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TASMANIA.

REPORT

OF THE

SECRETARY FOR MINES

FOR

1899-1900,

INCLUDING THE REPORTS OF THE INSPECTORS OF MINES, THE COMMISSIONERS OF MINES, THE GOVERNMENT GEOLOGIST, THE MOUNT CAMERON WATER-RACE BOARD, &c.

Tasmania:

JOHN VAIL, GOVERNMENT PRINTER, HOBART.

1900.

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REPORT OF THE SECRETARY FOR MINES.

Mines Department, Hobart,
1st September, 1900.

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, 1900.

APPENDICES.

Appended will be found the following Reports and Papers :—

- Annual Report of the Mount Cameron Water-race Board.
- Mine Managers' Examination Papers.
- Reports of the Commissioners of Mines.
- Report of the Government Geologist.
- Report of the Chief Inspector of Mines.
- Reports of the Inspectors of Mines.
- The Government Geologist's Reports on—
  - Gold Mines near Hogan's Track.
  - Some Tin Mines in St. Paul's River Valley, near Avoca.
  - The Strata in the Shaft of the New Sovereign Mine, Mangana.
  - The Asbestos Deposits, Anderson's Creek, near Beaconsfield.
  - The Arba Extended Tin Sections at Branxholm.
  - The North Mount Victoria Goldfield.
  - The Queen of the Earth Gold Mines and neighbourhood.
  - On the Deep Lead or infra-basaltic stanniferous gravels of the Ringarooma Valley, near Derby.
  - The Mineral Fields between Waratah and Corinna.
- Paper by Messrs. W. A. McLeod and O. E. White on the occurrence of a new species of Garnet at Port Cygnet.
- Notes on a Fayalite Basalt from One Tree Point, by Messrs. O. E. White and W. A. McLeod.
- Notes on the discovery of a Fossil Reptile by G. Thureau, F.G.S., by R. M. Johnston, Esq.
- Further notes on the permo-carboniferous Fossil Cliffs at Maria Island, by R. M. Johnston, Esq.
- Petrographical Report, by W. H. Twelvetrees, Esq.
- Description of the treatment of Ores at the Smelting Works of the Mount Bischoff Tin Mining Company, Registered, Launceston, by Geo. J. Latta, Manager.
- Description of the Cyanide Process at the New Golden Gate Mine, Mathinna, by T. J. Andrews, Assayer.
- Description of the Treatment of Tailings by the New Pinafore Gold Mining Company, Lefroy, by J. T. Stubbs, Manager.
- Description of the Tasmanian Smelting Company's Works at Zeehan, by Max Heberlein, General Manager.
- Description of the Treatment of Ore at the Works of the Tasmania Gold Mining and Quartz Crushing Company, Registered, Beaconsfield, by Joseph Davies, General Manager.

GENERAL REMARKS.

There has been a marked progress in the Mining Industry of the Colony during the year, and, owing to the high market value of metals, greater activity in prospecting and mining operations has resulted. There is a very satisfactory increase in the output of all minerals except coal, and an increase of £496,063 in the total value of the output as compared with the previous year.

The total amount paid in dividends and bonuses was £596,571.

The high price of tin maintained during the year (which averaged £134 3*s.* 3*d.*) has stimulated activity in some of the dormant fields, while old abandoned claims have been taken up again, and large amounts are being expended in the construction of water-races to work some of the permanent mines in the Eastern and North-eastern Districts.

The Anchor Tin Mine, Limited, has erected works for smelting tin at George's Bay, and expects to start work in a few weeks.

During the year 15 reward claims for the discovery of asbestos, bismuth, coal, copper, silver, and tin, embracing an area of 1350 acres, have been applied for.

The work of the department has increased to such an extent that it has necessitated the appointment of another Commissioner of Mines for the West Coast. It is also found necessary to appoint a second Geologist and another Inspector of Mines for the West Coast. Applications for these appointments, which will probably take effect from the 1st January next, will shortly be called for by advertisement.

