parallel to the lode, and some of this contains considerable quantities of black oxide of copper in the joints. The main lode-channel, however, through which the mineral-bearing solutions originally circulated, is evidently represented by the seam of pug along which the tunnel has been driven.

In entering the tunnel, for the first 70 or 80 feet, the whole lode-matter, or the metallic contents thereof, have been leached away, and no copper minerals are to be seen. After this the pug seam becomes stained green with copper sulphate, and other oxidised copper ores appear.

At 150 feet from the entrance the first pay shoot was struck. The ore, which consisted of black and red oxides of copper (melaconite and cuprite), green and blue carbonates (malachite and agurite), and copper sulphide (chalcocite) was discovered just in the bottom of the drive, and it is possible that had the latter been put in two or three feet higher the shoot would never have been found. A winze was put down, and at a depth of 12 feet water was struck, which stopped further sinking. The ore above water-level was, however, stoped out, and yielded 20 tons of high-grade copper ore. The length of the shoot at water-level was 25 feet, or, in other words, its length increased from practically nothing to 25 feet in a depth of 12 feet. The ends of the stope are in grey, decomposed slate, carrying a fair percentage of black oxide of copper, but not sufficient to pay for mining under present circumstances. To the east of the stoped ground a chamber has been taken out, 10 feet wide and 12 feet in length. The character of the stone in the ends of the chamber is much the same as that showing in the ends of the stope, and carries black oxide of copper freely through it, though whether payable ore was got from here I was unable to ascertain. For the next 250 feet along the course of the lode the drive follows the same pug seam, and all along the latter is stained a bright green with copper sulphate. This mineral, it should be noted, has been formed since the drive has been put in. It represents the leaching of the lode above the tunnel, and has only been precipitated in the tunnel by evaporation. Nowhere does it occur in payable quantities. At 400 feet from the entrance the second pay shoot was struck. This shoot was of exactly similar nature to the first, but rose above the tunnel for a distance of 20 feet before it cut out. It has been stoped out to water-level (again 12 feet below the tunnel), and at that depth proved to be 70 feet in length. In all, 296¾ tons of ore were obtained from this stope, of which 100 tons mined in 1896 yielded an average of 28 per cent. of copper and 17 ozs. of silver; and 196¾ tons mined during the latter portion of 1900 yielded an average of 17 per cent. of copper and 13 ozs. of silver. A winze was put down at this point for a distance of 85 feet, and is said to have been in payable ore all the way, but, owing to the water present, this could not be taken out. Six inches of chalcocite are said to be showing in the bottom of the winze. The shoot is said to have been 8 feet in width at its widest point. The drive has been continued on the course of the lode for a total distance of 870 feet, but, owing to the ground having fallen in, I was unable to examine it further. The general character of the lode is stated to be the same throughout, but no more rich pay shoots were struck.

At 400 feet from the entrance of the tunnel a crosscut was put in on the hanging (western) wall, at right angles to the drive, for a distance of 200 feet. For the first 150 feet the country is sandstone, with a little shale interbedded; after that there is more shale than sandstone. At 160 feet a winze was put down on a seam of kaolin and decayed rock, and at 16 feet, at water-level, a seam of about five inches of black copper ore (chalcocite?) and iron pyrites was struck. Owing to recent rains there were two feet of water in the bottom of the winze, and I was unable to examine it.

At 450 feet from the entrance another crosscut was put in, in a north-easterly direction; and at 30 feet a winze was put down on a vein of puggy matter, containing black copper-ore. The depth of the winze is stated to be 16 feet, water having been struck at 12 feet. At water-level four inches of black copper-ore were found.

On the southern section (57-93M) a second tunnel has been driven along the course of the lode for a distance of 40 feet. Beyond finding the presence of copper, however, nothing of importance was discovered. The lode here is of essentially the same nature as in the other tunnel.

It will be evident from the above description that there is very little hope of finding copper-ores in payable quantities, or in quantities that will pay the present cost of transportation, in the oxidised portion of the lode. The lode has already been driven on for a distance of 870 feet, and only in one place has payable ore been found above tunnel-level, and this was only the top of a shoot of ore which rises a little higher above water-level than usual. In order to be able to come to any conclusion as to the probability of payable shoots being found below water-level, it will be necessary to inquire into the chemical and geological processes which have been at work. The copper mineral originally deposited in the lode at the time of its formation was no doubt chalcopyrite, the common sulphide of copper and iron, which experience has shown to be, in the vast majority of fissure-lodes, the primary copper mineral. This was associated with iron and arsenical pyrites, quartz, a little zinc-blende and galena, and, probably, other minerals. Since its formation, however, denudation has been actively at work, and has excavated deep gullies in the vicinity, which carry away the surface water and lower the level of the ground water. The result is that a large part of the lode is exposed to the oxidising action of the surface waters. The permanent water-level is now, as shown by the mine-workings, about 12 feet below the level of the tunnel. Above this the lode has been subjected to the action of waters trickling down from the surface along the lode-channel and carrying with them oxygen gas. These waters quickly change the insoluble iron and copper sulphide into soluble sulphates, and in in this form carry them downwards till they reach the water-level. This action is still going on, as shown by the water, heavily charged with copper sulphate, passing down the sides of the tunnel, and which, on evaporation, deposits its mineral contents. When the copper-bearing solutions reach the permanent water-level, movement does not cease; it tends to flow towards the surface at some lower level, and in doing so, it will utilise the entire available sectional area of the openings leading thereto. But the extent to which these openings are utilised will be inversely proportional to the amount of resistance which they offer to flowage, and this will depend upon their relative size and the distance which the water must flow before reaching the surface. The result will be that, in most cases, the flowage will be principally confined to the lode-channel. Concerning the direction of flow in the lode-channel, this will have a vertical, as well as a horizonal, component, and the vertical component will be greater, or the amount of water flowing downwards will be greater, in proportion as the distance of outflow is greater. These general principles, however, are probably, in reality, greatly modified by the irregular distribution of the openings in the lode-fissure, and it is probable that the bulk of the water follows certain paths of least resistance, which occasionally may carry it to great depths before it again emerges at the surface.

We have now to consider the action of these solutions of sulphates on the unaltered ores below water-level. These, as I have already pointed out, consist largely of sulphate of iron, the latter mineral, contrary to what is often stated, is less soluble than copper sulphide. The result of contact of copper sulphate with iron sulphide will be a chemical substitution. Copper sulphide will be precipitated and iron sulphate will go into solution. This reaction has been proved experimentally by Schürmann, and may be represented by the following equation :—

$$Cu_2\,S\,O_4 + Fe\,S_2 + O_2 = Cu_2\,S + Fe\,S\,O_4 + S\,O_2.$$

Similar equations may be readily made to represent the alteration of iron pyrites to bornite or chalcopyrite; or the alteration of chalcopyrite to bornite or chalcocite; or the alteration of bornite to chalcocite. All these reactions may take place, and the presence of large quantities of these rich copper sulphides at water-level, and for some distance below it, in the case of lodes the upper portions of which have been subjected to oxidation, is satisfactorily accounted for. This subject has lately been dealt with exhaustively by C. H. Van Hise, in a paper read before the American Institute of Mining Engineers, entitled "Some principles controlling the deposition of Ores," and is well worth consulting.

In the case of the Eastern Proprietary Mine, the presence of the enriched zone has been proved beyond doubt, and it remains for the future mining operations of the company to prove its extent. Only the top of the zone has been reached so far, and the ores have been proved to be rich in copper. The possibilities are very great. As a somewhat similar occurrence may be mentioned—the copper lodes at Butte Montana. The latter have been described by S. F. Emmons, as follows:—"The prominent characteristics of the Butte copper lodes are, firstly, an upper oxidised zone extending down from 200 to 400 feet from the surface, which contains less than one per cent. of copper on the average, the values being principally in silver; it is a mass of crumbly honeycombed quartz, singularly free from metallic oxides, when one considers the great mass of the original sulphides found in the veins in depth: secondly, below this is a rather ill-defined zone, characterised by great values in the rich copper sulphides, bornite, and chalcocite or copper glance, associated with pyrite and chalcopyrite. The proportion of these rich sulphides gradually decreases with depths, until, in some mines, the ores consist only of pyrite, with a slight admixture of chalcopyrite. Enormous amounts of copper-glance were found in many of the mines; generally, in the upper levels of the sulphide zone. Sometimes they constituted solid masses, 15 feet or more in thickness, in which, however, close examination showed a sprinkling of chalcopyrite or pyrite, in minute, irregular, and often pitted grains throughout the mass of the glance. Not infrequently the cleavage faces are coated with very thin films of native silver."

The Scamander lodes differ from these in the upper levels principally by their poverty in silver. The gossans met with have all been poor in this metal, though containing it in appreciable, but unpayable, quantities. It is not likely that bodies of such extent will be found here as at Butte, for the upper portion of the lode is not so wide, but I believe that the nature of the concentration of the sulphides is the same in both places. Obviously, there is only one thing to be done with the mine; namely, to sink and drive along the lode at a lower level. I should recommend the shaft to be put down near the mouth of the present tunnel, and to open out at 150 feet. At this depth the probability of striking rich shoots is very great, and the risk, from an investor's point of view, is very small. Should developments warrant it, and I think there is every reason to hope that they will, deeper levels could be opened, and the mine worked to as great a depth as payable ore exists. Pumping machinery will probably have to be erected, but it would be worth while to try bailing with tanks before going in for an expensive pumping plant. In any case the creek at the tunnel entrance should be flumed for some distance on either side of the lode, in order to prevent the water from flowing into the mine. This would not be a very expensive item, as the creek is not a large one. A good cart road has been lately made into the mine, connecting it with the road on the south side of the Scamander River, at Berwick's Farm.

The Paul Beahr Prospecting Association.

Sections 4000-93M (40 acres) and 5161-93M (5 acres). This mine is situated south-east and adjoining the Eastern Proprietary Mine. The Eastern Proprietary lode may be traced right through the property. Much of the country here is overlaid by a very coarse sub-angular wash, or *débris*, of Tertiary age, which forms the capping of several of the hills in this vicinity, the creeks cutting through this and into the solid country. The lode, of course, does not live into the capping, but its course is, nevertheless, marked by the presence of bog iron in the wash, which acts in places as a cement for the fragments of *débris*. The true lode is found in the valleys of two creeks which flow into the "Right Arm" of the Scamander River; and also on the banks of the latter river itself. On a mining easement, situated on section 3976-93M, a tunnel has been driven cutting the lode, and the latter has been driven on for a distance of 300 feet. Where first struck the lode contained galena and pyrites distributed freely through the lode matter. The galena, when concentrated, is said to have given a return of 64 per cent. lead and 84 ozs. of silver. This lasted for 70 feet, after which the lode was filled with pug and broken slate, containing pyrites, but no galena: this lasted for 130 feet. For the last 100 feet the lode contains about a foot of pyrites, showing evident signs of decomposition. It contains, in places, a lot of zincblende and oxidised zinc ores, as well as patches of black copper ore. The tunnel was put in only about 20 feet above sea-level; the water in the "Right Arm," which is just below the tunnel, being brackish. The lode, probably, does not rise more than 70 feet above the tunnel, for the hill above is capped with tertiary *débris* or wash. The idea of the management appears to have been, that the lode, being protected by the capping of wash overhead, might be expected to be found in its original state, and that the rich sulphide ores met with at water-level in the Eastern Proprietary Mine, might be found at the adit level in this mine. This pre-supposes that the rich sulphide ore is the primary ore of copper, which, I believe, is not the case; moreover, notwithstanding the capping of wash, a considerable amount of oxidation has taken place. I think, however, there is still the possibility of finding rich patches in this mine, though I cannot regard the indications in as favourable a light as at the Eastern Proprietary. The mine being situated at such a low level, and being capped with wash, there is not the extent of lode overhead from which large concentrations could be derived.

Section 229-93M.

40 acres. This section is situated to the north-west of the Eastern Proprietary Mine, there being one 40-acre section (4089-93M) intervening. The Eastern Proprietary lode may be traced through the section, the spur along the crest of which the lode runs reaching its highest point, namely 650 feet above sea-level, in this section. At about the centre of the section another lode, crossing the Eastern Proprietary lode, may be seen by its big gossanous outcrop, striking nearly north and south. This lode is well worth prospecting, but, like the Eastern Proprietary lode, it will probably be found barren in the upper levels. It is possible that the oxide zone might be got under by bringing in a tunnel from the north, where the spur falls steeply, but I think it probable that in this case also sinking will have to be resorted to before any satisfactory results can be obtained. The section is not held at the present time.

Sections 4126-93M *and* 4127-93M.

Each of 80 acres, charted in the name of A. Pfaff. These sections are situated north-east and adjoining the Eastern Proprietary Mine. Two lodes, both parallel to the Eastern Proprietary lode, occur on these sections.

They present the same gossanous outcrop associated with chlorite as the Eastern Proprietary. The most easterly of these lodes has been traced right through both sections, and most of the work done has been confined to this lode. In Section 4127, on the side of a rather steep hill, a shaft has been sunk 60 or 70 feet, but did not reach to the bottom of the oxidised zone; nothing but a little decomposed iron pyrites and traces of carbonate of copper were found. On Section 4216 a tunnel has been put in from the valley of a creek in a north-westerly direction, but again the lode was almost completely oxidised; a little arsenical and copper pyrites occurring in bunches surrounded by gossanous and mullocky lode-matter was found, but evidently the principal copper contents had been removed. A shallow shaft had been put down near the entrance of this tunnel, but as it was full of water I could not examine it. A good deal of trenching has been done on the lode, which in many places is very promising, but no rich patches were discovered; it is evident that this is a similar case to the Eastern Proprietary. The copper has been removed from the upper portions of the lode, and probably occurs in a concentrated form in the lower levels. A shaft should be sunk and the lode driven on at a fair distance, say 150 feet below water-level.

Section 745-93м.

80 acres—H. Robinson and D. Delaney. This section is situated about a mile to the west of the Eastern Proprietary Mine. Another strong lode, parallel to the Eastern Proprietary, runs through this section. A tunnel has been driven into the side of the hill with the object of cutting the lode, but work had been stopped before the lode was struck. I fear that at this level the lode will be found to be completely oxidised, but as so much has been done it would be worth while continuing the tunnel to ascertain the nature of the lode before deciding on future operations. The lode could be tapped at considerable depth by means of a long tunnel from the south, and in all probability this would be below the zone of oxidation.

Between Robinson's and Delaney's there are three other outcrops of apparently parallel lodes to the Eastern Proprietary, all on Crown land. Should other developments in the field prove the existence of payable ore bodies below water-level, these lodes will be deserving of attention.

The North Scamander Mine.

Sections 3940-93M, 3941-93M. This mine is situated about a mile to the south of the Eastern Proprietary. The workings are confined to the south-western portion of Section 3941-93M. A large formation, carrying iron and copper pyrites, pyrrhotite, zinc blende, galena, and magnetite, is exposed in the bed of a creek. The work has, unfortunately, been carried on in an unsystematic manner, the stone from one opening being thrown into the next, with the result that, although a good deal of work has been done there is very little to be seen, and I could form only an approximate idea as to the nature of the deposit. The magnetite is, apparently, confined to the north-eastern wall of the formation. Here it occurs fairly massive, with a good deal of pyrite and zinc blende and a little galena, and may be traced for several chains running in a north-western direction. To the north of the creek the minerals have the appearance of replacing quartzite, as they appear disseminated more or less strongly in that rock. To the south-west of this band of magnetite the country is very strongly impregnated with pyrites, and some nice copper pyrites has been got out of the trenches. The lode appears to be of a different character to the other lodes in the district. The ore is not the filling of a fissure, but is an impregnation from a fissure. The latter is worth locating and following up. This could be best done by means of a tunnel driven from the creek in a north-easterly direction, when it is quite possible that a payable ore-body might be struck. The ore has not undergone any large amount of oxidation at this place. From the strike of the magnetite ore-body it is possible that this is a continuation of Robinson's and Delaney's lode, which is evidently running in this direction.

The lodes which have now been described all lie in what has been known as the Scamander River Copper Field. No work was being done at the time of my visit, but it is to be hoped that this state of affairs will not be of long duration. There is, as I have already pointed out, a great hope of payable ore existing below water-level; and should this be proved to be the case, there are quite a number of lodes which will be worth a trial. The value of the ore below the enriched zone is at present quite problematical, and I could not venture on an opinion as to its economic value. But the possibilities of the enriched zone itself are, in my opinion, sufficient to warrant the expenditure of the very limited amount of capital which will be required for its exploitation.

Section 4835-93M.

40 acres. E. P. Ryan and M. Fitzpatrick. This section is situated about five miles west of the Scamander River Copper Field. A little trenching has been done on a quartzite spur rising out of the valley of one of the tributaries of the Scamander River. A number of veins and bunches of copper, iron, and arsenical pyrites, up to six inches in width, occur somewhat irregularly in the quartzite. Assays up to 6 per cent. of copper and 3 dwts. of gold are said to have been obtained. Higher up the spur the rock is traversed by numerous veins of quartz, which, where opened on, are much iron-stained, and evidently contain a good deal of pyrites in depth. I also noticed the presence of chlorite, which, in this district, appears to accompany all the deposits of copper ores, though I failed to find anything which could be correctly defined as a lode. However, in the present state of development, it is impossible to say what may be found below the surface. It is very possible that if the spur were driven under a payable ore-body might be discovered.

The Silver Echo Mine.

Section 330-93M. 20 acres. This mine is situated about three miles south-east of St. Helens, and presents some features of exceptional interest. The country is a continuation of the Silurian strata, in which the copper deposits of the Scamander River district occur; but here they are greatly hardened and metamorphosed by contact with the granite. The southern extremity of the main mass of granite already mentioned is situated a short distance to the north of the mine. A small creek, an affluent of the Golden Fleece Rivulet, runs through the centre of the section with a northerly course, the sides of the valley rising steeply on either side. In the bed of this creek an open cut has exposed a very wide quartz formation, carrying irregular bunches or masses of pyrrhotite, with a little pyrite, copper pyrites, and a whitish easily-decomposed pyrite, probably marcasite; some of the latter is said to have given as much as 15 dwts. of gold to the ton, but the majority of the metal is of low grade. In some of the quartz I noticed some needles of tourmaline, and Mr. H. Grant showed me a piece of pyrrhotite with a crystal of tourmaline imbedded in it from this mine. The strike of the formation is 15° to 20° east of north. Its width could not be accurately determined, owing to the eastern wall not being exposed, but it is probably about 40 feet. The quartz is singularly pure and homogeneous, white or smoky in colour, and, as far as I could see, no bands or fragments of country rock were enclosed in the formation. Associated with the quartz, and apparently forming the marginal portions of the formation, there is an extremely quartzose rock, composed of quartz, feldspar, and mica (biotite and muscovite), but with the quartz greatly in excess. The junction of this rock with the country is quite sharp and distinct, but there is no such defined line of contact between it and the quartz; there is rather a gradual passing over from the one to the other, the quartz gradually increasing in quantity until it entirely replaces the feldspar and mica. Unfortunately, at the time of writing, I have not received the slices of this rock for microscopic examination, but as it is moderately coarse-grained, the constituent minerals may be recognised macroscopically. I take the rock to be of the nature of an extremely acid granitic dyke rock. The whole formation is evidently the filling of a fissure, for it cuts across the stratification of the country. The question arises—How can this intimate association of an apparently eruptive or dyke-filling rock with the pure reef-quartz be accounted for? There has always been a tendency to regard the filling matter of fissures as divisable into two well-defined classes: one, formed by cooling from a molten condition, and the other, formed by precipitation from solution in water; and these classes have been called dykes and veins (or reefs). But here we have a fissure filled in part by a dyke-rock and in part by a vein-rock; and, as the one passes gradually into the other, it is impossible to assume a dyke origin for the one and a vein origin for the other. Whatever the mode of formation, it has been the same for both rocks. The case is not, however, an isolated one. Instances of the passing over of granitic dyke-rocks (pegmatite, aplite, &c.) into quartz reefs have been noted by quite a number of geologists, especially of late years, and the opinion is gaining ground that no sharp line of distinction can be drawn between them, but that there are intermediate rocks which, according to the old definitions, cannot be strictly classed either as dyke-rocks or vein-rocks. I believe this is the case in regard to the Echo Mine.

It is well recognised now that granite is not a product of fusion by heat alone, but that the presence of water in the molten rock has played a great part in preserving the liquid state of the original magma down to comparatively low temperatures. It is believed that the magma existed in a state analagous to solution in water, the solvent power of the water being enormously increased by heat. This conclusion is principally based on three classes of facts. 1st. The order of solidification of the mineral constituents is not what we should expect from fusion alone. In granite, it is found that the acid minerals have solidified later than the more basic, and quartz has solidified last of all, for it is seen to occupy the spaces, or interstices, between the crystals of the other minerals. But quartz is much less fusible than the basic minerals, and under conditions of simple fusion should crystallise out before them. The difficulty is explained when we recognise the great solubility of quartz in small quantities of superheated water. 2nd. There is no baking, calcination, or fusion of the country rock in the vicinity of granite, such as is often found at the contact of basic rocks. All the contact phenomena indicate a comparatively low temperature. 3rd. The contact phenomena connected with granite have evidently been brought about by the action of mineralising waters, with which the granite was impregnated. This is shown by the enormous amount of silicification always observed, and the fact that porous strata have been altered to very much greater distances from the granite than strata which are comparatively impervious to water.

In a magma which is in the process of consolidation, the basic minerals are the first to crystallise out, and the residual liquid portion becomes more and more acid and aqueous with the progressive solidification of the basic constituents. It is this residual liquid portion of the granite magma which I conceive to have been ejected from the granite mass into a fissure at the Echo Mine. It has been observed in very numerous instances that the marginal portion of igneous masses are of a more basic nature than the centre. This is no doubt due to differentiation or segregation during the progress of cooling, the minerals which solidify first having a tendency to segregate towards the margin. This process would be the more complete the larger the mass, and in the case of such an enormous mass of granite as we have to the north of the Echo Mine, the process of consolidation would be extremely slow, and the possibility of segregation correspondingly great.

According to this theory the Echo reef or dyke is the product of the final stage of the solidification of the granite, and the mineral contents have been derived directly from this rock. I conceive both the quartz and the acid granitic rock to have consolidated from an aqueo-igneous state of solution, or possibly fusion, and the presence of the latter at the margins of the dyke to be due to segregation during the process of consolidation. Almost the same theory is put forward by J. G. Spurr (the 18th Annual Report of the United States Geological Survey), to account for the origin of the gold quartz reefs of the Yukon Gold District, Alaska; where he observed a gradual passing over from dykes of pegmatite and aplite into typical gold quartz reefs. He summarises his theory as follows :—

"A molten magma may become segregated or differentiated into distinct portions by the successive precipitation of basic and the excretion of acid portions. With increasing amount of silica in the residue, there is also an increasing proportion of water over other materials, this water being in all cases in a high state of union with the other materials so long as these materials are unsolidified; this state of union may be either chemical or physical. In the final residue the fluid becomes so aqueous and so siliceous, that it passes with no sharp division line into highly heated siliceous waters, which contain also small amounts of most of the other rock-forming elements, and among them gold. Gold occurs in the igneous rocks, but is uniformly disseminated, since it has no opportunity to segregate on account of the relative slight fluidity of these rocks during the process of solidification. In the final highly siliceous and highly aqueous residue, however, the fluid becomes so attenuated that circulation becomes very free, and concentration of the rarer elements is permitted; so the gold is segregated often into pockets of considerable size, and in a like manner other materials are concentrated, generally independent of the concentration of the gold. It is also probable that the residual solution is, owing to physical or chemical conditions, or both, especially adapted to the retention of gold, and therefore is relatively richer in this metal than ordinary metalliferous solutions, and possibly more so than the molten magmas out of which the igneous rocks solidified. The theory is not intended to apply to the occurrence of gold in any other form than in the typical gold-quartz veins."

I think it very possible that the genesis of the copper lodes in the Scamander River copper-field may be explained by this theory.

As regards the economic value of the deposit under consideration, the occurrence is so unusual that it is impossible to venture on any conclusion as to its probable contents in the valuable metals. From a geological point of view it would be very interesting to see the deposit opened up, but as a mining venture I can only say that it would be purely speculative. If we accept Spurr's theory as to the deposition of the gold, the deposit is not likely to be highly gold-bearing, for, according to him, the segregation of the gold only takes place after the solution has become highly attenuated; and I think in this case the quartz has been deposited before a high state of attenuation had been attained.

Deposits of Wolframite South-west of St. Helen's.

These deposits are situated about seven miles to the south west of St. Helens, in the same slate and sandstone country in which the deposits of copper already described occur, but here contact metamorphism is very marked. A massive belt of granite occurs about a mile to the north, crossing the country in an east and west direction, and from this belt other dykes of granite porphyry protrude into the country.

The Baden Powell Wolfram Co., No Liability.

Section 4916-93M. 80 acres. Quite a number of quartz veins carrying tungsten ore (wolframite) have been discovered on this section, some of which strike north and south, and the others north-east and south-west. They are situated on the sides and crest of a bold spur which falls into a small creek, an affluent of the Scamander River.

Lode No. 1.—6 inches to 8 inches in thickness, striking north and south and dipping 80° to the west. Carries a fair percentage of wolframite, but, owing to its small size, is far from payable.

Lode No. 2.—Exposed in trench about four chains south-west of No. 1. Strike north-east and south-west. Dip 70° degrees to the west. About 12 inches in thickness. Carries wolfram freely through the stone.

Lode No. 3.—Situated about 3 chains to the west of No. 1. Strike north and south, dipping to the west. Width about 2 feet 6 inches Carries a little wolfram.

Lode No. 4.—About half a chain to the west of No. 3. Strike east of north, from 15 inches to 2 feet 6 inches in thickness, but carries very little wolfram.

Lode No. 5.—Situated 3 chains to the south-west of No. 4, and very possibly a continuation of that lode. The strike is north-east and south-west, and the dip 80° to the west. The lode has been opened up along its course for over a chain. It is split up into two parts, with 6 feet of country in between. A little underhand stoping has been done on this reef, and about a ton of wolfram ore mined. The stope was full of water at the time of my visit, but some of the stone exposed carried a very fair percentage of metal. It appears to be very bunchy.

Lode No. 6.—This reef is exposed in a small trench, and appears to be about 18 inches in width. It is considerably broken up where exposed, and strike and dip were not determinable. Very little wolfram present.

Lode No. 7.—Situated 4 chains to the south of No. 5, strike north and south. Dip 85° degrees to the west. Carries very good wolfram, but the size of the vein is small, being only 6 inches in width.

From the above description it will be evident that nothing of a very payable character has yet been discovered on the property. Some of the veins are promising, but unfortunately those which carry the most satisfactory amounts of wolfram are unsatisfactory as to size. The wolfram occurs in moderate-sized crystals in the quartz.

None of the ore is rich enough to ship without careful dressing, and this could not be done economically by hand. However, the difference in specific gravity between wolframite and quartz being great, the ore could very easily be separated mechanically. It would require to be first crushed in a jaw-crusher, to say 1-inch cube, then treated on jigs, and the middle products further crushed in a ball-mill or other suitable crusher, and treated on a Wilfley table. Very little classification would be required. This would, however, entail a considerable outlay, and should not be entered upon until the actual contents in wolfram have been definitely ascertained. In order to do this more development work is necessary, the work done so far having been purely superficial. A couple of tunnels should be put in to cut the most promising of the veins, and they should then be driven on, and the stone obtained carefully stacked and sampled. I must, however, own to being doubtful as to the contents in wolfram being rich enough to pay the cost of mining and treatment, as most of the veins are very small.

Carson De Beers Wolfram Company, No Liability.

Sections 3516-93M and 3517-93M, each of 40 acres, and 470-93M of 3 acres. This mine is situated south-east and adjoining the Baden Powell Mine, on a spur at the opposite side of the creek. Quite a number of small veins have been cut on this section, all carrying wolfram, but, unfortunately, as far as I could see, in quantities which are quite unpayable. The largest of these veins is situated on the southern slope of the hill where one 2 feet 6 inches, and another 2 feet in width, are exposed. They are both very poor in wolfram. I understand that about a ton of wolfram ore has been won and exported. This evidently occurred in bunches in the veins, as I could not find any place where wolfram was showing freely in the stone. In the north side of the hill a tunnel has been driven on a course of north 30° east for a distance of 250 feet. Four formations containing small veins of quartz, varying in width from 2 inches up to 8 inches, were cut in the tunnel, and one of these is said to have contained nice bunches of wolfram, but nothing of a payable nature was struck. I cannot regard the results obtained as at all encouraging.

Sections 4382-93M.

40 acres. Charted in the name of Isaac Jacobs. This section is situated to the south of Carson De Beers Mine, and on a parallel spur. A number of large trenches or open cuts have been made up the side of the hill, exposing veins of quartz, carrying a little wolfram and molybdenite. They are all very small, varying from 3 inches up to 18 inches in width, and in none of them are the wolfram contents anything like payable. I cannot regard the work done on this section as having been judiciously carried out. The open cuts are of very much larger dimensions than the size of the veins warranted; and quite as much information could have been obtained with one-fourth of the expense, had more intelligence been brought to bear upon the direction of the operations. I do not think that anything of value has yet been discovered on the section.

Alluvial Deposits of Tin at the Scamander River and at St. Helens.

The Scamander Tin and Gold Mining Company.

J. Bass, Mine Manager. This company has been recently formed, with the object of treating, by the process of hydraulic mining, some extensive alluvial flats on the banks of the Scamander River, for tin and gold.

I regret that the manager was absent from the mine at the time of my visit, operations having been temporarily suspended. In his absence I was shown round by Mr. J. Bass, jun., who did everything in his power to assist me.

The first flat examined was that lying highest up the river. It is extensive in area, widening out within the sections held by the company from 10 chains to nearly half a mile. Several lines of prospect holes have been sunk, two of which extend nearly across the flat. The most southerly of these lines contains eight holes, and near the eastern end of the line a paddock 25 feet square has been stripped and some of the dirt treated by box-sluicing. I was unable to learn what results had been obtained.

I regret that, with the exception of the wash exposed in the paddock, and also possibly present in the two holes on either side of it, which were not tried, the results of dish prospects were most unsatisfactory. In each case bulk samples were taken of the wash exposed in the bottom of the prospect holes, except where the latter were fallen in or were full of water, in which cases the wash at the mouth of the hole was tried. From the six holes tested in this way, the best prospect obtained was 0·11 ounces of tin ore to the dish. This was taken from about 2 ft. 6 in. of wash in the fourth hole, counting from east to west. The prospects obtained from the other holes gave an average of only 0·07 ounces to the dish. The depth of wash in these holes varies from 2 feet up to 4 ft. 6 in., with an average of about 2 ft. 9 in.; but two of them have not reached bottom. After striking the wash the water became too heavy, and no more work was done; these have not been taken into account in the above estimate. The average depth of the overburden is about 4 feet.

In the paddock mentioned above the depth of the wash is from 3 to 4 feet, with one or two feet of overburden. Two bulk samples were washed from different parts of the face, yielding, practically, equal results, namely, half an ounce of tin to the dish. The holes on either side of the paddock were not tested; one of them had not reached bottom, and the other was quite close up to the paddock where bulk samples had been taken. The extent of this better class of wash was, therefore, not accurately determined. I was told that prospects ranging from one to two pounds of tin to the dish could be obtained from this paddock. My informant did not know the spot where this had been obtained, and we were unable to find it. Certainly, there is no considerable amount of wash which will carry this proportion of tin.

The second line of holes has been sunk a few chains to the north of the first. It consists of five holes. In three of these the depth of wash is from 4 to 5 feet. In the other two it is under one foot in thickness. The overburden would average 4 feet. The average prospect obtained from all the holes was again 0·07 ounces to the dish.

The third row of three holes is situated about 10 chains to the north of the second row. In one of these there is no wash present. In the other two there is 2 ft. 6 in. of wash, which yielded only ·025 ounces of tin to the dish.

Several other holes have been sunk further north, but I tried no further prospects. The wash is not of promising appearance, and Mr. Bass informed me that the tin contents were no better than those already obtained.

South of the prospect holes already described, one block of ground has been worked by box-sluicing. The worked ground is about three square chains in area, but the wash was evidently shallow. I have not been able to ascertain the results obtained.

From information supplied me by Mr. E. R. Spain, the legal manager, I gather that the company proposes to treat the gravels of this flat in bulk by the process of hydraulic mining. A water-race has already been surveyed, nine miles in length, to tap the Scamander River, and of this some 60 chains have already been cut. This is to have a capacity of 500 cubic feet of water per minute, and will give a head of 200 feet. The fall in the river being small, it is proposed to raise the tailings by means of a jet elevator. The estimated cost of this work is put down at £5000. I am extremely doubtful if the developments so far obtained warrant the expenditure proposed. Only in one place has payable wash been discovered on this flat, and, so far, its extent is unknown. It is certain that the greater part of the flat is of no practical value. Excluding the one patch of better-class wash which has been found, the rest of the wash will not average over one-tenth of an ounce to the dish. This is equivalent to five-eighths of a pound to the yard. Reckoning the tin as being worth £80 per ton, this would give a total value of about 5·4*d.* per yard. This sum has, however, to be divided by at least two to allow for the overburden, which, according to my tests, contains, practically, no tin. This gives a maximum gross value of 2·7*d.* per yard of wash to be shifted. In my opinion the ground could not be treated for anything like this sum. The wash is shallow, there is little fall for the tailings, and there would be a considerable amount of expense in removing the timber, which grows fairly luxuriantly all over the flat. The only question, therefore, which arises is, whether the run of richer wash which has been discovered in the southern portion of the flat is sufficiently extensive to warrant the carrying out of the work. It has been already remarked that its extent is, as yet, undetermined. It does not extend much further to the west than the paddock already alluded to, as proved by the first line of holes. To the east its extent is, as yet, unknown, as neither of the two holes which were sunk in this direction reached bottom. If it extends in a northerly direction it must be narrow, for it has not been struck in any of the holes farther north. Towards the south it may extend for some distance, but here, also, it must be narrow. I do not think there is much probability of finding an extensive area of payable wash on this flat. The country around is composed of slates and sandstone, and is by no means typical tin country. It is true granite does occur some distance higher up the Scamander River, but we find very little granite in the wash, and it is certain that no extensive granitic area has suffered denudation in the watershed of the Scamander River.

The next flat on the river held by the company is situated about a mile to the south-east of that just described. It is small in area, but undoubtedly contains a lead of tin-bearing wash running through it. A paddock of about a square chain in area has already been worked at the top end of the lead. In the face, the wash is about 3 feet in depth, with 6 to 8 feet of overburden. A dish taken from near the bottom of this wash yielded 0·7 ounces of tin. I understand the ground was worked by the company, but I am not aware what results were obtained. The lead is, probably, about 7 chains in length, by, perhaps, two chains in width.

The third flat is situated about 60 chains west of the last. A good deal of prospecting has been done here, and has demonstrated the presence of a lead about 15 chains in length by one or two chains in width. The depth of the wash runs up to 10 feet. Bulk samples taken from the lead yielded prospects varying from one-tenth to one-third of an ounce to the dish. At either end of the lead the wash has been worked, but with what results I did not hear. It is possible that both this lead and the one higher up might be profitably worked by a party of working men; but I very much doubt if it will pay the company to work them. Certainly, the amount of wash is not sufficient to warrant any extensive hydraulic scheme being entered upon.

The company has applied for a road to be made from Ryan's farm along the Scamander River to its mine. There are no difficulties from an engineering point of view;

the road would follow approximately the course of the present pack-track, fording the river three times before reaching the upper sections. I do not think the construction of this road is justified at the present time; a pack-horse can be got almost anywhere through this country, and there is already a rough dray-road along the tops of the spurs by which two horses can draw a load of 15 cwt. The road, if constructed, would also serve Ryan's copper show, which is situated about two miles north-west of the Scamander Company's sections; but, I think, that in this case also the pack-track will serve all requirements for some time to come.

Tin Mining at St. Helens.

The majority of the alluvial tin-mining carried on up to the present in the St. Helens District is confined to the working of comparatively recent gravels and wash, on the top of, and in the vicinity of, what is known as Thureau's Deep Lead.

The tin in the present workings has been derived principally through the denudation of the older gravels of the lead, and these have derived their tin contents from the extensive granite area well known as containing many large deposits of tin ores, of which the Anchor Mine is the most conspicuous.

Thureau's Deep Lead has been carefully described and charted by Mr. A. Montgomery in 1893, and as very little has been learned about it since that date, it will be unnecessary for me to describe it in detail. The history of the lead is practically the same as that of several other similar leads in the Northern part of Tasmania, as for example the deep leads at Derby, Back Creek, &c.

It represents an ancient river channel, carved out probably in early Tertiary times by the George River, when the general level of the country was several hundred feet higher than it is at present. This we know from the fact that the gutter is now considerably below the level of the sea; how much below this level we do not know, but other old valleys cut out at the same time in the north and north-east of Tasmania have been shown to lie as much as 280 feet below sea-level, and it is probable that this one will prove nearly as deep. Since the old valley was cut out, however, there has been a long period of subsidence, during which the river silted up its valleys, and the sea advanced inland. At the end of this period of subsidence, the land must have been very much *lower* than at present, for deposits of marine gravels, deposited during this period, we now find several hundred feet above sea level. After the subsidence, therefore, there came a period of elevation, which raised the country to its present level. I am of opinion that in this part of Tasmania the elevation has now ceased, and I think it possible that another period of subsidence has already begun.

Rivers often form very delicate indicators of the up and down movements of the earth's crust. This is based on the fact that every river is continually seeking its "base level," or the level at which it neither erodes nor deposits. If it is above its base level, it seeks it by cutting; if below it, it seeks it by building up by sedimentation. Suppose a country to rise gradually, and then to remain stationary. All the rivers would immediately increase their velocity and begin to cut; and the cutting process would go on until, owing to decreasing fall, the transporting power of the water would be exactly counterbalanced by the tendency of the sediment to deposit. Now the river begins to widen out its channel, and the longer the land remains stationary, the wider and flatter becomes the valley. But now, if subsidence commences, the velocity of the water will be still further checked, and the river will immediately commence to deposit, and this will continue until the base level is again reached.

In the St. Helens and Scamander Districts the fall of the rivers for many miles from their outlets is very small; it is true they are not depositing large quantities of sediment, but the fact that so much difficulty is experienced in getting rid of the tailings is sufficient evidence that they are not cutting.

The estuary of the Scamander River, which runs inland for a distance of five miles from the sea, may be due to subsidence, in which case it might be described as a drowned river valley; but it may also have been produced by the erosive action of the tides. Against the latter proposition is the presence of the sand-bar at the mouth of the river, which is only opened for one or two days in each year. It is, however, possible that the bar may not always have been here.

Coming back to the alluvial deposits at St. Helens, we have seen that there have been immense quantities of gravel deposited in the old valley of the George River. These deposits are evidently estuarine, though no fossils have been found which would indicate that they had been deposited in salt water. I shall refer to them as "estuarine gravels," in order to distinguish between the gravels of the deep lead proper, and younger gravels which have been deposited in fresh water, generally by running streams. They are principally composed of semi-waterworn particles of whitish quartz, evidently derived from decayed granite, with sometimes kernels of this rock, and also numerous fragments of quartzite and slate. All the wash is tin-bearing, but, so far as is known, the estuarine gravels are unpayable. The latter extend inland from St. Helens for a distance of nearly six miles, and reach a maximum height above water-level of 265 feet. Their upper portions have been extensively denuded, and during this process the deposits of tin ore at present being worked have been accumulated. We may conveniently divide these deposits into the following three classes.

1st. *Concentrations in the surface soil.*—The gradual denudation of the low-grade stanniferous gravels naturally results in a concentration of the tin ore in the surface soil, for the heavier particles of tin gravitate into the creeks more slowly than the lighter particles of quartz. Large areas of this surface-wash have been already worked for tin, often under circumstances far from favourable, the wash having to be wheeled for considerable distances to water. The depth is, of course, shallow, varying from six inches to 18 inches; but the tin occurs from the grass-roots down. These deposits appear to be pretty well worked out now, though there are still a few men engaged upon them.

2nd. *Concentrations in the beds of present creeks.*—All the creeks flowing over the old lead contain important concentrations of tin ore. Many of these have been already worked, but, owing to the fact that the fall is slight, the miner, without capital, finds great difficulty in working them, and there are still large quantities of wash untouched. Recent improvements in the machinery, and in the methods of working low-lying alluvial deposits, promise to have an important bearing on the payability of these deposits, and it is probable that within the next few years a large amount of ground, which defied the more primitive methods of box-sluicing, will be worked with satisfactory results.

3rd. *Concentrations in old gutters.*—In many places the surface of the estuarine gravels is furrowed by numerous old gutters, which have been filled up by wash, and are now often extremely difficult to locate. The character of the wash is, of course, essentially the same as that of the estuarine gravels, being derived directly from these, and, at the surface, they are often not appreciably richer in tin than the older wash; but, when the gutter has been reached, it has often proved to contain very valuable concentrations of tin ore. A number of these deposits are being worked at present, and it is highly probable that a great many more remain to be discovered. As soon as one gutter has been located others branching off from this are often found during the process of mining.