The various reports of Commissioners and Inspectors of Mines contain detailed information of the progress made in the districts under their charge, and I have, therefore, only given a brief account of the work done by some of the principal mines in the Colony.

GOLD.

Beaconsfield.—The Tasmania Gold Mining and Quartz Crushing Company still continues to maintain its output, and the 65-head battery has been running continuously. The yield of gold from this mine during the year was 30,058 ozs. 15½ dwts., valued at £116,250, and the amount paid in dividends, £27,000. The total quantity of gold won by this company since its formation is 487,534½ ozs., valued at £1,780,684, and the total amount paid in dividends is £721,071 12*s.*

The other companies working on this field have been endeavouring to discover a continuation of the Tasmania Company's reef, but so far their efforts have been unsuccessful.

The total quantity of gold obtained from this field during the year was 30,479 ounces, value £118,106.

Lefroy.—The New Pinafore Mine is now driving and crosscutting at the 1200-feet level, having availed itself of the Deep Sinking Encouragement Act, passed last Session, a sum of £2000 having been granted by the Government upon the £1 for £1 principle.

The Volunteer Mine, which has reached a depth of 1250 feet from the surface, unfortunately relinquished work last year, but will, probably, shortly test the mine to a greater depth by means of a diamond drill. There is no geological reason why these two companies should not, with continued sinking, get out of the barren zone which begins, in this district, about 400 feet from the surface, and reach gold-bearing quartz again.

Some miners are engaged successfully working the tailings in Sludge Creek, which have been accumulating for years from the operations of several mines. The quantity of gold obtained was 2584 ounces; value, £10,013.

Lisle.—An average number of about 40 miners have been working the alluvial ground on this field.

The Lisle Dredging Company is having a plant constructed which, it is estimated, will cost £4000. The ground intended to be worked has been prospected, and satisfactory results have been obtained.

Mathinna.—The New Golden Gate Mine continues its dividend-paying career. Its adoption of the cyanide process for treating its tailings has been an unqualified success. This mine is now down to a depth of 1430 feet, and is the deepest mine in Tasmania. The average number of men employed daily is 137. The quantity of quartz crushed during the year was 19,650 tons, from which 15,920 ounces of gold were obtained by battery and treatment of pyrites saved; value £59,600. 36,300 tons of sand were treated with cyanide of potassium, and 3409 ounces of gold obtained, valued at £10,200. Dividends have been paid amounting to £32,800. The total quantity of gold obtained from this mine is 154,900 ounces, and the amount paid in dividends is £268,000.

A good deal of exploration has gone on outside the New Golden Gate Mine, at and near Mathinna, and some of the outside properties are likely to meet with some success.

The country to the north-east of Mathinna, along Hogan's Track, has been prospected a little for gold during the year, but the quartz has been found to be very irregular and patchy, so far, and the gold is alloyed with silver. It is contemplated making a start again with one of the old mines there—the Queen of the Earth.

Mangana.—The Mangana (Tasmania) Gold Reefs, Limited, has sunk another hundred feet, and the shaft is now down to a depth of 414 feet. A crosscut has been put in 100 feet. The reef in this mine, though poor in gold, is a fine massive body of quartz.

The other mine at work at Mangana is the Golden Entrance Company, a Melbourne syndicate. It has five 10-acre sections, on which a reef was discovered by Messrs. Goodall and Smith, which has been traced for about 5 chains along the surface. A trial crushing has been got out from the shaft, which is down about 30 feet.

Prospecting operations are being carried on by the South Sovereign Company.

Mount Victoria.—The Ringarooma and Central Ringarooma companies have persevered in opening up their mines, and, in doing so, have succeeded in paying their way. The Ringarooma Company has erected a complete electrical pumping and winding plant. One or two smaller ventures are also carrying on work at the mount. It is a fairly rich auriferous field, but the gold shoots are short and capricious, and will require very judicious mining. With this, and above all, with sufficient capital, the outlook is promising.

At New River, alluvial gold-mining has been continued, with satisfactory results.

West Coast.—Gold-mining on the West Coast, during the year, has been insignificant. On the Madame Melba Flat a few men have been at work, and operations have been resumed at the Woody Hill Mine, the old King River Mine, &c.

Along the Waratah-Corinna line desultory work is proceeding at a few mines, and an attempt is about to be made by the Whyte River Gold-Dredging Company to dredge the bed of the Whyte River for gold.

Prospecting work is being carried on at the old Mount Huxley Mine, now known as the Mount Ellen Mine.

SILVER.

West Coast.—The increase in the output of ore from the Zeehan field, as compared with the previous year, has been very satisfactory, being over 5000 tons. This is, no doubt, due to the erection of the Tasmanian Smelting Company's works, which have now been smelting for a little over twelve months; and low-grade mines, which could not be profitably worked when the ore had to be exported, are now able to sell their ore to the local smelters at a profit.

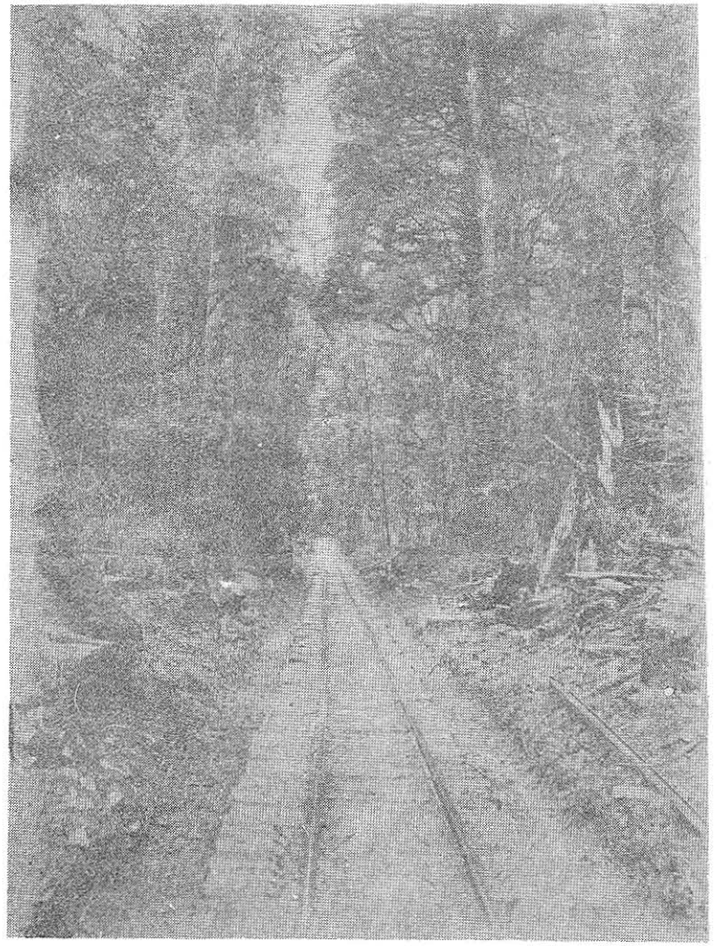
Mr. Max Heberlein, General Manager of the Tasmanian Smelting Company, Limited, gives the following information respecting copper-smelting at his works:—

"We ran through our furnaces about 1000 tons of copper ore from Curtin-Davis and, also, Lyell districts, out of which we produced 100 tons copper matte, containing 52 per cent. cu. and 480 oz. ag. per ton. This product was shipped to Europe for further treatment.

"We shall always have a small production of copper matte as a by-product from our lead-smelting, and may even reserve one of our three furnaces entirely for this purpose if enough material can be secured to supply it."

Photo-Algraphy Process.