There is one other proposition which may, in the future, prove of greater importance than any of the deposits already described. I refer to the possible concentration of tin ore in the lower gravels of the deep lead. The estuarine gravels, which have filled up the old valley of the George River, all contain appreciable quantities of tin, not in sufficient quantities to be themselves payable, but still sufficient, when concentrated at the surface, to form very extensive deposits of payable wash. The question arises—Is it not possible that the old gutter may also contain concentrations of tin ore? The estuarine gravels were deposited during a period of subsidence, when the wash was laid down in wide layers and left undisturbed. There was no opportunity then for the tin to become concentrated, for this only takes place when the wash is being continually agitated and moved about; but during the time the George River was cutting out its channel, and especially after it had reached its base-level and was widening its valley, then the tin had an opportunity of becoming concentrated in the bed of the river; for then the gravel would be continually agitated, and a natural sluicing process would be in operation. If, then, this same class of wash was transported by the river during this period—and we have every reason for believing it was—it is absolutely certain that accumulations of tin ore took place, and the amount of these accumulations would be proportional to the length of time which the river remained at its base-level before subsidence commenced. How long this period was we have no means at present of forming an opinion, but as other leads in Tasmania formed at the same time as this one have made important accumulations of ore in their lower gravels, it is probable that similar concentrations will be found here. I think, therefore, that there is every inducement to undertake the work of proving the value of the lower gravels. This will have to be done by shaft-sinking. The best plan would be to first locate the position of the gutter accurately by putting down a number of holes with the diamond-drill or the water-augur; then sink a main shaft in the solid granite and drive to cut the gutter at the proper level. Water would, probably, be heavy, and adequate pumping machinery would have to be provided.

Royal Ruby Tin Mining Company, No Liability.

This company holds Sections 5079, 4822, 5075, 4189, 4838, 5122, and 5123, all 93M; total area, 110 acres. The sections are situated about two miles west of St. Helens, and follow the course of the Golden Fleece Rivulet for a distance of over a mile. The company proposes to work the gravels in the bed of this rivulet. In Section 5123 and 5122 the stream follows, approximately, the contact of the estuarine gravels of Thureau's Deep Lead and the granite. Through the other sections, the stream flows to the north of the lead, but higher up the stream follows the lead for a long distance. There has, therefore, been every opportunity for the stream to accumulate tin-bearing wash, by the denudation of the upper gravels of the lead. There appears to be some doubt as to whether some of the stream has not been already worked in former days by hand labour. This is difficult to determine at present, owing to the bed of the stream being covered by a layer of tailings from workings higher up the stream; and much of the ground is difficult to prospect, because it is impossible to sink holes in what may be expected to be the richest ground on account of water. The company has, however, satisfied itself that whether this be the case or not, there is a large amount of payable wash in the creek which it can treat; and it has shown its confidence in the claim and in the district by erecting a small plant driven by steam-power in order to work the ground.

At the time of my visit, the plant was being given a trial run, and everything appeared to be going smoothly. It consists of a gravel pump worked on the principle of the ordinary centrifugal pump, but with special liners which can be accurately adjusted to allow for the wear in the blades of the pump. The method of working is briefly as follows:—the pump is erected in a spot which commands as large an amount of wash as possible; a hole or sump is sunk by hand for the suction pipe, and the wash is then sluiced into this hole by streams of water, assisted by men with mattocks, forks, &c., and is elevated by the pump on to the tail-race, which is placed on a raised platform. In this way all the ground is worked which will gravitate into the sump, after which the pump must be removed to another place. In order that this operation may be carried on with a minimum of expense and delay, it is advisable to erect the pump and engine on a pontoon. When they have to be moved, it is then only necessary to let the water rise in the workings and float the pump into its new position close to the working face. Very little water is required, as the same may be used over and over again, and no get-away is wanted for the tailings, as they are deposited on the ground that has been already worked. As regards economy, the system, of course, cannot be compared with either that of hydraulic mining or dredging, but over hydraulic mining it has the advantages already mentioned of requiring little water and no fall or get-away for the tailings; and over dredging it has the advantage that the bottom can be effectively cleaned up, and that logs and boulders do not seriously interfere with the operation. Of course, if plenty of water at adequate pressure be available it may be utilised effectually in breaking down the wash, as in hydraulic mining, or, failing the latter, a second pump may be used to eject the water onto the working face through a nozzle.

The system is suitable for treating medium to high-grade wash on very flat ground, either with or without an abundant supply of water, the former, of course, being preferable. It seems particularly adapted for working much of the flat ground near St. Helens where sluicing water is often scarce, and ground water so abundant as to render its treatment by manual labour impossible.

In Victoria, 10 gravel pumps of similar construction to that employed at the Royal Ruby were at work during the year 1900, working a total of 285 weeks, and treating 452,283 yards of gold-bearing wash; this gives an average of 1587 cubic yards per week per pump. In addition to these, 15 port-runner gravel pumps were also employed, working a total of 588 weeks, and treating 2,861,093 yards of wash, or an average of 4866 cubic yards per week per pump. I am informed by Mr. J. Travis, the Secretary for Mines and Water Supply for Victoria, to whom I am indebted for the above information, that a full account of the system will appear in the next annual report of the Mines Department of that State, which will be published in about a month's time. The system has also been worked with success in New Zealand.

In the interests of the district it is to be hoped that the system will prove successful, as there is no doubt that there is a lot of ground of a similar nature to be worked. Unfortunately, the engine employed is hardly powerful enough for the work it has to do, but this should not prevent the company from proving the efficiency of the system. The company is to be complimented on the energy it has displayed in bringing the plant into operation.

Fern Tree Creek.

This is an affluent of the Golden Fleece Rivulet, about $3\frac{1}{2}$ miles to the west of St. Helens. The run of wash, which is at present being worked by Patterson Brothers, runs, approximately, parallel to the creek. It has an overburden of six or eight feet of loam and sand, and an average thickness of three feet of payable wash, which goes up to six or eight feet in the centre of the gutter.

Several prospects were washed from the latter with excellent results. The ground is very flat, and all of it has to be dug out and removed by wheelbarrows. That, under these circumstances, the ground can be made to pay, speaks well for the tin contents. A limited supply of water for sluicing purposes is obtained from the Golden Fleece Rivulet. North of Patterson Bros.' claim, Riley and party are working some good ground on the same lead. A paddock which had just been taken out before my visit, 19 feet by 10 feet in area, yielded two bags and 20 lbs. of tin. The ore is of the finest quality, being principally composed of Ruby Tin. South of Pattersons' workings the lead is said to have been traced for a long distance, but owing to the presence of ground water it is difficult to prospect. The ground seems admirably adapted to the gravel-pump system of mining; but before any such plant should be erected it would be advisable to make sure of the presence of sufficient quantities of wash to warrant the erection of the machinery. The plant is an expensive one, and the undertaking should not be entered upon without careful investigation in this direction. I am told that south of the present workings above Russell's Dam, about two miles of the present creek has been worked in former years with excellent results. If this is the case, there is a strong probability of this lead also continuing payable for a long distance above the present workings.

Saxelby Creek.

This is another affluent of the Golden Fleece Rivulet, about five miles west of St. Helens, where C. E. Russell and party are working a promising run of ground. The wash is about seven deep, and has little or no overburden, though the upper layers of wash are poor. A dish washed from the lower portion gave a prospect of nearly 11 ozs. of tin-ore. Mr. Russell tells me that the ground they work averages 3 lbs. to the yard, taken all through. The water used for sluicing and mining purposes is brought from one of the tributaries of the Scamander River along a race eight miles in length. With their present arrangements the party is only using a fall of 50 feet for working the small nozzle which they use for breaking down the wash, but Mr. Russell tells me that his race commands 120 feet more fall than they are at present using. He also tells me that by cutting another six miles of race another branch of the Scamander River can be intersected, from which an abundant supply of water can be obtained. North of their present workings there is a fine face of wash over 14 feet in height, from which some nice prospects of tin were washed; some of this has been lately worked with excellent results, but work had to be suspended through shortage of water. This ground has the exceptional advantage, in this district, of having a good fall, so that there would be no trouble in getting rid of the tailings. On the whole, there appears to be a large amount of wash available, and provided that an adequate supply of water is obtainable there should be a good opportunity for a strong company to work the ground by hydraulic mining. Before entering upon the undertaking, however, the amount of payable wash should be definitely ascertained. This would involve a survey of the ground and a careful estimation of the tin contents of the wash.

Thureau's Deep Lead Tin Mining Company, No Liability.

B. H. Whittle, Manager. The company holds Sections 5323-93M, 1999-91M, 4284-93M, 1473-87M, 5279-93M, and 251-87M; in all, 120 acres. The sections are situated about five miles W.N.W. of St. Helens, on the western portion of the deep lead. The ground, at present, being worked by a party of Chinese tributors, consists of filled-in fresh water gutters on the surface of the old lead. Quite a number of these have been found and followed up in the process of mining, though they are very difficult to locate by surface prospecting. The depth of the working face varies from 10 to 20 feet, and that of the payable wash from 1 to 10 feet. Mr. Whittle informs me that, taken all through, the ground will average 2 lbs. of tin ore to the yard of dirt. The water is, at present, taken from Powers' Rivulet. Six heads only are available, but the company is engaged in renovating the old race, and constructing 15 chains of new fluming, when it is expected that 20 head will be available during the winter months, and as the new fluming is at a higher level a much larger area of ground will be commanded. A large amount of tin has evidently been taken out of this ground, and it is probable that much more still remains.

Several attempts have been made on these sections to bottom the deep lead, and to ascertain the value of the gravels in the lower portions of the lead, but, so far, without success. Quite a number of shafts were put down in the wash to depths of from 30 to 60 feet, only one of which touched bed-rock, and this one evidently far away from the gutter. In each case the work had to be abandoned, owing to the influx of water proving too strong to be dealt with by hand labour. These shafts proved the wash to be stanniferous throughout, some of the seams going as high as ½ ounce to the dish, but nothing payable was struck. It is evident that if the lead is to be found, operations will have to be carried on in a more systematic manner than has yet been attempted. Pumping machinery will certainly be required, and it would be most advisable to locate the gutter first by boring before the main shaft is sunk.

Fenton's Mine.

Mr. W. Fenton is working an excellent run of wash to the north-west of Thureau's Deep Lead Company. The depth of his face is at least 20 feet, and he tells me that the wash will average 4 lbs. to the yard. The lead is a fresh-water deposit on top of the old estuarine gravels. He is unfortunate in having to pay a heavy royalty for his water.

The Upper Ruby.

The property known as the Upper Ruby consists of a number of sections charted in the name of A. Deedes, A. Lee, and George Briggs, situated about a mile to the south of Thureau's Deep Lead Company's sections, and comprises a total area of 420 acres. The ground is held by a strong syndicate, which proposes to bring in a large supply of water from the Groom and George rivers. The scheme involves the cutting of 34 miles of race, and the erection of 2¼ miles of syphon, at an estimated cost of £15,000. The pressure available is stated to be 370 feet. Unfortunately, I was unable to make a thorough examination of the property, there being no one on the mine to show me round. The surface gravels and soil have already been largely worked for tin, and there is a probability that fresh-water gutters, such as occur at Fenton's, and Thureau's Deep Lead Company's sections, will also be found here. The syndicate, however, evidently proposes to work the old estuarine gravels in bulk by hydraulic mining; and as it will have an abundant supply of water at an efficient working pressure, it will certainly be able to treat the gravel at a very low cost. There is, therefore, every hope that the venture will turn out a success. I was unable to ascertain what investigations had been made as to determining the tin contents of the wash. The quantity available is very large.

The Rose Tin Company, Limited.

Henry Lansdale, Mine Manager. This company was formed in London to work the sands on the Southern beach of George's Bay for tin, by means of dredging. The company holds a number of sections along the beach to low-water mark, and several others embracing extensive sandy flats in the vicinity. The Manager informed me that he had been greatly disappointed with the results obtained so far. A great number of prospect holes had been put down along the beach and over the flats, but the great majority of these only contain a few colours of tin to the dish. In one place only is the beach sand anything like payable, so far as has yet been proved, and here, Mr. Lansdell estimates it to carry 1¼ lbs. to the yard. Unfortunately, at this point the wash is very shallow. The company has purchased a Priestman Dredge, with the object of prospecting the sands below high-water mark, and at the time of my visit this was in process of erection. I fear there is little chance of anything payable 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-MINING DISTRICT OF BEN LOMOND

Government Geologist's Office,
Launceston, 30th June, 1901.

SIR,

ACTING on instructions received from Mr. W. H. Twelvetrees, Government Geologist, I left Launceston on the 10th June to examine and report upon the tin-mining district of Ben Lomond.

The field is a large one, and will, I think, in the near future, become important. There was only one mine actively engaged in mining operations at the time of my visit; but I do not think that this is a state of affairs which will be of long duration. Tin ore is distributed more or less freely over the whole district, and there are, in my opinion, a large number of shows which are well worth opening up. It is, of course, too much to expect that all, even of the promising shows, will develop into permanent ore-producing mines, but, I think that, in a district like this, where tin ore occurs, not only in small veins and stringers, but also in large and massive formations, it is safe to predict that some really good mines will be developed which will contribute in no small degree to the mineral output of the State.

Ben Lomond is situated about 14 miles north of Avoca, and the mining district lies to the south of the mountain. The general geology of the district is, with the exception of some of the occurrences of the greenstone and Mesozoic strata (which do not affect the mining industry in this district) very simple. The general features of the country are shown upon the geological sketch map of the district (Plate I.), and the geological section (Plate II., Fig. I.) appended to this report. The bedrock of the district is granite of Devonian age. This rock solidified under a probably massive covering of Silurian sedimentary rocks—slates, sandstones, &c.; but these have long ago been removed over the greater part of the district. Remnants, however, remain in several places, especially in the eastern and north-eastern parts of the field, where, in the vicinity of Storey's Creek, a considerable area is still covered by Silurian strata. These rocks are also found in the north-western portion of the field, and further south, very small isolated patches are sometimes encountered on the summits of the highest ridges. The denudation and removal of the Silurian strata must have taken place during the later portion of the Devonian period, for, lying on the top of the granite, and often covering the remnants of Silurian strata, we find horizontal beds belonging to the Permo-carboniferous period. These have however, also been very largely denuded, and in the southern portion of the field, are for the most part confined to the tops of the granite spurs, where the harder grits and sandstones have resisted denudation, and have protected the softer or more easily decomposed granite underneath. Much of the northern portion of the field is overlaid by quite a thin layer of Permo-Carboniferous strata, and through this the granite outcrops frequently. Further north, on the slopes of the mountain itself, the Carboniferous strata increase in thickness until the perpendicular cliffs of columnar greenstone, which form the massive capping of the mountain, are reached. The contact however, of the columnar greenstone and the Permo-Carboniferous rocks is obscured by a heavy talus of greenstone blocks fallen from the mountain. Next to the Permo-Carboniferous strata in question of age are the Mesozoic strata, which are mentioned by Mr. Montgomery* as occurring on the mountain at an elevation of 4000 feet above sea-level, and apparently, from his sketch, overlying the greenstone. Unfortunately, I was unable to examine this occurrence, as, at the time of my visit, the mountain was inaccessible, owing to snow. I found, however, the typical felspathic sandstones of Mesozoic age in the valley of Gipps Creek, at an elevation of only 1400 feet, apparently underlying the greenstone. These rocks are exposed in steep cliffs, rising up on the western side of the creek for a height of about 200 feet. Above these there are, perhaps, 500 feet of columnar greenstone. The dip of sandstone is about 15° or 20° to the south-west. On the eastern side of the creek we find horizontal Permo-Car-

* Report on the Ben Lomond District, 5th May, 1892.

boniferous sandstones resting on the granite. The position is a difficult one to explain, unless we assume that faulting on a very large scale has taken place. Unfortunately, the time at my disposal did not permit me to inquire into this question as fully as I should have liked, and it is quite possible that further investigation may suggest another explanation.

The eruption of greenstone took place towards the end of the Mesozoic period, as has been proved in other parts of the State. Its relation to the Permo-Carboniferous and Mesozoic strata are extremely various and perplexing, sometimes overlying, sometimes underlying, and sometimes breaking through these rocks; but in order to obtain a safe interpretation of all the phenomena presented, it will require a much more exhaustive examination than I was able to give it. The greenstone question is one of the greatest practical importance in connection with our coal measures, and I believe a careful study of the Ben Lomond district during the summer months, when the Mesozoic measures on the mountain could be examined and compared with those occurring in the valley of Gipps Creek, would yield much valuable information.

The district is of great interest from the point of view of the mining geologist, as affording much evidence concerning the origin of metalliferous deposits. As everything which throws light upon this subject is not only of absorbing interest, but of great practical importance, I consider it advisable to describe the occurrences somewhat in detail.

The majority of the granites in which the deposits of tin ore occur are composed essentially of feldspar and quartz, there being very little mica present. Much of the feldspar (orthoclase) occurs in fine large crystals of the Carlsbad twin type, distributed porphyritically through the groundmass of the granite, which is composed of a finer-grained, but thoroughly granular mixture of quartz and feldspar. In many places a rock very much finer grained than the granite, but composed of the same constituents, is to be seen. Only once did I observe this rock *in situ*, and then it formed a small dyke in the granite. It is probable that the other occurrences are of the same nature. Quartz porphyry also occurs, sometimes forming the margin of the granite mass, but at other times possibly forming dykes in the granite. One interesting occurrence is to be seen on the old Republic Mine, where a quartz porphyry occurs with perfect double-ended crystals of quartz distributed through it. The granite is traversed by numerous veins of pegmatite, varying very largely in composition; occasionally they are found composed mainly of giant crystals of quartz, feldspar, and mica, with needles of tourmaline, and in one conspicuous instance, with very large crystals (up to 2½ inches in diameter, and 5 or 6, or even 10 inches in length) of beryl embedded in the quartz. Mr. W. H. Twelvetrees has examined thin sections of this beryl under the microscope, and has proved the presence of minute enclosures of liquid carbonic acid, proving that the mineral has been deposited under conditions of very high pressure. The pegmatite veins very frequently contain tin ore, and in one case, the old Lomond Mine, extremely rich patches of tin ore were found in a small vein of pegmatite. A careful study of these pegmatite veins proves indisputably that they pass over by insensible gradations, *i.e.*—by loss first of mica and then of feldspar—into quartz-tourmaline veins, which are usually more or less tin-bearing, and these again pass over into plain quartz veins, with only, very occasionally, a content of tin oxide. However, these veins of tourmaline-pegmatite, tourmaline-quartz, and quartz, although all are at times tin-bearing, do not by any means represent the typical tin ore of economic importance in the district. A very small proportion of the tin is found in the veins themselves; it is found very much more abundantly in the rock on either side of the veins, and very often the vein is so small and so insignificant, in comparison with the impregnation which has taken place from it, that it may very easily escape notice altogether. The typical tinstone of the district occurs as a hard, highly quartzose granular rock, seldom containing true mica, but frequently a massive mineral of almost the same composition, locally called porphyry, steatite, talc, &c., but really, I think, being a variation of one of those massive muscovites which have been grouped together under the general name of pinite. Chlorite is also almost always present, even in the hardest portions of the stone. Tourmaline occurs sometimes in large quantities, but more often in the normal tinstone it is absent. Fluorspar is apparently always present; it occurs somewhat sparingly as the filling of small veinlets running through the stone, though occasionally it is met with in larger masses. Of the metallic constituents, tin oxide (cassiterite) is the most abundant, and the only one of commercial importance. It occurs in fine grains and crystals throughout the stone. Besides this, we find in small quantities, blebs of galena, black zincblende (marmatite), chalcopyrite, arsenopyrite, and pyrite, distributed through the stone. These minerals also occur in small irregular veins and patches, and one case is recorded in which a considerable mass of argentiferous galena, assaying 80 ozs. of silver to the ton, was found in the tinstone at the surface. The component minerals are not evenly distributed throughout the tinstone; often it is composed entirely of granular quartz, and, as a rule, quartz is very much more abundant than any other mineral. After quartz, chlorite is the most regular constituent. Pinite occurs sometimes distributed evenly through the stone, at other times in irregular patches, in which case it is often highly tin-bearing. Topaz is apparently absent. Genetically, the tinstone is closely allied to greisen, but as mica is absent, I think it advisable to retain the miner's term, tinstone. The German miner has the convenient term "zwitter" for such stone, but I am not aware of any English equivalent. The term tinstone must not be taken to imply that tin is necessarily present in payable quantities. I believe it will always be found to contain some tin, but the tin content may fall so low as to become practically indeterminable by ordinary methods.

The boundary between the tinstone and the granite is not marked by any defined wall; there is rather a passing over from the one to the other, though this cannot be said to be gradual, since it takes place within the space of a few inches. The stone in the vicinity of the granite is apparently always poor in tin. From the nature of the boundary existing between the two rocks, only one conclusion can be arrived at, namely, that the tinstone is a product of the alteration of the granite. This conclusion is abundantly demonstrated by an examination of the mineralogical and structural character of the tinstone. In the massive tinstone pseudomorphs of various minerals after feldspar are often to be found. Thus, during my examination of the district I was able to identify the form of the original porphyritic crystals of feldspar occupied by the following minerals:—(1) cassiterite; (2) cassiterite and quartz; (3) chlorite; (4) chlorite and quartz; (5) pinite; (6) tourmaline. This amounts to definite proof that all these minerals occur as a replacement of the feldspar in the granite. The replacement is of course not evident in all the stone; it is only occasionally that the shape of the feldspar crystals can be observed, and it was only after diligent search that specimens of evident pseudomorphs of all of the above minerals were obtained. But the fact that replacement of feldspar has certainly taken place by all these minerals in some instances goes far to prove that the whole mass of the stone has been produced by similar alteration.