MAGNET SILVER MINE, NEAR WARATAH



MAGNET TRAMWAY

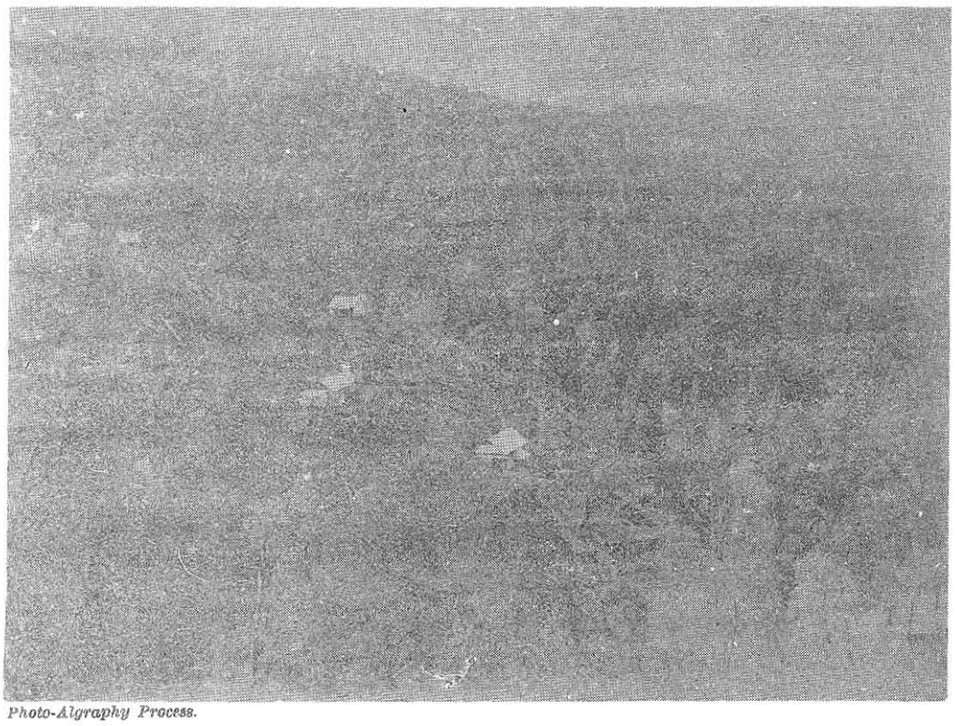


Photo-Algraphy Process.

MAGNET SILVER MINE, NEAR WARATAH

One of the principal ore-producing mines is a tribute known as the South King or Fahey's Tribute, on one of the Silver King Company's sections. Since September, 1899, this tribute has produced over 4717 tons of ore, valued at £59,215. The success attending its development has induced the Silver King Company to renew operations, and it has purchased a plant, and is now erecting it on the Silver King Mine.

The Western Silver Mining Company has erected a new pumping plant. During the last six months of the year it exported 1642 tons of ore. The shaft is now down 650 feet.

The Zeehan-Montana shaft is now 400 feet from the surface, and No. 4 level is being opened at that depth. During the year 3188 tons of ore were raised, valued at £63,882.

Full particulars of the mines working in this district, and the progress made during the year, will be found in Mr. Commissioner Hall's Report.

To the west of Zeehan is the Comstock District, with its numerous zinc-lead lodes ; and this is destined, in the immediate future, to be an important feeder of Zeehan. The South Comstock tributors are already selling small quantities of ore, both zinc and silver-lead, and work is also being done on the Britannia sections. The other properties in the neighbourhood are only waiting for improved means of transport to resume work.

The Mount Reid Company is sending its zinciferous ore to the smelters at Zeehan. It is constructing a line of tramway to connect with the Government line, and is preparing for the erection of concentrating works at a suitable position below the mine.

The Hercules Company has found the zinc silver-lead ore, which occurs in the upper part of its mine on Mount Read, giving way to copper ore in depth, and it is, accordingly, preparing to develop the new discovery vigorously, and to erect a smelter in the Ring Valley for the reduction of the new and the more tractable of its old ores.

North-Western District.—A new silverfield has come into existence at Mount Farrell, and is one of distinct promise. The North Farrell Mine is at present raising more ore than the pack-track will allow it to send away. Other mines are putting out ore in the course of progressive work, and, when the district is connected with the railway, still more satisfactory developments may be anticipated. The North Farrell Company is preparing for the construction of a seven-mile tramway for the transport of its ore to the trunk line north of the Pieman.