It is, therefore, very clear that the tinstone has been produced by the action of mineralising solutions circulating through small fissures generally now filled up by pegmatite or quartz. The general composition of the solutions may be inferred from the alteration which they have produced on the wall-rock, and from the minerals which they have deposited. Evidently, they were very highly charged with silica, and contained also in smaller quantities boron, fluorine, sulphur, and carbonic acid. Of metals there were present tin, tungsten, copper, lead, zinc, silver, and probably gold (see later).

The connection existing between the deposits of tinstone, quartz-veins, and pegmatite-veins affords the strongest evidence that they were formed during the latter stages of the consolidation of the granite. We may assume that the solutions emanated from this rock, and are the result of a process of differentiation during the cooling of the granite whereby the residual liquid (or gaseous) portion of the magma becomes very aqueous and very siliceous, and has the property of retaining in solution the heavy metals, tin, wolfram, copper, &c., originally present in the magma. This residual portion becomes expelled from the granite mass through small cracks and fissures, and owing to its high temperature and the presence of boron and fluorine, possesses extremely active chemical properties which are capable of bringing about profound alterations on the wall-rock of the fissure in the cooler parts of the granite mass. It is very possible, indeed probable, that the emanations were above the critical temperature of water (365° C.), and in this case would be in a gaseous condition. Daubrée, the illustrious French Geologist, long ago proved the extraordinary chemical activity of superheated steam containing boron and fluorine, and was able to produce synthetically many of the minerals which we find associated with tin; so that it is quite certain that these two elements have had a most important part to play in bringing about the phenomena connected with tin deposits.

The above theory, known as the "pneumatolytic" theory of the origin of tin ore deposits, is that which is now very generally accepted by mining geologists as affording a good and sufficient explanation of the facts as observed. I have dwelt upon it at some length for two reasons: in the first place the Ben Lomond district is of exceptional interest as affording very strong evidence in favour of the theory; and, in the second place, I think there is a great probability of a connection being established between the deposits of tin ores and those of other metals, especially those of copper, silver-lead, zinc, and gold. It has already been pointed out that besides tin ore the deposits in the Ben Lomond district contain small quantities of copper, iron and arsenical pyrites, argentiferous galena, and zinc blende (marmatite.) These minerals have evidently been deposited by the same granitic "after-action" process which deposited the tin ore. This is proved by the widespread association of these minerals with the tin ore and the fact that they so commonly occur disseminated through the hard tinstone. It should, however, be added that Mr. A. Montgomery, who visited the district in 1892, considered the galena to belong to a younger generation than the tinstone. This opinion was based upon observations made upon the rich patch of silver-lead ore found near the surface at the Mount Rex Mine. This patch cannot, however, be regarded as the typical mode of occurrence of galena in the district. Judging from the descriptions which have been given me, I think there is no doubt that this patch was of secondary origin, and therefore, does belong to a younger generation, but this does not affect the origin of the original galena in the deposits, for there is everything to show that this was deposited during the formation of the tinstone, and, therefore, by the same solutions which produced the alteration. I think it is also very possible that a little gold will be found associated with the pyrites of these deposits. It is generally got in small quantities by alluvial miners when working the surface gravels for tin. I think there is little doubt that its origin is to be found in the pyrites of the tinstone deposits.

Now, the geological proof of the derivation of ores of copper, lead, zinc, silver, and probably gold from the granite by "after-action" processes, is of great interest to the student of ore deposits, for it opens up the question as to how far these pneumatolytic processes have contributed to supplying the metallic constituents of deposits other than those of tin. In the Ben Lomond district there is often a distinct tendency for the copper contents of the veins to increase, and one or two of them have been actually opened up for copper lodes. In my report on the Scamander River Copperfield I have suggested a similar origin for the copper deposits in that district. Subsequent microscopic examination of the ores and rocks from the Scamander and St. Helens districts has gone far to confirm the views I then expressed. On the whole, I think we have in this question a field for investigation which may prove to be extremely fertile.

There is one other mode of occurrence of tin ore in the Ben Lomond district which I must mention. It consists of a highly feldspathic, rather fine-grained, rock, containing, as far as can be seen with the naked eye, quite a subordinate amount of quartz. This tin oxide occurs distributed through the stone in fine grains, and, I believe, is an original accessory constituent. I did not notice any other minerals present. Mr. W. F. Petterd has shown me similar stone from this district, with galena present in the place of the tin, and he tells me that it contains an appreciable quantity of gold. The exact nature of this rock is at present obscure. Unfortunately, I had no opportunity of studying its contact with the normal granite. It is pretty massive, and if it occurs as a dyke, it must be over 20 feet in width. I am inclined to regard it as a product of differentiation during the consolidation of the granite, allied to the pegmatites, but of earlier birth, and deposited from a less aqueous solution. It is more basic than the normal granite, but this may be accounted for by supposing differentiation to take place during deposition, the greater part of the silica in the solution being carried on and deposited at a higher level.

Besides the quartz veins associated with the veins of pegmatite and the deposits of tin ore, there is a another totally different set of quartz veins running, as a rule, parallel in strike, and sometimes also in dip, with those already described. These veins are usually much larger. The quartz is of an extremely dense, massive, almost chalcedonic, appearance, and often contains a good deal of iron pyrites. Very often the quartz retains the impressions of crystals of some mineral crystallising in cubes, probably pyrites, but every vestige of the mineral has been removed. These quartz veins are very much younger than the veins which are associated with the tin ore deposits. The latter are always cut off quite sharply by the Permo-Carboniferous measures, and, therefore, were already formed before the latter were laid down. But the newer quartz veins pass up from the granite into the Permo-Carboniferous strata. This is well seen in the adit of the old Ben Lomond mine, of which a section is shown in Plate II., Fig. 3. It will be seen from this section that, near the entrance of the tunnel, the granite is overlaid by strata of the Permo-Carboniferous period, and that about 12 feet in from the adit-mouth a strong quartz vein was cut, rising up through the latter. Further in, several similar veins were cut, as well as one belonging to the older formation. The difference between the two formations is very remarkable; the younger veins cut through the granite without any perceptible alteration of the wall-rock, whereas on either side of the older vein the feldspar of the granite has been eliminated for three or four feet, and been replaced by quartz. These younger quartz veins are widely distributed all over the district; they are, apparently, quite barren, containing no mineral of economic importance; but they sometimes appear filling the same fissure as the older quartz. I noticed one excellent example of this on Section 4851-93M. The fissure had evidently been reopened, and the younger quartz now occurs as a filling of the druses in the older vein. Another case I noticed was where fragments of the old tin and tourmaline bearing quartz were enclosed in the younger massive quartz. It is important that those who are engaged in mining and prospecting in the district should make themselves familiar with the appearance of these veins. They are easily recognised, and should not be confused with the veins which are connected with the tin deposits. Unfortunately, in the past, a lot of money has been fruitlessly expended in sinking and driving on these veins without any result. They are frequently met with in the Permo-Carboniferous strata, and, in some parts of the district, the whole of the pyrites has been removed, and the veins occur as big gossan lodes. Many of these were taken up for silver at one time, though, according to Mr. Montgomery's report, it is very doubtful if a trace of silver has ever been got from them.

As throwing further light upon the age of the veins of this quartz-pyrite formation, I must mention a remarkable formation, to be seen at the contact of the greenstone and the granite, near the Mount Rex Mine. Between these two rocks there exists a vein filled with fragments of Permo-Carboniferous sandstones and shales, tightly cemented together with the same dense quartz as is found in the younger veins in the granite. This vein also contains iron pyrites and, in parts, the same impressions of crystals of cubes which I noticed in so many places. I think there is no room for doubting the identity of this quartz with that occurring in the veins in the granite. The vein can be traced for at least over a mile in length, and preserves its character throughout. I think there is no doubt that it is a fault-fissure which was formed after the consolidation of the greenstone, and, since it has been filled with the same dense quartz as occurs in the other veins, it follows that the latter is of more recent age than the greenstone. The greenstone eruption took place towards the end of the Mesozoic period, and therefore the quartz veins are probably of Tertiary age. This occurrence is worth bearing in mind when we are considering the origin of quartz veins. It shows that the mere connection of quartz veins with granite is not sufficient to establish a pneumatolytic, or "after action," origin for the quartz veins. It is not possible for the "after action" to have continued from the Devonian period up to the Tertiary. I think it will probably be found that the phenomena connected with the alteration of the wall-rock will afford valuable criteria as to the origin of quartz veins, and of mineral veins in general.

The Mount Rex Tin Mining Company, No Liability.

Mr. Mark Ireland, manager. This company holds Sections 4345-93M, 1608-91M, 3473-93M, 1191-87M, 1520-87M, 4547-93M, with a total area of 240 acres; also eleven other sections, with a total area of 400 acres. The latter are situated about 2½ miles north of the mine, and are held for the purpose of securing an extensive dam-site and water reservoir. The mine is about five miles north-west of Avoca, with which it is connected by two rough cart-roads. The most direct of these is about six miles in length, but is so steep in places, and in such bad repair, that it is impassable for cart traffic. The other road is very circuitous, being about 12 miles in length, but, as the grades are better, all the mine supplies are at present brought by this route. The Government has lately agreed to spend £500 on a new road to the mine, and I understand that a fair grade has been obtained, following in general the shorter of the two present roads. The mine is situated near the boundary of the granite and the greenstone, three of the company's sections being almost entirely in the latter rock (*see* Plate I). Towards the north the granite is overlaid by horizonal layers of granitic wash and sandstones of Permo-Carboniferous age. The granite is composed almost completely of quartz and feldspar, with the latter often developed in large crystals. Several tin-bearing formations are known on the company's sections, the most important, as far as is known at present, being situated about the centre of Section 1191-87M, and all the energy of the company is at present being concentrated upon this deposit. It consists of a large mass or chimney of tinstone, from 60 to 80 feet in diameter. A general idea of the shape of the formation may be gathered from Plate III. Fig. 1 is a plan, and Fig. 2 a vertical section, of the mine workings. Figs. 3 and 4 give separate plans of the mine workings at two levels, showing the contact of the tinstone and the granite as far as has yet been determined. It will be evident from these that the shape of the deposit is very irregular, and the horizontal section is very different at the two levels. It is almost too early yet to form a correct idea as to the strike of the deposit, but, by comparing Figs. 3 and 4, it would appear that the greatest dimension is, approximately, north and south. At the upper level (Fig. 3) it appears to be a little west of north, but at the lower level appears to be a little east of north. The general strike of many other tin-bearing veins in the district is a little west of north, and there is some reason for believing that this will also prove to be the case with the Mount Rex deposit. The latter is often traversed by small quartz veins, which have a general strike west of north, and it is in all probability these which have served as the channels for the tin-bearing solutions. There are also small, and often discontinuous, veins of fluorspar running through the stone, but these do not appear to have any regular strike. As has already been shown, the tinstone has been formed by the alteration of the granite under the action of hot mineralising waters or vapours. It is not definitely known what the conditions are which determine the alteration of the granite in certain places, or why some parts of the granite should be altered for 20 or 30 feet away from the fissure which has brought the mineralising solutions, while in other parts the alteration has only extended for as many inches. It is probably due to the irregular distribution of minute fissures and cracks through the original granite. However this may be, the fact remains that in all tin-mining districts the zones of impregnation are somewhat irregular in their occurrence. The shape is usually more or less lenticular, and in all probability this will be in general the shape of the Mount Rex deposit. When mining operations have proceeded further, the axis of the lens-shaped mass will be more accurately determined, and it will probably be found that it continues in the direction of its greatest length as a vein, or series of veins, with more or less alteration of the wall-rock. These should be followed up in strike, with the object of discovering other lenticular masses, of the presence of which evidence at the surface is not entirely wanting.

Besides tin, the stone contains small quantities of galena, copper, iron and arsenical pyrites, and zinc blende (marmatite). These minerals cannot be separated by mechanical means, but, by a process of roasting the first concentrates, re-dressing, and leaching with dilute sulphuric acid, practically everything but the lead can be eliminated. The latter is, however, present in such small quantities in the bulk of the stone that it is not anticipated that the value of the bullion will be greatly depreciated ;

in fact, I understand that local buyers are prepared to pay for the tin, after usual deductions for freight and smelting charges, &c., at the rate of 30*s.* per ton below the current price of the best Australian tin.

It will be seen from plate III. that a large chamber has been excavated at a depth of about 80 feet from the surface. Part of this had been mined before the present company took over the property, and I have been unable to obtain accurate information as to the amount of tin actually won. The present company has crushed 1160 tons, with the very satisfactory return of 81 tons of concentrates, or nearly 7 per cent. The latter averaged 68 per cent. of metallic tin, and, after treatment in Sydney, were sold at a satisfactory figure. A shaft has been sunk to the south-east of the deposit to a depth of 142 feet. From this, a cross-cut has been driven across the deposit. The tinstone was struck first, at a distance of 48 feet from the shaft. The crosscut continued in tinstone until, at a distance of 126 feet from the shaft, the granite was again met with, making the deposit in this direction 78 feet wide. At distances of 65 feet and 98 feet from the shaft, cross-drivages were put in on either side of, and at right angles to, the crosscut. In three of these the granite boundary has been reached, but the fourth, or most northerly of the cross-drivages, has not yet struck the contact. Since my visit, this drivage has been extended from 20 feet to 36 feet, and is still reported to be in tinstone. The width of the deposit in the direction of this cross-drivage is proved to be over 74 feet. As regards the tin content of the ore at the lower level, this seems to be satisfactory. Some is very rich, and other parts poor, but, as far as one can judge at present, it appears to be about the same as that at chamber-level. The average tin content of the ore-body is a figure which cannot be correctly estimated at the present time. It might be thought that the 1160 tons taken from the chamber, which yielded 7 per cent. of concentrates, might be taken as a fair bulk sample. It is true that the stone was taken just as it came, and was not picked or classified in any way before crushing, but several very rich bands of ore were struck, which must have had the result of raising the average of the sample above that of the deposit as a whole. The average of the deposit can, however, afford to fall a good deal below this figure. If the deposit will bulk one-fourth of this amount the mine will still be a very payable one. The tin contents are by no means uniform—rich bands and patches occur along with poor ones—and a correct idea can only be obtained after large parcels have been treated in the battery. For the present, all that can be said is that some of the stone is very rich; a large portion is certainly payable; and it is quite possible that, under the economical conditions for mining and treatment which the mode of occurrence and the position of the ore-body renders possible, almost the whole of the ore-body will pay to put through the battery. In order to give an idea of the amount of stone available, I have estimated the amount of stone now proved to exist between the crosscut and the bottom of the chamber: this amounts to 25,000 tons. The actual amount between these two levels must be more than this, because the limits of the deposit have not yet been definitely determined. There can be very little doubt as to the ore-body living in depth. From all we know of tin ore deposits, they are certainly of deep-seated origin. The present position of the surface of the ground can have had nothing to do with the deposition of the tin, because the surface has only been brought to its present position by long periods of denudation, and at the time of the deposition of the tin must have been many hundreds, more probably thousands, of feet higher than it is at present. Moreover, we are unacquainted with any means by which a concentration of tin oxide could be brought about by surface waters, as this substance is unsoluble in all the acids occurring in these waters. The soft and decomposed portions of the deposit may have been enriched by a mechanical process of concentration, but these patches are only very small and unimportant. The bulk of the tin is contained in the hard quartzose tinstone. Even the Ben Lomond district itself affords evidence of the permanency of tin in depth. The Great Republic Mine worked its shoot of ore (compared with the Mt. Rex deposit, a small one) to a depth of 450 feet, and then abandoned it, not because the tin gave out, but because, owing to the low price of tin and the increased cost of mining, the venture ceased to be profitable. I think there is every reason to believe that the Mt. Rex deposit will live down to very great depths, though its size and contents may vary at different depths; at any rate, we can reasonably hope that the mine will become one of the permanent metal-producers of the State.

In the upper portions of the Mt. Rex deposit considerable quantities of galena were found, and, as a matter of fact, the mine was first started as a silver mine. This was on the strength of a large mass of galena, which was discovered on the surface. About 20 tons of silver-lead ore were taken out, which are said to have assayed as much as 80 ozs. of silver to the ton. The old company drove an adit under the supposed galena lode, at a depth of about 40 feet, and was much disappointed to find a good deal of the galena replaced by tin ore. The mixture of galena and tin proved a most unsaleable product, and cast a cloud over the prospects of the company for many years. Happily, below the old adit level (*i.e.* the top of the present chamber) the percentage of galena in the ore has decreased very much, and is now so small as not seriously to affect the sale value of the tin ore. I think there is no doubt that the galena which was found in the upper-levels was principally of secondary origin, due to the leaching out by surface water of the lead from portions of the deposit now removed by denudation, and the precipitation of the same at lower levels. If this is the case, there need be no fear of encountering other large masses of highly refractory ores in depth.

About 7 chains north of No. 1 deposit, which I have just described, another tinstone formation is exposed in some trenches and open workings. We may call this No. 2 deposit. From No. 2, about 20 tons of stone have been stacked for a trial crushing. The stone is of the same nature as that occurring in the other deposit, and contains nice visible tin. It will be very interesting to learn if this deposit is connected with No. 1. I think it will prove to be another lens-shaped mass connected with the same series of veins which traverse No. 1. It is a promising show, and should receive attention as soon as work on the present deposit is placed on a firm footing.

On the eastern portion of Section 1520 a third (No. 3) deposit exists. Two old shafts have been sunk about 50 feet apart, from which some stoping has been done; an open cutting has also been made. The formation is a large one, and apparently strikes about 70° west of north. Some very rich stone was obtained in years past, and the remains of an old stamp-shoe and springer still exists where a party of working men were engaged in crushing the stone. It is stated that over a ton of tin ore was won by this primitive appliance. About four years ago thirty odd tons of stone were put through the battery from t is place, and are said to have returned 6 per cent. of ore, assaying 73 per cent. of metallic tin. I learn from Mr. Fritz Rubenach that the good stone is about 8 feet wide—the total width of the formation being from 20 to 30 feet. About 120 tons of stone are now at grass; these have been taken out with the object of obtaining a trial crushing. The stone looks well, and apparently carries a fair percentage of tin.

The company has lately erected a 20-stamp battery, with a complete concentrating and calcining plant, for the treatment of their ore. The battery is situated in a convenient position below the main shaft. The ore from the mine is shot into an ore-bin, from which it passes over a grizzly into a jaw-breaker. The products of both jaw-breaker and grizzly pass into a large ore-bin, which delivers into four challenge ore-feeders. The battery consists of 20 heads of 1000-lb. stamps, crushing to 14 mesh. The pulp passes through a pair of spitzlutten, which separate the sands from the slimes. The former are treated on two compartment jigs, and the latter, after further classification, in spitzkasten, are treated on Wilfley tables. The whole of the tailings are to be passed over a pair of Munday's concave buddles, with the object of catching any tin which may have escaped the other saving appliances. The calcining plant attached to the battery is of somewhat novel design. It consists of six circular compartments, separated from each other by steps and cast-iron bridges. The draught from the furnace passes successively over the ore contained in the compartments. In each of these there is a revolving arm or raddle, put in motion by gearing from the top, which keeps the ore in a state of agitation, and continuously exposes fresh surfaces to the heat of the furnace. Each compartment is connected with the next one lower down by means of a slot in the bridge, which can be opened or closed at will, and thus the rate at which the ore travels from one compartment to another can be regulated. In order to prevent the cast-iron bridges and raddles from burning away, those belonging to the first two compartments are water-jacketed. It is expected that the temperature in the other compartments will be so low that water-jacketting will be unnecessary. I am doubtful as to the wisdom of introducing a new machine like this on a mine which is just starting operations. As a rule, there are quite enough risks to be run in the mining part of the venture, without trying experiments with new machinery.

The first concentrates from the jigs and Wilfleys are to be calcined to get rid of the sulphur and arsenic, and then re-dressed. This will eliminate the greater part of the iron originally present in the pyrites, but now converted into oxide. The second concentrates will be leached with dilute sulphuric acid, in order to get rid of the zinc and copper. Lead, unfortunately, cannot be got rid of by this means, on account of the insolubility of the sulphate.

The Mount Rex Company has secured a most extensive dam-site and water reservoir, and its capable manager has projected an extensive scheme for water conservation, upon the capabilities of which I am instructed to report by the Hon. the Minister for Mines.

The scheme involves the construction of two large dams on Egan's and Buffalo creeks, about $2\frac{1}{2}$ miles north of the mine. North of the dam-sites, the creeks flow through extensive marshes, which extend almost to the foot of Ben Lomond, and are separated from each other by a low, flat ridge. The largest of these dams, that on Egan's Creek, has already been constructed in part, but in the complete scheme it is intended to increase its present height by 16 feet. When complete, this dam will be 1120 feet in length, and will give a maximum depth of 41 feet of water in the reservoir. The dam on Buffalo Creek will be 272 feet in length, with a maximum depth of water of 21 feet.