The Magnet Company, near Waratah, is preparing for the construction of a line of tramway to connect with the Emu Bay Railway between Waratah and Burnie, a distance of about 11 miles. The output of ore prior to the 1st September, 1899, was 22,696 bags, weighing 772¼ tons net ; net value, £9596 9*s.* 8*d.* Total output of the mine to the 30th June, 1761 tons 3 cwt. 0 qrs. 2 lbs. : net value, after all deductions, £20,628 1*s.* 4*d.*

Copper.

Mount Lyell.—The Mount Lyell Mining and Railway Company's mine still continues to maintain its output. During the year 9843 tons of blister copper, valued at £929,705, have been produced, showing an increase of 3764 tons over the previous year. The amount paid in dividends was £220,000.

The total quantity of blister copper obtained from this mine is 22,911 tons, value £2,071,000, and the total amount paid in dividends, £642,511.

The start of a mill at the South Tharsis Mine for concentrating low-grade cupriferous schist during the year will probably be found to mark an epoch in the history of the field, for, if the experiment prove successful, it means a future for many mines which otherwise would not be able to live.

The North Lyell Company has been working on high-grade ore, of which large quantities have been shown to exist, and it is just completing its line of railway from Kelly Basin to the Linda Valley. This line will communicate with the smelting-works which the company intends to erect at the King River, taking the ore to the works and the metal to the port. The railway will also open up the country on Mounts Jukes and Darwin, where, already, North Lyell investors are fostering several mines. These mines are now carrying on operations in that rugged, precipitous country under serious difficulties, but the advent of a railway line, which skirts the eastern base of the mountain-range, will greatly ameliorate their condition. These two mountains are largely copper-bearing, with immense iron formations, and very extensive prospecting will have to be carried out in order to establish their real value as sources of profitable metal.

The same class of country extends northwards through Mount Huxley, Mount Tyndall, Red Hills, and east of Mounts Murchison and Farrell, all more or less copper-bearing, and there is very little doubt that the next decade will witness great developments in the copper-mining industry of these ranges.

Mr. Commissioner Fowell gives details of the work done by the other mines at Mount Lyell in his Report, which is appended.

Rosebery.—Very little mining is being done in this district. Most of the mines have been awaiting development of the tests being made by the Tasmanian Copper Company for profitably extracting the zinc contents of its ore. The mines at Mount Read are affected by the same difficulty.

Corinna.—There is a large copper-bearing belt of country near Corinna on the Rocky River and Rio Tinto line, the value of which, owing to its undeveloped state, it is impossible to estimate at present. It may be that future work will make this field an important one.

The Rocky River Company is making a survey for a tramway to the Pieman above Corinna, which is intended to serve as an outlet for the ores from its mine and those adjacent.

Tin.

The exceptionally dry weather of the past year has interfered with the production of tin ore, especially on the East Coast. At the beginning of the year the water supply was plentiful, but afterwards fell off.

Blue Tier.—The Anchor Mine has taken steps to secure a permanent supply of water, and its Smelting Works at St. Helens are fast nearing completion. The quantity of stone treated during the year was 42,451 tons, and the quantity of tin obtained was 143 tons, value £11,615 2*s.* 2*d.*, employing 90 men. A lot of dead work has been done during the year, two tunnels have been driven, disclosing good tin ore, a new face has

been opened and tramline laid to same, and a number of test bores have been put down with the diamond drills.

The Australasian, Liberator, and Cambria mines in this locality have been greatly handicapped for the want of water. The former has been obtaining some good payable stone from the sections known as the Don Sections.

Weldborough.—This old tin field which was the scene of great activity a few years ago, and from which large quantities of alluvial tin were obtained, has again revived.

Between four and five hundred acres have been applied for during the year, and several dredging claims have been taken up with the object of working the river beds for tin ore.

Avoca.—Nearly 1000 acres of land have been taken up during the year. The South Esk Company has 12 men at work and is cutting a race to bring water to its mine. An 8-inch hydraulic elevator has been erected. It is reported that the prospects of this mine are very good.