The two reservoirs are connected by means of a flood channel across the intervening ridge, so that one by-wash serves both reservoirs. In order to secure as large a catchment area as possible, the company propose to construct a race 3 miles in length, bringing the head waters of the Ben Lomond Rivulet into the watershed of the Buffalo Creek. A temporary race is being made to bring the waters of Buffalo Creek into the present reservoir through the flood-channel. It is expected that this will give a sufficient supply of water to keep the mill going, except during the very driest portion of the summer. The dam is a very massive structure, and reflects very great credit upon its designer. A detailed description of it will be found in the *Australian Mining Standard*, November 22, 1900. The site is a magnificent one, and when complete will dam back the water for nearly a mile up the marsh. In order to get an idea of the capabilities of the scheme for affording a regular supply of water, it is necessary to have the following data :—

1. The capacity of the water reservoir.
2. The catchment area.
3. The rainfall record for the district.

Concerning the first of these items, this cannot be accurately determined without a very careful contour survey of the reservoir; this was out of the question in my necessarily hurried examination, and I had to content myself with somewhat rough measurements. I estimate the capacity of the two reservoirs, when complete, at 300,000,000 gallons, or 1,334,300 tons of water. This estimate is liable to an error of perhaps 25 per cent., but I think it is near enough for the purposes of the present estimation.

In estimating the catchment area, I was at a disadvantage in not being able to ascend Ben Lomond on account of the snow; I therefore could not tell what proportion of the top of the mountain, and this is very large in area, was to be included. I have therefore been compelled to make a conservative estimate, and one which I think will be exceeded. My estimate of the catchment area is 6000 acres.

I have before me the rainfall records of the districts of Avoca, Ormley, Fingal, and Mathinna, all in the vicinity of Ben Lomond. Of these the rainfall at Avoca is decidedly the smallest; it is, however, the nearest station to our catchment area, and I have based my calculations upon it. This is certainly very well within the mark, as the greater part of the catchment area is on Ben Lomond, where the rainfall is no doubt much greater than that at Avoca.

In the following table column I. gives the average monthly rainfall for the last ten years. Column II. gives the monthly rainfall for the driest year during the last ten years—1900 :—

TABLE I.

RAINFALL AT AVOCA.

Month.	I. Monthly Average.	II. Driest Year (1900.)
January	1·474	0·89
February	0·578	0·45
March	1·353	0·42
April	1·992	1·01
May	1·421	0·40
June	1·676	1·00
July	1·628	1·58
August	2·141	2·61
September	1·634	0·23
October	1·501	1·12
November	1·102	0·57
December	1·443	1·37
TOTAL	17·943	11·65

In my estimate I have used the figures in Column II., that is, I have taken the lowest rainfall of any year during the last ten years. Before these figures can be used, however, we must allow for absorption, evaporation, &c. The factor of available water discharged by streams draining such an area as we have here would be about ·7 during the wet months, and ·4 during the dry months. I have, therefore, used these factors, the former for all months the rainfall of which was one inch and over, and the latter when the rainfall was under one inch per month. From the figures thus obtained I find that a constant monthly supply of 363,400 tons of water can be taken from the dam throughout the year.

In the following table Column I. gives the available monthly rainfall in inches after allowing for absorption, &c. Column II. gives the amount of water in tons which the rainfall in Column I. represents over the catchment-area of 6000 acres. Column III. gives the amount of water in tons taken from the reservoir each month, and Column IV. gives the contents of the reservoirs in tons at the end of each month. The table starts with August, the wettest month, when the reservoir may be supposed to be full :—

TABLE II.

Month.	I. Available Rainfall.	II. Water flowing to Reservoir.	III. Water taken from Reservoir.	IV. Content of Reservoir at end of Month.
	(inches.)	(tons.)	(tons.)	(tons.)
August	...		...	1,339,300
September	0·092	55,200	363,400	1,031,100
October	0·784	470,400	,,	1,138,100
November	0·228	136,800	,,	911,500
December	0·959	575,400	,,	1,123,500
January	0·356	213,600	,,	973,700
February	0·180	108,600	,,	718,900
March	0·168	100,800	,,	456,300
April	0·707	424,200	,,	517,100
May	0·160	96,000	,,	249,700
June	0·700	420,000	,,	306,300
July	1·106	663,600	,,	606,500
August	1·827	1,096,200	,,	1,339,300

This proves the water scheme to be capable of affording a constant supply of 363,400 tons of water per month. Assuming the water is used for 25 days in each month, this represents a daily supply of 14,536 tons, or 3,256,064 gallons. I estimate that the battery and concentrating mill now being erected at the Mount Rex Mine will require 1,500,000 gallons daily when working three shifts. There will, therefore, be a surplus of 1,756,064 gallons, or a little over eight Tasmanian sluice-heads per day of 24 hours during 25 days per month over and above the present requirements of the company. As I have already pointed out, the estimate is based upon the driest year in the last 10 years. The wettest year in this period had nearly twice the rainfall of the year taken. In this case the supply would, of course, be much greater, but not necessarily proportionately greater. During wet weather much water will be lost, owing to the dam being full.

The land held by the Mount Rex Company for its reservoir site is, of course, all low-lying, and a large portion of it is covered by Permo-Carboniferous strata. It is possible that, in that portion which is not covered by these strata, tin lodes may exist, but none have so far been discovered. Flat ground is not, as a general rule, a likely place to look for tin lodes, for the very good reason that, as a rule, they are accompanied by an induration or hardening of the granite in their vicinity, and this naturally produces irregularities in the surface as denudation progresses.

Section 376-93M (40 acres), A. J. Ritchie. This section is situated directly north of the eastern portion of Section 1520-87M, belonging to the Mount Rex Company, About the centre of the section, and directly north of the Mount Rex No. 3 deposit, a shaft has been sunk on a tinstone formation, from which a few tons have been taken with the object of obtaining a trial crushing. Some of this stone contains very good tin, and is of practically the same nature as that occurring on the Mount Rex Mine. North of this again, there is a second shaft sunk on similar stone, containing a little tin, together with pyrite, marmatite, &c. Both these shafts were full of water, so that the stone could not be examined *in situ*, nor could any idea be obtained as to its extent. The stone is of a favourable appearance, and is well worth testing.

Section 3677-93M (40 acres), A. J. Ritchie. This section is north and adjoining Section 1191-87M, belonging to the Mount Rex Company, and the Mount Rex No. 2 deposit is situated only a couple of chains from the boundary. On the southern portion of this section, a strong tourmaline lode has been exposed in several trenches, and a shaft has been sunk upon it for some distance. A little tin appears to have been got, but the tourmaline stone seems, for the most part, barren.

A quartz vein some feet in thickness, belonging to the younger quartz pyrite formation, occurs near the tourmaline lode, and some work has been done upon it. It should be remembered that this quartz is not tin-bearing, and, as a rule, work expended upon these reefs is wasted. The exception occurs when the younger reef follows the course of an older tin-bearing reef. This does not appear to have happened in this instance.

Section 3460-93M, C. R. Foster. This section is northwest and adjoining section 1191-87M of the Mount Rex Company. On the southern portion of this section there is a lode with apparently well defined walls, about 3 ft. 6 ins.

in width, dipping vertically and striking west of north. Although the walls appear to be well defined, and have more the appearance of the walls of a true fissure vein than of a tinstone lode, I am doubtful if they are really walls. I broke into one of them and found it to consist of similar stone to that contained between the walls. In prospecting the mine, I should recommend the walls to be broken into from time to time, with the object of ascertaining the character of the stone, and whether it contains tin or not. The western wall, at any rate, is occupied by a small quartz vein, which will probably be found to have altered the rock on both sides. A good deal of tinstone has been taken out of a prospecting shaft which has been sunk on the lode, and some of this contains good tin. A trench two or three chains north of the shaft has exposed similar stone. The show is certainly worth a trial.

Section 4234-93M, J. C. Macmichael. This section is situated about three quarters of a mile to the north-east of the Mount Rex Mine. A little to the north-east of the centre of the section a lode, known as "Christoe's Show," has been uncovered by trenching along its course for some chains; the strike is about east and west. The lode consists of small veins of quartz and tourmaline, and on either side of these the granite has been altered by the replacement of the feldspar with quartz, &c., for some feet, and contains some very nice tin ore. The tin-bearing stone goes up to six or eight feet in thickness. Towards the west the stone which is exposed is poorer, but the same characteristics continue. The lode is a promising one, and is worth prospecting. The ground falls sharply to the north, affording good facilities for tunnelling. A large portion of the section is covered with old Permo-carboniferous grits or wash, which is often very difficult to distinguish from granite. Both in an east and west direction the lode must dip under these old beds of wash. It is impossible for it to live through them, since it was already formed before they were deposited. This must be borne in mind when prospecting the section, and care must be taken to distinguish between the granite and the old granite wash. The approximate position of the lode is shown on Plate I.

Section 4260-93M, E. Gaunt. Near the centre of this section a shallow shaft has been sunk on a tin lode about two feet in thickness, and striking about east and west. The stone is the typical tinstone of the district, being composed of quartz, chlorite, &c., with a little pyrites; it is for the most part poor in tin. Further west another shaft has been sunk for a considerable distance on a vein of white dense quartz of the younger quartz-pyrite formation. Curiously enough some tinstone has been got out of the shaft, but the latter cannot be connected with the quartz-reef. It is probable that this quartz-reef has followed the course of an older tin-bearing lode, the old fissure being re-opened at a later date when the younger quartz was introduced. I have definite proof that this has taken place in two other instances in this district.

Section 4652-93M, P. C. Weetman. This section is situated about three quarters of a mile to the north of the Mount Rex Mine. A very promising formation is exposed in the eastern portion of the section. It consists of tinstone of a similar nature to that occurring at the Mount Rex Mine, and contains, in places, very good tin. The surface of the formation is only exposed in a few places at present, and the extent of the tin-bearing stone cannot be determined. It is well worth opening up. A tunnel might be driven from the valley of a small creek to the north of the show. With 100 feet of driving perhaps 50 feet of backs could be obtained.

Section 4851-93M, C. E. Cheshire. This section is about three quarters of a mile south-east of the Mount Rex Mine. Two promising lodes have been discovered on this section. The first examined is situated to the south of the centre of the block and is opened up in a trench, from which a ton or so of really rich stone has been taken. Enough work has not been done to prove the extent of the formation, but the stone is of the same character as that occurring at Mount Rex, consisting of quartz with chlorite pseudomorphs after feldspar; the tin is finely distributed through the stone. The second lode is north of the first, and has had very little work done upon it. Such stone as has been taken out is, however, rich in tin. This lode presents some very interesting features.

The tin occurs, as usual, in the altered granite on either side of a quartz-vein, and where exposed, the stone is very rich. The vein contains quartz belonging both to the tin formation and also to the younger quartz-pyrite formation. The older quartz is easily distinguishable from the younger, being white and crystalline, and forming the lining of both walls of the vein, whereas the younger quartz is dense, light yellow in colour, and occupies the centre of the vein. It is quite evident, in this case, that the older fissure has been reopened at a later date, and the younger quartz has been introduced, filling up the druses formed in the older vein.

Both lodes on this section are promising, and are well worth prospecting.

Section 4986-93M, E. Williams and J. A. Lyall. Several prospecting shafts have been put down on this section, on tin-bearing formations, none of which I was able to examine, owing to the shafts being full of water. In two of these the typical tinstone of the district occurs, and some of it contains good tin. I also noticed a vein of white quartz on the section, containing tin ore. This is not a usual occurrence in the district, as the tin is, as a rule, only present in the altered granite on either side of the quartz vein. The same quartz vein carries a little feldspar in places. I would not be at all surprised to hear that it passes over into a true pegmatite. I should say the the prospects met with, so far, are promising.

The Ben Lomond and Great Republic Mines.

Both these old mines are now held by the same company. The sections include 3750-93M, 3751-93M, 3752-93M, 3990-93M, 4079-93-M, 4232-93M and 4796-93M; with a total area of 200 acres. They are situated about three miles distant, and a little west of north from the Mount Rex Mine. Both the old Ben Lomond and the Great Republic mines were carefully described by Mr. A. Montgomery in 1892, when the latter mine was in operation, and, as there has been very little work done on either since, it will not be necessary for me to go over the whole ground again. In the old Republic Mine, a rather small, but very rich, shoot of tin was successfully mined to a depth of about 450 feet. The shoot is described as being from 10 to 17 feet in thickness, and from 20 to 30 feet in length. It occurs on a small fissure vein of quartz and fluorspar, and represents a zone of impregnation from this fissure. The shoot appears to have maintained its tin contents as depth was gained, though varying in richness in different places. Shutting down the mine was caused by the fact that the shoot of tin was not large enough by itself to bear the whole cost of the deadwork which its exploitation necessitated. It is most unfortunate that the old company did not do more driving along the vein of fluorspar, with the object of discovering other shoots of ore. Had the company had one or two other shoots to share the cost of the deadwork, there is no doubt that the mine would be working to-day. The mine was abandoned when the price of tin fell so low as to render mining unprofitable. From all I can hear about the mine, I think it is quite possible that the shoot of ore would be payable at the present price of tin, but it would be the height of folly to attempt to work it unless the company were prepared to pursue a vigorous policy of development, by driving along the fluorspar vein in both directions from the known shoot of ore. It is highly improbable that the shoot is the only one on the vein; it is much more likely to be one of a series which can only be discovered by systematic development. The Great Republic shaft is situated in the north-western portion of Section 3751-93M. The mine workings were, of course, inaccessible, and my conclusions are, therefore, based only on the reports of others.

The old Ben Lomond Mine (Sections 3750-93M and 3990-93M) has been practically at a standstill since before Mr. Montgomery's visit in 1892. The two principal lodes (Nos. 1 and 2) are situated in Section 3750. No. 1 is a tinstone formation, on which two underlay shafts have been sunk—one 80 feet, the other 50 feet, in depth. Mr. Montgomery states that this lode was said to have averaged 3 feet 6 inches in thickness, and I note from a report of Mr. J. H. Rilstone's on the property, that it goes up to 15 or 20 feet. The stone at grass is mostly very poor in tin, but, as Mr. Montgomery observes, presumably the best of the stone has been sent to the battery. In the most northerly of the two shafts, a little work has been done lately, and the stone which has been taken out carries very fair tin. It seems pretty evident, therefore, that Mr. Montgomery's conclusion is correct, and that all the stone carrying payable tin has been crushed. North of these two shafts two more openings have been made on the lode. In the first of these, the tin is, for the most part, confined to the fissure vein, which is from three to eight inches in thickness, and most of it is rich in tin. In the tinstone, or altered granite, the tin appears to be present only in the joints and floors. In the next opening, further north, tin is again met with, but the lode appears to be considerably broken up. The strike of this lode is 37° west of north, and dips to the east. A main shaft has been sunk to a depth of 100 feet, with the object of working the lode, but I could not ascertain if the lode had ever been intersected by crosscuts from the shaft : I think probably not. As to the economic possibilities of this lode, I cannot pretend to have been able to come to any conclusion, as I could not examine it where it had been best opened up, owing to the two underlay shafts being inaccessible. The character of the stone is favourable, carrying, as it does, small veins of fluorspar, and I think it is certainly worth a trial.

No. 2 "lode" appears to have been a rich patch of ore which cut out about 12 or 15 feet from the surface, but from which about 38 tons of tin ore have been won. Little is to be seen now at the surface to indicate the former presence of the tinstone, as the bottom of the open working is now mostly covered with mullock. From Mr. Montgomery's report I note that the lode continued downwards, "as a small vein of quartz and quartzose granitic matter, showing little or no tin, and enclosed in hard country." The rich patch, moreover, was "in soft granite, and when the hard country came in the ore died out." From what I can learn of this deposit, the whole of the tinstone was quite soft, and of a different nature from that which I have described as the typical tinstone of the district. Under these circumstances it is possible that a large amount of mechanical concentration of the tin oxide may have taken place near the surface. The open working from which the tin was taken has been driven under, at a depth of 120 feet, by a long tunnel, and, with the exception of a small vein of quartz less than a quarter of an inch in thickness, nothing was found to which the tin above could be attributed. It is possible that, by following up this small vein, other patches would be discovered, but, unless this could be done in conjunction with other necessary mining work, I do not think it would be worth following.

The Ben Lomond adit, a very unnecessary piece of work at the time when it was put in, is 735 feet in length, driven on a course of 57° east of north, and is still 120 feet short of No. 1 lode. Its chief interest at present is that it affords valuable information concerning the age of the lodes of the quartz-pyrite formation. In Plate II., Figs. 3 and 4, the tunnel is shown in plan and section. From the section it will be seen that the first 140 feet were driven through Permo-Carboniferous wash, overlaid conformably by shales of the same age. It is often extremely difficult to distinguish between this wash and the decomposed granite. Mr. Montgomery, on his visit to the mine, was unable to examine the tunnel beyond the first 100 feet, and, therefore, had no opportunity of comparing the stone near the mouth of the tunnel with that occurring further in. Under these circumstances, I am not surprised that he mistook the old granitic wash for granite, and, in his report, gives a sectional sketch of the mouth of the adit, showing the granite apparently intrusive in the Permo-Carboniferous shales. In Mr. Montgomery's sketch, if we alter the granite to granite wash, conformable with the shales, the meaning of the section is at once apparent, and the positions of the strata are satisfactorily explained by faulting. The same section is shown to a smaller scale in Plate II., Fig. 3.

I noticed that seven different veins or lodes had been cut in this tunnel. In order not to lead to confusion with other older descriptions which may be in existence, I have denoted these veins with letters A. to G., in the order in which they were struck in the tunnel.

Vein A. was struck about 12 feet from the mouth of the tunnel. It is a very strong reef, composed of dense flinty quartz, and a good deal of pyrite. Apparently, it is quite barren. It cuts through the Permo-Carboniferous wash, and is, therefore, younger than these rocks. As I have shown elsewhere, there are strong reasons for believing that the veins of this quartz-pyrite formation are as late as the end of the Mesozoic period. The fact that these are younger than the Permo-Carboniferous rocks is the strongest evidence that they do not belong to the tin-bearing formation. Were there no other reasons for believing the tin to be older than the Permo-Carboniferous rocks, the presence of alluvial tin in ancient wash of Permo-Carboniferous age (at Roy's Hill and, to a limited extent, also, in the Ben Lomond district,) would be abundant proof of this.

Veins B. and C. are both strong formations, composed of the same dense quartz. Here the country rock is granite, and the reefs cut through this rock without producing any perceptible alteration of the walls, the feldspar being quite unaltered.

Vein D. is a small one, striking a little west of north, and is composed of quartz and mica. It apparently belongs to the tin-bearing formation, but it was not well exposed.

Vein E.—This is a typical vein of the tin-bearing formation. It consists of a small vein of quartz and a little kaolin, with the feldspar in the wall-rock converted into quartz for a distance of 18 inches to 3 feet on either side of the vein. It has been driven on on both sides of the adit for a total distance of about 100 feet, and the stone has been shot away overhead for a distance of 10 or 12 feet. I did not notice any tin in the stone, but it is quite possibly present. In any case, the vein is worth following up. The strike is about 30° west of north, and the dip easterly.

Vein F strikes almost at right angles to the majority of the others met with in the adit; namely, 50° east of north, dipping to the south. It is a strong reef of the quartz-pyrite formation, and is, evidently, the line of a fault of considerable magnitude, as shown by the large amount of crushing to which the granite has been subjected. This reef will probably be found to fault all the tin-bearing reefs which it crosses. This is a point worth bearing in mind.

Vein G is very small, being in places less than $\frac{1}{8}$ of an inch in thickness, and certainly very little, if any alteration of the granite has taken place in its vicinity. Still, from its general appearance, I am inclined to regard it as belonging to the tin-bearing formation. It appears to be the only continuation of No. 2 deposit on the surface which has been struck in the adit. If driven on, it would probably widen out. All these reefs are shown in the plan and section of the adit in Plate II. The only one worth paying further attention to, in my opinion, is Vein E.

On the southern portion of section 4232 a new lode, known as "Rilstone's" lode, has been uncovered in a surface trench. It consists of a small vein or fissure, with the wall-rock altered on either side. A good deal of the stone carries nice tin. The strike of the formation is about 30° west of north, and the dip easterly. That it has not been struck in the adit is, I think, to be accounted for by the fact that, where it crosses the adit, the latter is in Permo-Carboniferous strata into which the tin-lodes never penetrate. If this is the case, it is quite possible that it may exist in the granite below the Permo-Carboniferous strata which has been passed through by the adit. The show is certainly a promising one, and is worth a trial.

On the most northerly of the sections held by the Ben Lomond and Republic Company (3752-93M) there are two formations which I consider well worthy of attention. The first of these is situated about the centre of the southern portion of the section. It consists of a large formation of stone of a similar nature to that already described as the typical tinstone of the district. I did not see any tin in the stone, but it contains a little zincblende and pyrites. The second formation is situated some chains to the north-east of this, and is of a different character. The stone here is composed almost entirely of white feldspar, with a little quartz. A large open cutting has been made, and evidently the greater part of the stone has been removed and crushed. About 20 tons, however, are still at grass, and all this contains good tin distributed through it in fine grains. If this 20 tons can be taken as a sample of the stone, the show is certainly payable. Unfortunately, owing to the excavation being full of water, I could not examine it *in situ*. Very similar stone, belonging probably to the same formation, is met with in another excavation further south, but most of the stone at grass is poor in tin. I was told a crushing had been also taken from this hole, so that, presumably, the good stone has all been removed. The formation is a large one, and if it can be proved to contain even a small percentage of tin it would be very valuable. This is a really promising surface show and should not be allowed to remain untried.

These were all the shows which I examined on the Ben Lomond and Republic Company's sections. Several of them are, in my opinion, very promising, and are well worth prospecting. The company holds a large area of ground, and to do it justice will require the expenditure of a large amount of capital.

Section 5305-93M, J. Rilstone and T. Briggs. About the centre of this section two parallel holes have been cut in a number of trenches. They are about 40 feet apart, and strike 30° west of north. All the trenches were full of water, so that the stone could not be examined *in situ*. Judging by the stone at grass, this consists of the typical tinstone of the district, and contains very fair tin. Mr. Briggs tells me that the tinstone is about 7 feet wide in the lode on which most work has been done.

Sections 4397-93M and 4395-93M. These sections, formerly known as the Lomond Tin Mine, are not held at the present time. An extraordinarily rich patch of tin was discovered and mined some years ago. The stone is described as being almost massive tin oxide, containing 80 per cent. of ore, and, indeed, numerous large blocks of stone still remain which would carry nearly this percentage. The shoot appears to have been very limited in extent, and to have cut out at 10 or 12 feet from the surface. The vein where I saw it was composed of pegmatite and contained little bands of dense massive cassiterite, as well as a good deal of tin in the form of small grains. In some places the country rock has been slightly altered, but to no great extent. The vein has been traced for a long distance through both sections. If the vein were exploited other rich patches would no doubt be met, but the venture would, to say the least of it, be a risky one.

Section 3865-93M. I understand this section is held under a Prospecting Licence by J. Rilstone. Near the north-west corner of the section a lode exists on which some stoping has been done from an underlay shaft. The stopes are mostly fallen in now, and I could not get a good view of the formation; it is striking a little to the north of west and dipping towards the south. The lode is about two feet in width. Most of the stone has been removed and, presumably, taken to the battery. Some of the stone at grass carries very fair tin, but of course the best of it has been taken away.

The St. Aubyn Tin Mining Company.

This company holds 18 sections, comprising 930 acres, charted in the names of W. Martin, R. J. Sadler, P. Barrett, and S. Pinnington. Unfortunately, no one was present at the mine at the time of my visit, and it is possible that I did not see everything which was to be seen. The sections are situated at the head of Gipp's Creek, about three miles north-west of the Ben Lomond Mine. Section 4484 was the most promising of the sections visited by me. On this section several large quartz-tourmaline lodes have been discovered carrying a fair percentage of tin. The first of these examined is situated in the south-east portion of the section and on the southern slope of a creek which flows diagonally through the section It is composed of quartz and tourmaline, with a little tin. The quartz is of two generations, one belonging to the tin formation, and the other to the younger quartz-pyrite formation; the latter often enclosed angular fragments of the former in its mass. This lode, where exposed, does not carry payable tin. A little further west and on the same side of the creek there is a large quartz-tourmaline lode; it has been broken into in the end of an excavation which has been made alongside it for a distance of two feet six inches, but the hanging-wall was not reached, so its actual width is unknown. The stone is composed of hard quartz impregnated strongly with tourmaline; in places the latter is nearly massive, and contains a good deal of tin distributed through it in large brown crystals. The quartz also contains some visible tin, but it is difficult to identify on account of the presence of the tourmaline. A little wolfram is also present. On the other side of the creek what I take to be the same lode, or a parallel one of the same nature, has been cut. It is 5 or 6 feet wide, and is composed of quartz and tourmaline, with a fair percentage of coarse brown tin distributed through the stone. East of this, and higher up the creek, a couple of trenches have been cut, from which a great deal of similar quartz-tourmaline stone has been got. The lode, however, as far as I could see, has not yet been found *in sitú*. Some of the blocks are rich in tin and evidently come from a strong lode. It is thus evident that two or more strong parallel lodes occur on this section. The results which have been got by surface trenching are most encouraging, and they should be followed up by a more thorough scheme of exploitation. I should recommend an underlay shaft to be sunk upon the most promising of the lodes, and the stone taken from it to be carefully sampled or sent to a battery. The desired information may be had by sampling, provided sufficient care and labour is expended on it, but a battery test is generally more convincing.

On Section 4452 a tunnel has been driven into the side of the hill for a considerable distance. It starts in a north-easterly direction, and after 93 feet of granite had been passed through, a strong quartz vein, 3 feet in thickness, was cut. This vein strikes west of north, and dips easterly. It was followed for at least 180 feet, but at this point the roof had fallen in, and I was unable to proceed further. The vein is evidently one of the quartz-pyrite formation, and, therefore, could not be expected to carry tin. Above the adit three underlay shafts or winzes have been put down. One of these follows the quartz-pyrite vein, and connects with the drive below, near where the adit struck the vein. The other two have been sunk on a tourmaline quartz vein, carrying a good deal of copper pyrites. This is apparently parallel, and very close to the other vein. That this vein has also been cut in the adit is shown by the presence of quartz, with tourmaline, copper pyrites, and a little tin oxide at the mouth of the tunnel. Not having had an opportunity of seeing this tourmaline-quartz lode *in situ*, I am unable to form any opinion as to its value, but, according to Mr. Montgomery's report, the lode is well worth a practical trial. Two other tunnels have been driven on the property, one of them being 560 feet in length. This was driven for a large part of the distance on a course of 12° west of north, or just about parallel to the general strike of the lodes in the district. It is, therefore, not surprising that very little was discovered. All this work was done a long time ago. A large amount of money was spent upon it, but so injudiciously that it cannot be said that the prospects of the mine are any better or any worse than before it was spent. It has been practically thrown away, though possibly some of the old tunnels may be used in further prospecting the ground.

On Section 4453 a vein carrying some very good wolfram ore has been cut in a small trench. Unfortunately, the trench had partly fallen in, and I was unable to examine it *in situ*, but certainly the stone at grass looks promising. I take this vein to be a parallel one to two others occurring on the Ben Lomond Tungsten Company's ground, which will be described below.

There is some alluvial ground on the Company's property, but time would not permit of an exhaustive examination. Without this, it is impossible to form an opinion as to the value of alluvial ground.

The Ben Lomond Tungsten Mining Company, No Liability.

This company holds Sections 3679-93M, 4802-93M, and 4918-93M, with a total area of 72 acres. The mine workings are situated about the centre of Section 3679. No. 1 vein, on which most work has been done, is from 18 inches to two feet in thickness, and consists of quartz, tourmaline, tungsten, and very small quantities of tin and galena. It is very flat, dipping not more than 20° to the south, while the strike is about east and west. No. 2 vein is parallel to No. 1, and, perhaps, 20 feet below it, vertically. It is, apparently, of exactly the same nature and about the same size. These flat veins or reefs are not uncommon phenomena in connection with intrusive masses of granite. The original fissure is believed to be caused by the contraction of the granite during the process of cooling. They usually occur as a series of veins, roughly parallel to the margin of the granite mass. Plate IV., Fig. 1, gives a diagrammatic representation of similar occurrence at Zinnwald, in Saxony, after H. Zinkeisen.*

No. 1 vein has been opened up along its outcrop for a distance of a couple of hundred feet, and the stone taken out until the overburden increased to 8 or 10 feet. In the eastern end of the workings a tunnel has been driven

* R. Beck. Lehre von den Erzlagerstätten.

along the vein for a distance of about 30 feet, and a portion of the vein has been stoped out. Some of the stone lying at grass is very rich in wolfram, and all of it contains a little. The vein will, probably, prove to be patchy, but, judging by the work done, the patches are fairly close together. Mr. T. Briggs, the late mine manager, tells me that 16 tons of wolfram ore were obtained from the mine, assaying from 68 to 70 per cent. of tungstic acid. There is a small crushing and dressing plant on the mine; it consists of a jaw-crusher and rolls combined, and a Wilfley table, the power being supplied by a small vertical engine. The crushing apparatus is a mere toy, and totally inadequate to crush the hard stone in which the wolfram is enclosed. Mr. Briggs tells me that a ton of quartz per shift was as much as could be treated. Under these circumstances, I am not surprised to hear that, as soon as the price of tungstic acid fell, the mine ceased to be profitable. I think that it is very possible that, with more appropriate machinery, the mine would become a profitable concern. It does not want a large plant, but one which will be effective. I should suggest a jaw-crusher, preferably with the greatest motion at the top end of the jaw (*i.e.*, pivoted at the bottom), in order to get as uniform a product as possible. This would crush to $\frac{3}{4}$-inch cube. The sands and slimes should be screened off, and treated on the Wilfley table, and the coarser product treated on a jig. The tailings from the jig might be recrushed in a ball-mill of the Grüssonwerk type, and treated on another Wilfley table.

Storey's Creek Tin Mining Company.

Sections 3272-93M, 3275-93M, and 856-93M. In all 125 acres. This mine is situated in the north-eastern portion of the field. The country rock is composed of Silurian strata, overlaid in parts by Permo-Carboniferous grits and sandstones. A great deal of alluvial tin has been obtained from these sections in years past, and two men are still working the surface soils and gravels. That the wash is rich is shown by the fact that in many places the surface soil has been stripped, even where it is only six or eight inches in thickness. At the time of my visit, unfortunately, there was no one at the mine, and I did not see all the workings. As far as I can learn, the only underground mining which has been carried on of late years is in connection with some quartz veins which were worked for wolfram. One of these veins has been followed, striking west of north from the valley of a creek into the side of the hill by means of a tunnel. At 120 feet a crosscut was driven to the east, and, about 10 feet away from the first, a second parallel vein was cut. These veins have both been stoped out above the tunnel for about ninety feet in length. At the end of the stoped ground the two veins are close together. At this point the western vein is 2 feet in thickness, and the eastern vein 18 inches, with about two feet of mullock between. I could not examine the drive further, on account of the water being dammed back at this point. The crosscut mentioned above was extended for over 300 feet, and, about 70 feet from the drive, another lode was cut, one or two feet in thickness. This was also driven on and some stopes taken out, but, again, the water prevented me from completing my examination. In all these veins the stone carries a little wolfram, and, of course, the parts which have been stoped were much richer than that which has been left. I am told that another good shoot of ore is exposed in one of the drives; but this I did not see. Apparently, the results obtained by the company were not satisfactory, as it has sold its battery and concentrating appliances, and these have lately been removed. From Mr. Montgomery's report, I note that a number of small tin veins had been discovered on the property. To these he attributes the presence of the alluvial tin.

Egan's Freehold.

Lot 982. 620 acres. This freehold property was leased some time ago to a party of prospectors, who set about prospecting it in a very energetic manner. Several lodes have been uncovered, the most promising of which is exposed in a good-sized excavation. The stone is composed of quartz and massive muscovite, with a little tourmaline. Most of the stone taken from this hole carries little or no visible tin, but one paddock, containing, perhaps, 20 tons of stone, carries good tin. The venture has been abandoned, but I think there is still a possibility of a good shoot of stone being discovered.

Section 5051 (Brooks' and Millers')—I visited a small prospecting shaft on this section, from which some tin-bearing stone had been taken out, containing also tourmaline and a little copper pyrites. The stone has been apparently taken from a large formation, but I could not examine it *in sitú*. Several trenches have been cut to the west of the shaft, from which similar stone has been obtained.

The Demmocks Prospecting Association.

Sections 4568-93M, 4539-93M, 4482-93M, 4483-93M.—These Sections are situated on a steep granite spur, which runs in a north and south direction, several miles to the east of the country I have been describing. On the top of this spur several parrallel tin lodes, striking W. of N., have been discovered. They are all, practically, of the same character, being composed of granular quartz, with a little tourmaline, chlorite, &c.—in fact, the typical tinstone of the district. These lodes have been exposed in a great number of trenches and small shafts, and almost everywhere I was able to find tin in the stone; a good deal of it contains fairly rich tin. The lodes are from four feet up to 12 or 14 feet in width, and look very promising. Eventually, they could be mined by means of adits driven from either side of the spur, but, for the present, it would be more economical to sink a shaft and cross-cut across the whole system. From this cross-cut, each lode should be driven on, and the stone which is taken out should be carefully sampled. The show is a really good one, and is well worth developing.

The Excelsior Mine.

This mine is situated to the east of the Demmocks Prospecting Association. Unfortunately, I had not heard of it when visiting the district, and, therefore, did not see it. Mr. Fritz Rubenach tells me the show is an excellent one.

The mines which have now been described include all the tin lodes which I visited in the Ben Lomond District proper. I was agreeably surprised at the promising character of many of them, and I am still surprised that the district has not attracted more attention from the investing public than it has done. The cause, however, is not far to seek. A large amount of money was expended in the district some years ago, and that having failed to develop any good mines, it was naturally supposed that there were none to develop. As I have already pointed out, the greater part of this money was spent so unwisely that it did not really affect the prospects of the field at all. In the only mine on which work has been carried on to any depth, it was proved that the shoot of tinstone which was first discovered lived down. That it was not large enough by itself to bear the whole cost of developing the mine is not surprising, and is no discredit to the field; but that it lived down as far as it was followed is, to say the least of it, most encouraging to other mine owners. On two other mines a large amount of money was spent without finding anything of value. Had the intention been to avoid coming in contact with deposits of tin, the money could hardly have been more effectually expended.

At the present time the prospects of the district largely depend upon the result of the Mount Rex Company's operations. This company has a good mine, and a good manager, and I have very little doubt of the success of the venture.

The South Esk Tin Mining Company, No Liability.

Mr. A. Farquhar, mine manager. This company has acquired mining rights over a freehold block of 220 acres granted to J. Gilligan. The company also holds Sections 3937, 4869, 4281, 4895, and 3979, all 93M, with a total area of 76 acres. The mine is situated about 3½ miles north-east of Avoca. The ground which is at present being worked is in the western portion of an extensive alluvial flat, on the north side of the South Esk River. Gilligan's and Storey's creeks flow into the South Esk from the north, the former at the western, the latter at the eastern end of this flat. Besides these, several other smaller creeks flow into the South Esk (*i.e.*, across the alluvial flat) between the two larger creeks. There is strong evidence that the alluvial tin which the company is working has been brought down by these creeks. The company has been working along the western end of the alluvial flat, and has already worked the lead for about

9 chains in length. After the first 3 chains had been worked a granite bar was struck, which had to be cut through. This was about 2 chains in length. The total depth of the wash is from 15 to 20 feet, but, unfortunately, only a small portion is tin-bearing. The seam of tin-bearing wash varies from 1 foot up to 5 feet in thickness, and would average about 2 teet. To gain an idea of the quality of the wash, I measured up the last paddock which had been taken out, and from which Mr. Farquhar tells me he has obtained 6 tons 17 cwts. of tin. The total amount of dirt shifted amounted to 7746 cubic yards, and taking the tin-bearing wash as 2 feet in thickness, the total amount of the latter was 815 yards. This gives an average of 3·4 ounces of tin per yard of dirt shifted, and a trifle over 2 lbs. per yard for the 2-feet seam of tin-bearing wash. The paddock paid its way, but I understand the margin of profit was very small. The lead of wash appears to be divided into two in the present face. The western half of the lead is composed almost entirely of granitic material, and this appears to be heading towards Gilligan's Creek. The eastern half is largely composed of the *débris* of Silurian quartzites, slates, &c., and appears to be heading round along the northern edge of the flat. It is remarkable that in both portions of the lead the tin appears to be always associated with fragments of dense yellowish quartz, evidently belonging to the quartz-pyrite formation, which I have already shown to be widely distributed throughout the Ben Lomond district. This is very strong evidence that the tin also has been derived from this district. We may, therefore, regard Gilligan's and Storey's Creeks, and the other smaller ones between them, as the feeders which have carried the tin from the hills to the alluvial flat. These creeks emptied their burden of gravel and tin into the channel of the South Esk River, and the latter deposited it in a more or less concentrated form in its bed. Mr. Farquhar tells me that the quality of the wash is improving as they go on, and he hopes that a good lead will be found to continue round the northern edge of the flat. I think this is very possible. The company is at a disadvantage as regards water supply, as there is only sufficient to carry on work during the winter months. The ground is very flat, and all the dirt has to be elevated hydraulically.

There is not sufficient water to enable the nozzle to be used for breaking down the dirt, and the more laborious process of ground-sluicing has to be resorted to.

North of the mine workings a little prospecting has been done, and a lead of tin has been traced underneath what was originally thought to be decomposed granite. This is, I believe, an old granite wash of Permo-Carboniferous age. Careful observation reveals the presence of the rounded outlines of the old boulders which have decayed in their present position. The intervening spaces are filled with granite wash of practically the same composition, and it is now difficult to distinguish between the substance of the old boulders and the old wash. I think that the lead is worth prospecting. There is no reason why rich stanniferous wash could not have been found in Permo-Carboniferous times, and there is, therefore, as much reason for locating the gutter as if the lead belonged to a more recent formation. Payable wash of Permo-Carboniferous age has already beea worked at the Roy's Hill mine, and it is quite possible that it may exist here.

On some of the sections taken up by the company fragments of tinstone of similar nature to that occurring at the Demmocks Prospecting Association has been found on the surface, and the company is engaged in prospecting for the lode from which they were shed. From their position it seems to be certain that the lode is on the company's ground. A vein of quartz belonging to the quartz-pyrite formation has been laid bare and a small shaft sunk on it. This formation, as I have already shown, is not stanniferous.

Roy's Hill Mine.

I received instructions to visit this mine and to furnish a supplementary report to that of the Government Geologist of the 28th October, 1899. A detailed description of the mine will, of course, be unnecessary. The deposit consists of a greisenised zone forming the margin of a small granite spur which rises out of the surrounding Silurian strata. The old mine workings are in the shape of a horseshoe extending round the northern end of the spur. From their extent it is evident that a good deal of tin has been taken out in years past. The mine has been let to tributors, who have been working with small capital, and, owing to their inefficient crushing apparatus, have only been able to treat the richer portions of the stone. The deposit is patchy, and has earned the reputation of giving out in depth. As has been shown by Messrs. Montgomery and Twelvetrees, this latter is in the highest degree improbable. From all we know of tin deposits they are permanent in depth, though they may be patchy. Judging by the workings on this mine the rich patches are not separated by large areas of blanks, and there is no doubt that with more economical methods of mining and treating the ore, a much larger proportion of the deposit would prove to be payable. Under these circumstances I think the mine is well worth testing in depth. There has not been a great deal of work done since Mr. Twelvetrees' visit. A little stoping has been done on the south-west end of the deposit, and some good ore has been taken out; a good many tons are at grass which would not pay the tributors to crush, but which would pay well with an efficient battery. Two small shafts have been sunk in Silurian strata, but neither of these have yet reached the greisen zone. One of them is only a few feet ahead of the stopes, and is evidently just to the west of the greisen contact. North of the stopes another shaft has been sunk to a depth of 80 feet. This shaft was under water at the time of my visit, but Mr. Fritz Rübenach has kindly given me particulars of what was passed through.

The first few feet were sunk through horizontal Permo-Carboniferous strata, after which, highly inclined Silurian metamorphic slates were entered. At 30 feet from the surface the contact of the greisen and the Silurian strata was met with. The contact plane dips here to the west at a steep angle. At the contact, the greisen was fairly rich in tin. The tin-bearing stone appears to be about 6 feet wide, and dipped out of the shaft to the west, following the contact plane. After sinking 80 feet decomposed granite was struck. Fig. 2, Plate IV., gives a rough sketch of the section exposed by the shaft. As it is not from actual observation I cannot guarantee its accuracy, but I believe it represents the occurrence, at least, approximately. This confirms the supposition of Messrs. Montgomery and Twelvetrees, that the deposit is at the contact of a granite mass. It is evident that the mineral-bearing solutions travelled along the plane of contact, and attacked and replaced the feldspar in the granite from outwards. Of course, the solutions originally emanated from the heart of the granite mass. After passing up through fissures in the granite, they found the path of least resistance along the plane of contact, and followed it. It is, therefore, probable that if the mine is developed on a large scale, tinstone deposits will be discovered passing down into the granite. I believe the mine is well worth developing in depth, but none but a strong company should attempt it.

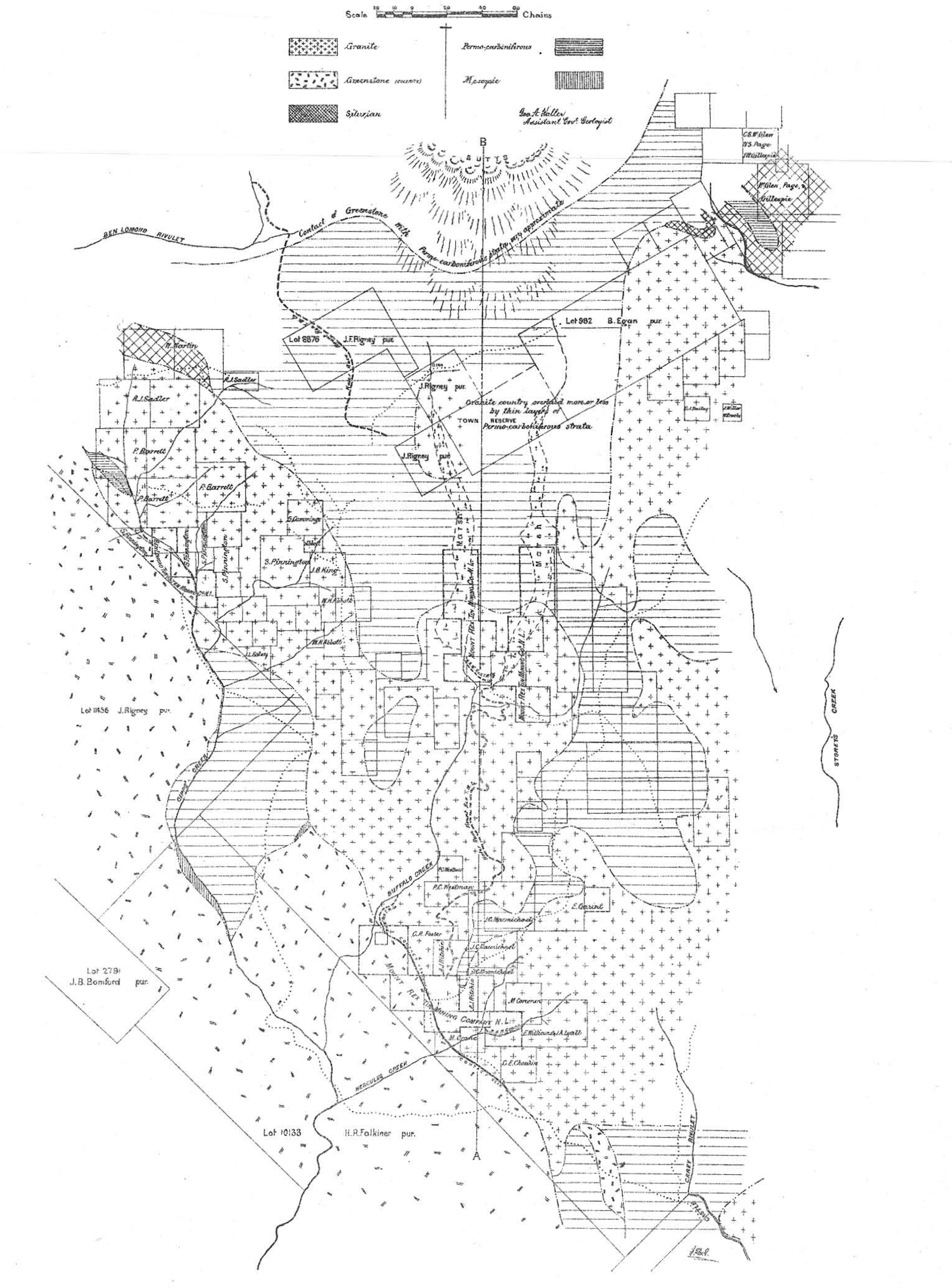
I have the honour to be,
Sir,
Your obedient Servant,

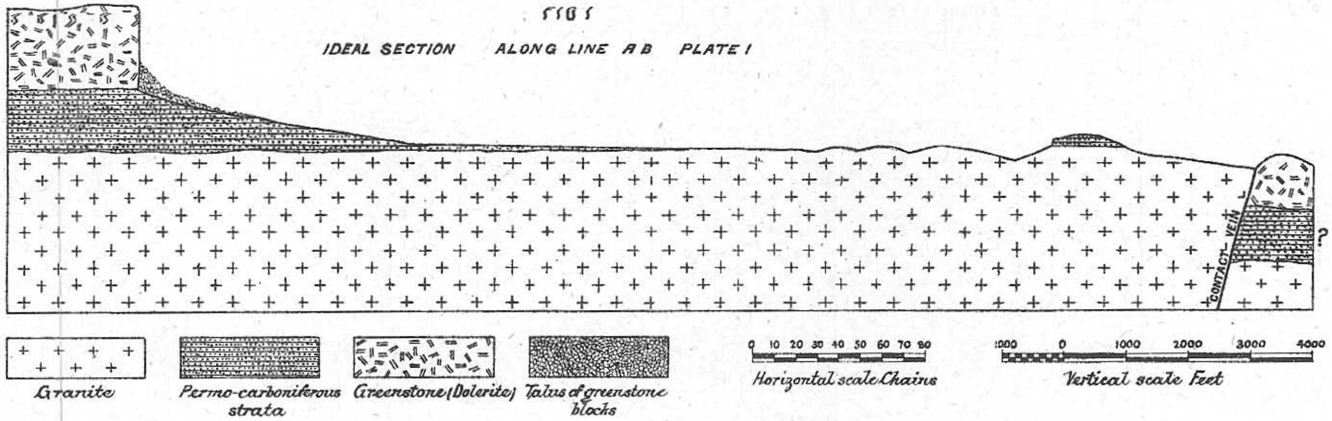
GEORGE A. WALLER,
Assistant Government Geologist.

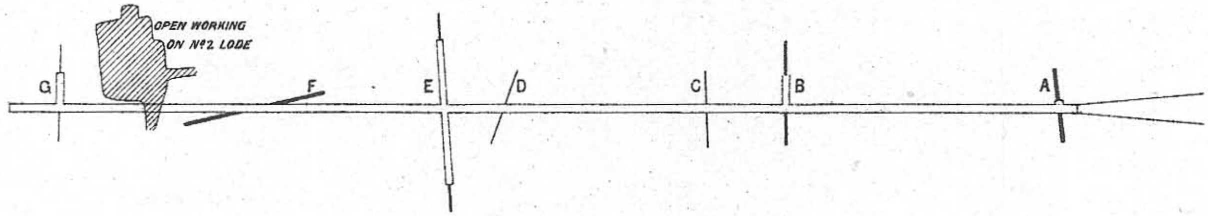
W. H. WALLACE, *Esq.*,
Secretary for Mines, Hobart.

GEOLOGICAL SKETCH MAP
BEN LOMOND TIN-MINING DISTRICT

PLATE I




IDEAL SECTION ALONG LINE A B PLATE I
CONTACT VEIN
?
Granite
Permo-carboniferous strata
Greenstone (Dolerite)
Talus of greenstone blocks
0 10 20 30 40 50 60 70 80
Horizontal scale Chains
1000 0 1000 2000 3000 4000
Vertical scale Feet


OPEN WORKING ON No. 2 LODE
G
F
E
D
C
B
A

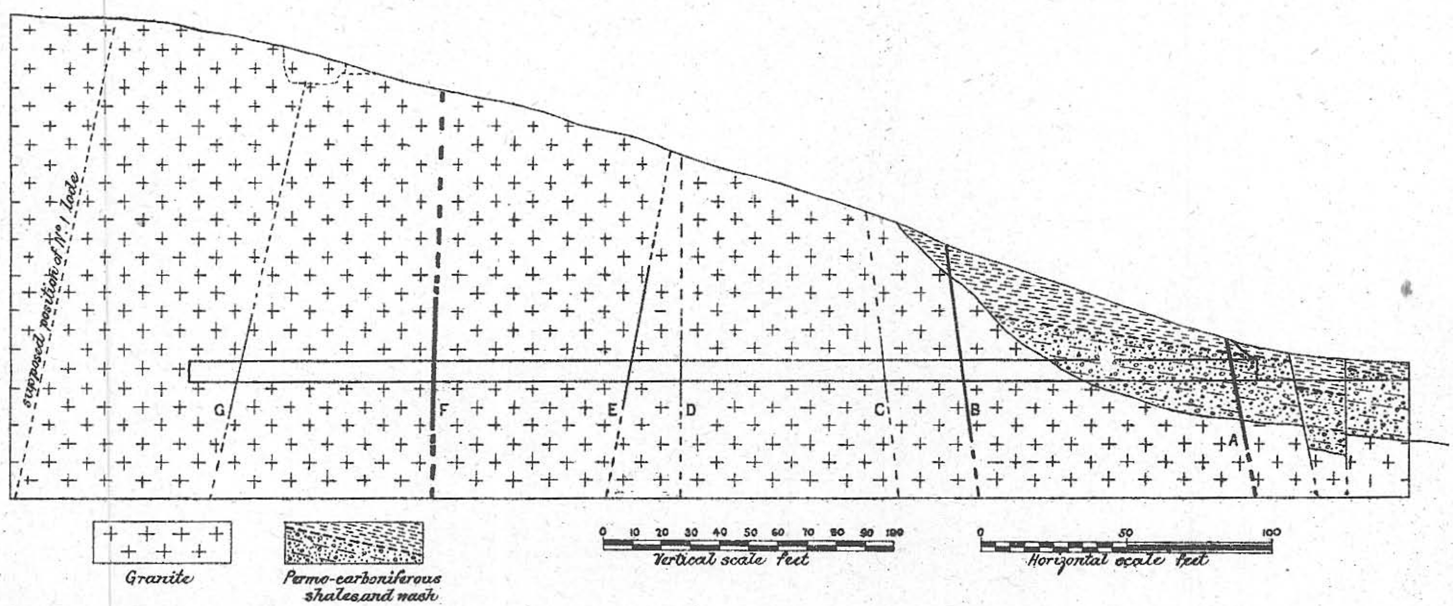

supposed position of No. 1 Lode
G
F
E
D
C
B
A
Granite
Permo-carboniferous shales and wash
0 10 20 30 40 50 60 70 80 90 100
Vertical scale feet
0 50 100
Horizontal scale feet

PLATE III

MOUNT REX TIN MINING COMPANY N.L.

5 cm

Scale 10 0 10 20 30 40 50 60 70 80 90 100 Feet

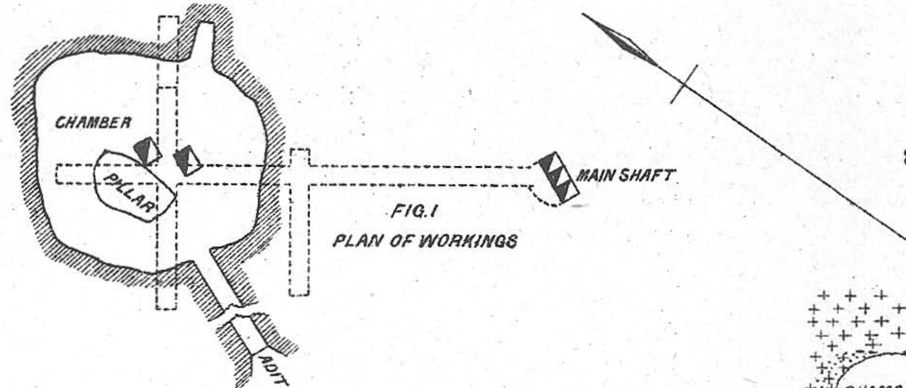


FIG. 1
PLAN OF WORKINGS

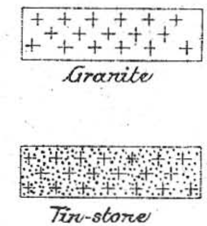


FIG. 3
PLAN CHAMBER LEVEL

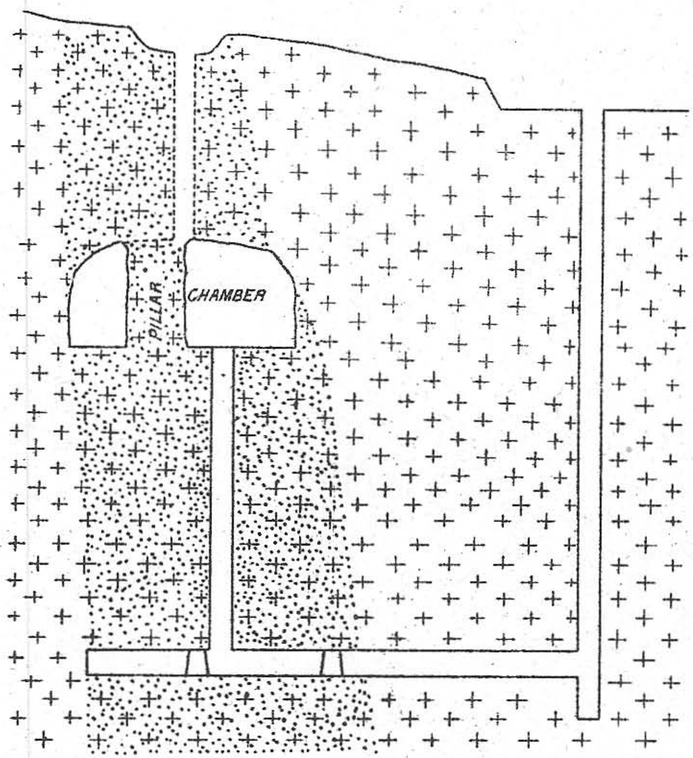


FIG. 2
SECTION ALONG CROSSCUT

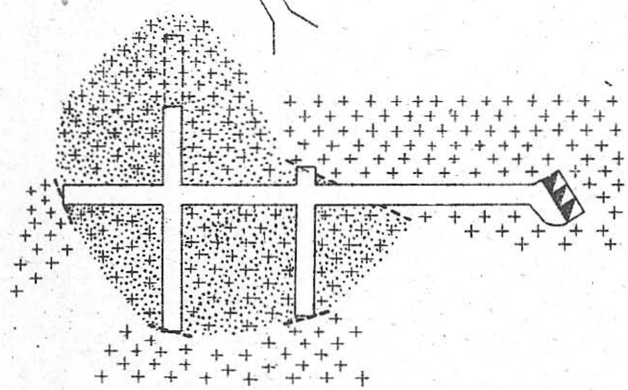
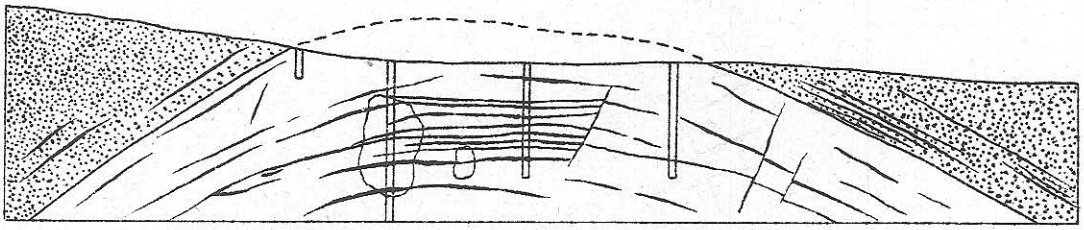


FIG. 4
PLAN CROSSCUT LEVEL

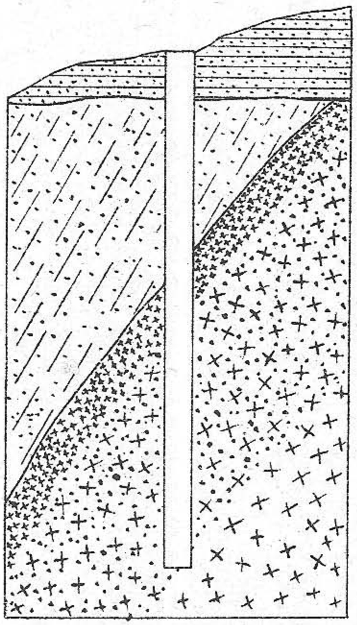
5 cm

FIG. 1

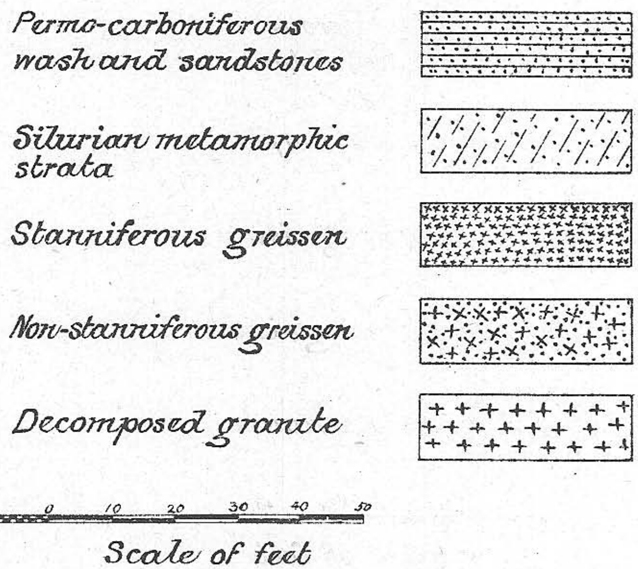


IDEAL SECTION THROUGH GRANITE BOSS OF ZINNWALD SHOWING FISSURES OF CONTRACTION

FIG. 2



SECTION EXPOSED BY SHAFT AT ROYS-HILL MINE



SUPPLEMENTARY NOTES ON SOME ANTARCTIC ROCKS AND MINERALS.

By W. A. Macleod and O. E. White.

In the proceedings of the Royal Society of New South Wales, Vol. XXIX., page 461, *et seq.*, appears a paper, read in 1895, on Antarctic Rocks collected by Mr. C. E. Borchgrevink.

The authors are Professor David, Messrs. W. F. Smeeth, and J. A. Schofield. A brief summary of this valuable paper will be interesting, more especially as since then there has been donated to the Tasmanian Museum a small collection of Antarctic rocks and minerals.

The paper mentioned is sub-divided into two parts :—

I. Introductory notes about Antarctica—

- (*a*) A general introduction.
- (*b*) A summary of the history of Antarctic Exploration.
- (*c*) A summary of Antarctic Geology.

Under this last head the authors show that *Eruptive Rocks* (Plutonic and volcanic, granite pegmatite, granulites, syenite, diorite, diabase, pumice, andesites, augite-labradorite rocks, basalts, basic scoriæ, Palagonite tuffs), *Sedimentary Rocks* (Tertiary limestones, and rocks of, perhaps, Triassic and Palæozoic age, sandstones, shales, quartzites, arkose), and *Metamorphic Rocks* (Gneisses, mica schists, argillaceous schists) are well represented. Then follows a list of the then known volcanoes, and their heights and other interesting Geological data.

II. Petrology of the rocks collected by Mr. C. E. Borchgrevink :—

(*a*) Specimens from Cape Adare—

Garnetiferous-Granulitic-Aplite.
Trachytes.
Glassy Augite Andesite.
Vesicular Andesite Glass.

Basaltic Andesite.
Olivine Dolerite.
Olivine Basalts.
Limburgites.
Basic Tuff.
Mica Schist (Biotite).

(b) Specimens from Possession Island—
Amygdaloidal Trachyte.
Augite Andesite.
Basalts.

The specimens presented to the Tasmanian Museum have been placed at the author's disposal, through the kindness of Mr. A. Morton, and comprise the following—

Minerals—
Quartz, containing Siderite.
Ferruginous Quartz Specimen.
Massive Olivine.

Rocks—
Basalt (Olivine).
Basalt (Olivine).
Basalt (Hornblende).
Scoriaceous Basalt.
Sandstone.
Mica Schist.
Decomposed Basalt (?) Ferruginous.

Taking these in the order above given, the first specimen is that of a milk-white variety of quartz, attached on one side to mica-schist, and fringed on the other edge (water-worn) with crystalline carbonate of iron. Another more massive specimen is a ferruginous or "rusty" quartz. Unfortunately, these specimens are barely large enough to permit of assay specimens being taken; still, the appearance of quartz would warrant prospecting for gold, if climatic conditions were favourable.

The remaining mineral specimen consists of a granular and fragile massive mineral, pale green in colour, and resembling bottle glass. The hardness, colour, and chemical tests (yielding $Si\ O_2$, $Mg\ O$, and a little $Fe\ O$) clearly point to the mineral being "olivine." This is a particularly fine specimen, and the mineral probably occurs in connection with the basalts to be mentioned.

Amongst the Rock specimens *Basalts* are well reprėsented, and vary in texture from fine-grained, dense, dark-coloured rocks to scoriaceous, lighter-coloured varieties.

The first and smallest specimen is that of a dense black *Basalt*, showing here and there a few black augites and very small grains of olivine. Under the microscope the augite (of which an excellent cross-section is present in one slide) appears almost colourless. Prismatic and a weaker pinacoidal cleavage are shown: prismatic angle about 87°. The augites are quite free from corrosion, and enclose a few magnetite grains. The olivine grains show traces of crystalline outline, and are altered round the margins and along cleavage cracks into ferruginous matter. Magnetite is present in large and small grains, sometimes showing crystalline form. The base consists chiefly of lath-shaped felspars, which show what appear like fluxion phenomena round the porphyritic constituents. The felspars, which are of a basic variety, are closely packed together, and in the interstices come fine grains of magnetite and a little glass. Fig. I. is a diagrammatic drawing showing a cross-section of an augite prism, and the base.

The rock termed Hornblende Basalt is one possessing a peculiar whitish-grey coat of weathering products, but, on fracture, shows a very fine dense rock, with here and there a few porphyritic crystals. Mr. Twelvetrees suggests that, on account of these porphyritic hornblendes, the rock is an andesite. In the New South Wales collection some doubtful andesites are mentioned. An analysis of this specimen gives 45 per cent. of $Si\,O_2$, placing this rock amongst the Basalts.

Under a high power the base of this rock is seen to consist of long lath-shaped felspars, grains of magnetite, and everywhere are scattered small needle-shaped crystals, which do not extinguish straight, and probably are felspathic microliths. These are set in a glass of a light brown tint. Fig. IV. shows the arrangement of felspars, microliths, and glass.

In the scoriaceous Basaltic Rock, augites and olivines are clearly visible to the naked eye. The augites are similar to those above mentioned, but the olivines are much better developed than usual, and exhibit good crystalline outlines, high refraction, straight extinction, and an irregular cleavage transverse to their length, and somewhat similar to that exhibited by the Fayalites in the Sandy Bay Basalt. Fig. II. diagrammatically represents a section of this rock. The olivines are only slightly decomposed. Magnetite sometimes forms peculiar skeletons (perhaps decomposition products of the olivine), one of which is represented in Fig. III. The section of this rock is too thick to admit of an accurate determination of glass in the base.

Of the Sedimentary Rocks we have a single representative, in the form of a sandstone, fine-grained, and composed of angular fragments of felspars.

Amongst the altered rocks there is one specimen of a grey schistose rock which, under the microscope, in transmitted light, shows a confused mass of transparent flakes (perhaps sericite), with here and there large spots, probably occupying the place of former crystals. Analysis shows this rock to consist chiefly of $Si\,O_2$, $Fe_2\,O_3$ (or $Fe\,O$), and $Al_2\,O_3$, with traces of $Ca\,O$, and a high ignition loss of 5·45 per cent. This would point to a rock from which $K_2\,O$, $Na_2\,O$, $Mg\,O$, and $Ca\,O$ had been leached out, and secondary hydrous compounds formed. This analysis agrees with those given by Rosenbusch (Elemente der Gesteinlehre, p. 497), and points to a rock of continental origin, and along with the Biotite Mica Schist of Professor David's collection, gives strong circumstantial evidence as to the existence, *at some time*, of an Antarctic Continent.

The remaining specimen is of a brown-red colour, and slightly scoriaceous, and, most probably, is a decomposition product of some scoriaceous basalt.

The authors, in conclusion, wish to thank Mr. Morton for the kind loan of the above specimens; and also Mr. W. H. Twelvetrees, for some kindly hints.

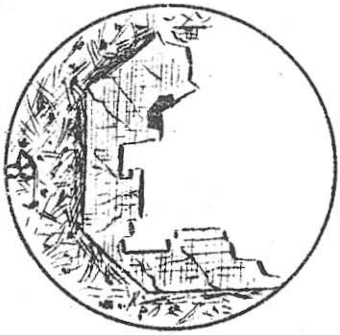


FIG. 1.

FIG. 2.

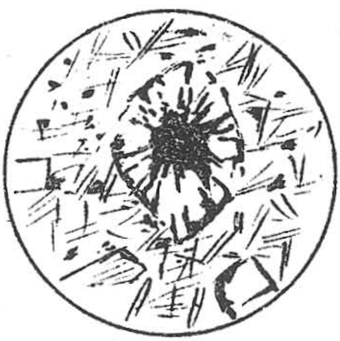


FIG. 3.

FIG. 4.

W.A.M.

5 cm

A FURTHER NOTE ON OBSIDIAN BUTTONS.

By T. Stephens, Esq., M.A., F.G.S.

The occurrence in Tasmania of these singular spheroids of jet black obsidian, popularly known as "buttons," was brought under the notice of the Royal Society in 1897, by Messrs. Twelvetrees and Petterd,* who gave a very full description of the specimens which had come under their observation, and discussed the various theories which have been put forward to account for their origin and distribution. In the same year I contributed a few supplementary remarks on the subject † with special reference to the earliest records of the discovery of these "buttons" in Australia and Tasmania. In 1898, during a journey from Texas, U.S.A., to San Francisco, I had noted the presence of obsidian in lava-flows of Northern Mexico, and had seen some extensive tracts of comparatively recent volcanic rock in Southern California, which suggested the possibility of our obtaining from that source further evidence respecting these singular volcanic products. Shortly after my return to Tasmania, I sent copies of the abovementioned papers to Dr. Joseph LeConte, the well known Professor of Geology in the University of California, in the hope that his intimate knowledge of the geological conditions of the United States might enable him to throw fresh light on this very obscure subject.

The occurrence of obsidian in the peculiar form under consideration does not appear to have been noted in California, but Professor LeConte kindly replied to my

* On the occurrence of obsidian "buttons" in Tasmania, by W. H. Twelvetrees, F.G.S., and W. F. Petterd, C.M.Z.S. Proc. Royal Society of Tasmania, 1897, p. 39.

† Remarks on obsidian "buttons," by T. Stephens, M.A., F.G.S. Pro. Roy. Soc. of Tasmania, 1897, p. 54.

inquiries, saying that he had consulted Dr. A. C. Lawson, Associate Professor of Geology and Mineralogy, and that their joint suggestion was, that the button-shaped forms described and figured in the paper of Messrs. Twelvetrees and Petterd might possibly be due to the formation of spherulites in a lava with obscure flow-structure, this structure being brought out by weathering; but this suggestion appeared to have been offered with some hesitation in the absence of any opportunity of examination of specimens. The next thing to be done was to attempt to supply specimens for personal examination, and an application to the Trustees of the Tasmanian Museum resulted in my being enabled to forward to San Francisco three obsidian buttons from a collection made many years ago near Glenelg, in Victoria, and presented to the Museum.

By the last mail from America I received a second letter from Professor LeConte, in which he says that, after careful examination of the specimens, he gives up the theory of their possible concretionary origin. His letter continues as follows :—

"I cannot think they have any relation to volcanic bombs: their meteoric origin seems to me out of the question. Professor Lawson throws out the following suggestion :—'May they not be the result of the bursting of bubbles on the surface of some liquid stiffly-viscous lava, ready to solidify? The bursting of such a bubble would probably leave a mound-like centre surrounded by an elevated ring-like margin, sharply elevated at first, but quickly becoming more rounded by gravity and by cohesive shrinkage, before setting completely. Thus might arise the appearance of the flat side. Subsequently the little ring and mound separate from the lava-mass by conchoidal fracture, forming the hemispherical side. The fracture is supposed to be determined by inequality of surface tension produced by the bursting of the bubble.'

"You see it is a mere suggestion, but I can think of nothing better to offer. As to their mode of occurrence, it is easy to see that their *form* would favour wide distribution by mechanical means, and their *singularity*, by human agency.

"Many thanks for these valuable additions to our Museum."

The suggestion thus offered by Professor LeConte claims attention as being the nearest approach to a satisfactory solution of a difficult problem that has yet been put forward. It is necessarily conjectural, for the exact conditions attending the bursting of bubbles of interstitial steam or gas near the surface of a rapidly cooling glassy volcanic magma have never been witnessed by any human eye. The ellipsoidal shape, which is not uncommon in Australian specimens of the buttons, is inconsistent with the theory of a long rotatory flight through the air, for any such volcanic ejectamenta must have cooled too quickly to allow of any change of form on reaching the ground. A similar elongation of originally spheroidal cavities in vesicular basaltic lavas is a familiar instance in this connection.

The general probabilities seem to be in favour of the origin of the obsidian in or near the country in which the "buttons" are found, even if volcanic rocks of the necessary acidic type are not now in evidence: that they have been largely distributed by human agency cannot be doubted. Their reported occurrence in drift gravels in certain localities is still a mystery for the elucidation of which no satisfactory explanation has yet been offered.

THE GLACIAL BEDS OF LITTLE PEPPERMINT BAY, TASMANIA.

A Paper read before the Royal Society of Tasmania by Professor E. G. Hogg, M.A.

Little Peppermint Bay is a small arm of the sea on the western side of D'Entrecasteaux Channel, about 27 miles south of Hobart. The nearest point at which the Channel steamers call is Woodbridge, or Peppermint Bay, about half a mile south of the beds described in this paper.

The prevailing beds in the locality belong to the Permo-Carboniferous series, and have, over a large area, a fairly uniform dip to the S.E., at about an angle of 30°. They are intruded into by two distinct types of igneous rocks, viz., the Oyster Cove porphyries and the diabase greenstone, and, near the contacts, are disturbed to a considerable extent.

The glacial beds are exposed on the beach at the western part of Little Peppermint Bay, along the new and old roads from Woodbridge to Kingston, where they cross the Little Peppermint Bay Creek, and may be traced along the course of the creek for over half a mile. The greatest height at which they are found above the sea-level is about 200 feet. This occurs at the most westerly point at which they can be traced. The rock in the neighbourhood at this spot is the felspar porphyry, but no contact could here be found to determine the relations of the glacial and the igneous rocks.

The glacial beds are composed of an extremely tenacious fine-grained matrix, in which are embedded boulders, generally of small size, for the most part rounded, and frequently striated. Photographs of some of the striated stones are appended to this paper. No boulders to which the term massive could be applied were found; in fact, no boulder was seen which was more than one foot in its longest dimension. The colour of the rock varied in places, but, except on the sea-beach, the prevailing tint was grey, with patches of purple-coloured clay in places. The clay, except for its greater tenacity, has many points in common with the glacial beds of Coimaidai, near Bacchus Marsh.

Among the included boulders are black, grey, and white quartzite, chert, coarse-grained granite, sandstone, slate (unfossiliferous), white and rose quartz, mica-schist, micaceous sandstone, quartz-porphyry, quartz-felspar-porphyry, and quartz-felspar-hornblende-porphyry. A large number of microscope slides were prepared from the igneous rocks for the purpose of comparison with the Port Cygnet and Oyster Cove igneous rocks—a very necessary point to determine if, as it would appear, certain of the Port Cygnet rocks are contemporaneous with the marine beds of Port Cygnet. However, a comparison of the slides of rocks taken from the glacial beds, and of over 100 slides taken from the Port Cygnet and Oyster Cove igneous rocks, appears to lead to the conclusion that the igneous rocks found as boulders in the glacial beds do not belong to the Port Cygnet and Oyster Cove series, and that we must look elsewhere for the origin of these rocks. From the granite specimens no conclusion can be drawn. It is worth mentioning that, so far as the author is aware, the nearest granite *in situ* is at the Hippolyte Rocks, south of Maria Island, on the east coast of Tasmania.

Among the included blocks was a piece of hard, dark-blue limestone, containing a fossil, which Mr. R. M. Johnston, F.L.S., has kindly identified for me as a form of Tellinomaya, probably of Upper Silurian age. The fossil is not in a state to admit of specific determination.

Where exposed on the beach in Little Peppermint Bay the glacial beds are pierced by three well-marked parallel dykes and an irregular dyke, all bearing S. 30° E. The dyke material is much weathered, but on the whole it appears probable that the dyke belongs to the Oyster Cove porphyry series.

The occurrence of glacial beds at the horizon of the Permo-Carboniferous series exposed at Little Peppermint Bay is of the greatest interest. The glacial conglomerates exposed at the north end of Maria Island lie nearly, if not quite, at the base of the Permo-Carboniferous series. The Little Peppermint Bay beds lie almost certainly on a much higher horizon. Further examination may tend to show that in S.E. Tasmania the glacial beds are related to each other in a manner somewhat similar to that of the glacial beds at Lockinvar and Branxton, New South Wales, as described by Professor David, F.R.S. (Proc. Roy. Soc. N.S. Wales, 1899, p. 154).

ON A METEORITE FROM THE CASTRAY RIVER.

BY W. F. PETTERD.

THERE is invariably considerable interest attached to the discovery and identification of meteoric substances. I therefore assume that a few remarks respecting the recent acquisition of a small but veritable meteroic stone, fully authenticated as having been unearthed in this State, may be of interest. The specimen in question makes the second* which has been discovered in this Island, and brings the total number recorded up to date as having been obtained in Australasia, to about 33 examples†. These vary in weight from 3 to 4 tons to that now described, which is the smallest hitherto obtained. It is beyond reasonable doubt that many have been, and are, overlooked, as to the average observer they are remarkably unattractive, and it is usually only when they fall into the hands of the mineralogist that their true nature is revealed. Specimens of over 250 independent occurrences in various parts of the world are preserved, often with detailed records (*vide* Dana's System of Mineralogy, 1898).

As is well-known to those interested, it has been found convenient to class these objects into three divisions, although they pass more or less gradually into each other, viz.:—

1. *Siderites*, or meteoric iron proper (consisting chiefly of nickeliferous iron, and enclosing schreibersite, troilite, graphite, &c.)
2. *Siderolites* (consisting chiefly of nickeliferous iron and silicates, both in large proportion.)

* The minerals of Tasmania, 1896, p. 53.
† Records of Australian Museum, 1897-8-9.

3. *Aërolites*, or meteoric stones, (consisting generally of one or more silicates, interspersed with isolated particles of nickeliferous iron, troilite, &c.).*

It is estimated that about one-third of the known elements have been detected in the various forms of meteoric substances, many in their free state, but by far the greater number as homogeneous mineral species in the condition of alloys, oxides, sulphides, silicates, phosphides, and hydrocarbons.† Of the somewhat large number of compounds which have been recognised and described, about 12 species are unrepresented among the terrestrial minerals.

Of the meteorites recorded from Australia, 22 are classed as belonging to the first, or siderite section, seven to that termed siderolites, and one doubtfully belonging to the aërolites.

That already recorded from this State, as well as the one now described, belong to the siderite or nickeliferous-iron section.

A noted peculiarity of the metallic ingredients in thin section is the development of the "Widmanstatten" markings on a polished surface being exposed to the action of acids or bromine, owing to the inequality of action on the various alloys of nickel and iron.

Details of Specimen.

Castray Meteorite—

Type: Siderite.

Weight: 51 grs.

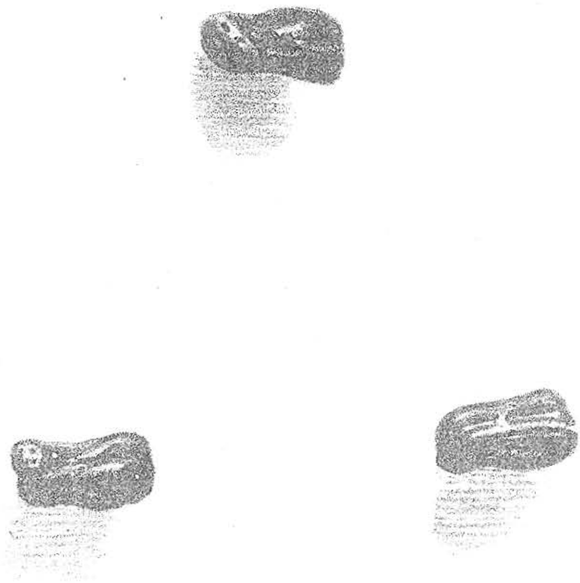
Size: Length, 18 millimetres; greatest breadth, 10 millimetres.

Locality: Castray River, North-West Tasmania.

The specimen is dark, almost black, with the characteristic smooth, almost graphitic, surface glimmer common to this class of meteoric substances. In shape

* Introduction to the Study of Meteorites. (British Museum, 1896.)

† The discovery of undoubted diamonds in the numerous masses of meteoric iron found in the Canyon Diable, America, was announced in the American Journal of Science, July, 1891.



THE CASTRAY METEORITE.

5 cm

it is elongably quadrate, tapering, and abruptly angulated at one end; it is longitudinally furrowed, and has several irregular pittings or diminutive "thumb-marks" on the respective surfaces. It is strongly magnetic. It was originally obtained, with two others of like size and character, by a miner, in 1899, when ground-sluicing the auriferous drift on the banks of the Castray River, and afterwards, direct from the discoverer, came into the possession of Mr. T. Birkett, a well-known mine manager, by whom it was presented to the mineral collection of the writer.

I have to thank Mr. W. H. Twelvetrees, Government Geologist, for illustrating this interesting object.

DESCRIPTION AND ANALYSIS OF A NEW SPECIES OF MINERAL, PETTERDITE, A NEW OXYCHLORIDE OF LEAD.

By W. H. Twelvetrees.

This apparently absolutely new chemical combination occurs in attached crystal groups in a quartz gangue containing disseminated pyrites, in the form of somewhat thin hexagonal plates, which are usually minute in size (about 5 millemetres in diameter), but occasionally reach 9 mm. dia., and, still more rarely, a larger size.

Macles are not rare, irregularly attached and implanted on each other, and on the matrix.

Fracture :—Rather irregular, brittle and dull.

Colour :—White, passing to pale grey on the surface.

Streak :—White.

Lustre :—Dull, inclined to rough, waxy, opaque, shining on the edges of the crystals.

Hardness :—1·5 to 2.

Gravity :—7·16, determined by Mr. W. F. Ward, Government Analyst.

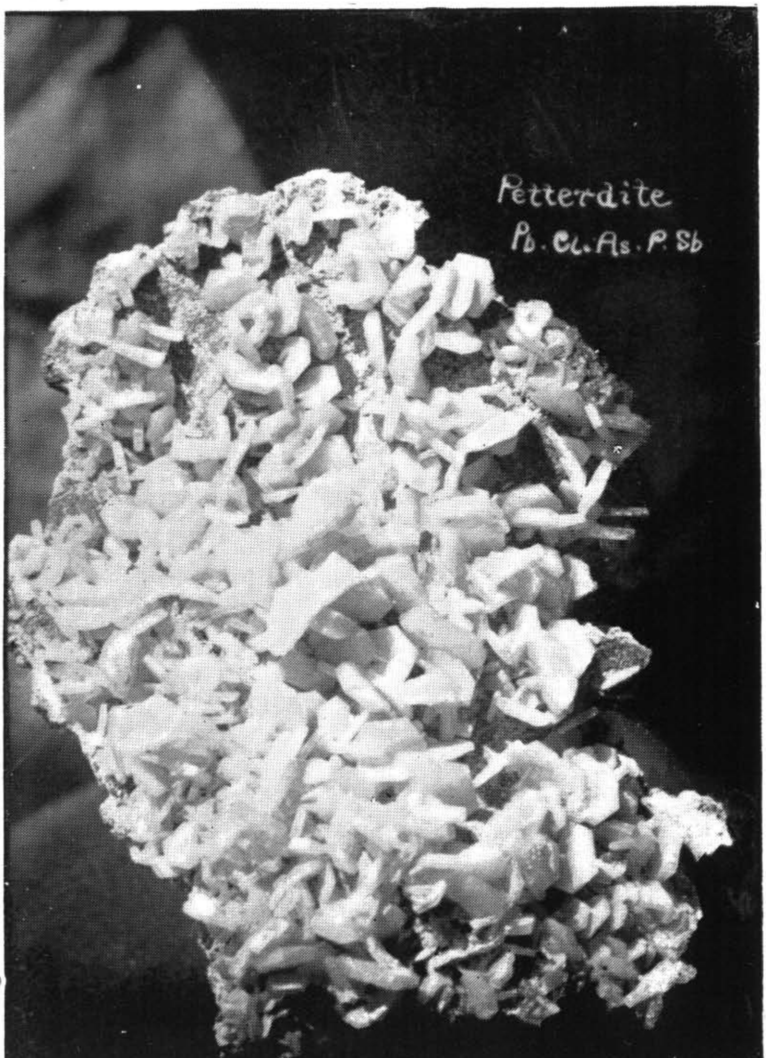
Before blowpipe :— On coal OF. forms white to yellow mass. RF. a bead of metallic lead is easily produced without fluxes.

Heated in forceps, strongly decrepitates.

Flame :—With OCu distinctly azure blue. In powder with $H_2\ SO_4$ dull greenish blue.

In cold HNO_3 dissolves quietly and very slowly ; in hot acid dissolves slowly, giving with $AqNO_3$ a thick, curdy precipitate.

The powder heated before blowpipe gives slight odour of As_2O_5.



PETTERDITE.

5 cm

Analysis, kindly made by Mr. O. E. White, of Hobart:—

$$\begin{aligned} PbO &= 74{\cdot}04 \\ As_2O_5 &= 2{\cdot}60 \\ P_2O_7 &= 2{\cdot}10 \\ Sb_2O_5 &= {\cdot}50 \\ Cl &= 20{\cdot} \end{aligned}$$

Locality.—In the superficial workings of the Britannia Mine, Zeehan.

It is evidently rare, and, so far as known, confined to the locality mentioned. One remarkably fine specimen contains about 200 perfectly formed implanted crystals. The accompanying illustration fairly represents this specimen. It is an attractive mineral when in large groups, as shown, and is easily distinguishable from the more abundant sulphate and carbonate of lead. It is occasionally associated with fine groups of campylite.

JOHN VAIL,
GOVERNMENT PRINTER, TASMANIA.