At the Rex Hill Mine about 50 men are employed, and 86 tons of tin ore have been obtained. A 10-head battery has been erected, and another 20 heads are being erected. A large dam has been constructed, and a race, 4 miles in length, has been cut.

Ben Lomond.—A large area of land has been taken up for associated minerals, tin and wolfram, and prospecting operations are being actively carried on on some of the claims.

Branxholm.—The Arba Company has been actively engaged repairing and constructing water-races, &c., removing the overburden on the tin deposit, and erecting machinery for hauling up the tin-wash for treatment. When these works are completed, satisfactory returns may be looked forward to.

Derby.—The Briseis Company's mine and the Krushka Brothers' mine have been taken over by the Briseis Tin Mines, Limited, and the Brothers' Home Extended Mine has been purchased by the Ringarooma Tin Mining Company.

It is proposed to work them on a very extensive scale, and for this purpose large amounts are being expended in constructing water-races and dams.

Bradshaw's Creek.—The Pioneer Tin Mining Company has been engaged in putting down bores for the purpose of thoroughly testing its ground and tracing the deep tin-lead. Its operations have proved successful, and a race is being constructed to bring in a supply of water from the Frome River for hydraulic purposes.

Waratah.—The output of tin ore from the Mount Bischoff Mine was 1945 tons, value £174,000, being an increase of 106 tons on the previous year. The total quantity of tin ore produced since the formation of the company is 57,358 tons, value £3,316,528, and the total amount paid in dividends is £1,674,000 The principal items of expenditure during the year were: dividends, £109,500; working expenses, £43,489; income tax, £5475; plant, &c., £3236; and £11,000 placed at fixed deposit with the company's bankers; total, £172,700.

West Coast.—Attention has been again drawn to the old abandoned tin field at Heemskirk, and mining operations are being successfully carried on on some of the claims; prospecting is going on also at North Dundas, on the Renison Bell Prospecting and Mining Company's sections.

Wolfram.

Owing to the increased demand for wolfram there has been some production by mines on Ben Lomond and at St. Helens, and the old Wolfram Reward Claims on the West Coast, about eight miles north of the Pieman Heads, have been taken up again, and are being worked for this mineral.

Coal.

There has been a decrease of nearly 5000 tons in the production of coal during the year ending 31st December, 1899.

The Mount Nicholas and Cornwall Companies, near Fingal, and the Dulverton and Mount Cygnet mines, have been the main producers, and their output has been maintained. The Russell Colliery has been shut down. A small quantity has been obtained from the York Plains mine.

Coal sections have been taken up at Leprena, near South Cape Bay, and very fair samples have been obtained. This mine is, as yet, only in the prospecting stage.

A very good coal has been discovered at Eden, near Strahan, West Coast. The seam is very small where found outcropping, and will not pay to work. Prospecting by means of boring is being carried on, and if payable seams are discovered the coal will command a ready sale for the smelters on the West Coast.

Some of the old coal sections at Sandfly, near Hobart, have been held under prospector's licence during part of the year, but little or no work has been done. The land is now vacant, and it seems almost incredible that this coal, which is reported by Mr. A. Montgomery, late Government Geologist, to be almost equal to Newcastle coal, should be allowed to lie undisturbed for so long.

Iron.

The immense deposits of iron ore on the Blythe River, near Burnie, are about to be worked by an influential company, which is now laying out a route for a tramway to the coast. It is intended, at first, to export the ore for smelting on the other side, but it is possible that, eventually, smelters will be erected near Burnie also.

Asbestos.

During the year an Australasian company commenced quarrying asbestos in a large deposit of that mineral in serpentine rock, near Beaconsfield. The owners at once began shipping the material in bulk with the view of establishing their market, and there are indications that this novel industry will prove a profitable one This start has already had the effect of stimulating search for profitable asbestos deposits in other parts of the Colony.

Osmiridium.

A new item has been added to the mining industry this year. A demand for osmiridium has set in, which has resulted in a quest for the mineral in the sands of the Savage River and other streams in the vicinity. Iridium, alloyed with osmium and other rare metals, has been found in small quantities, and disposed of at profitable rates.

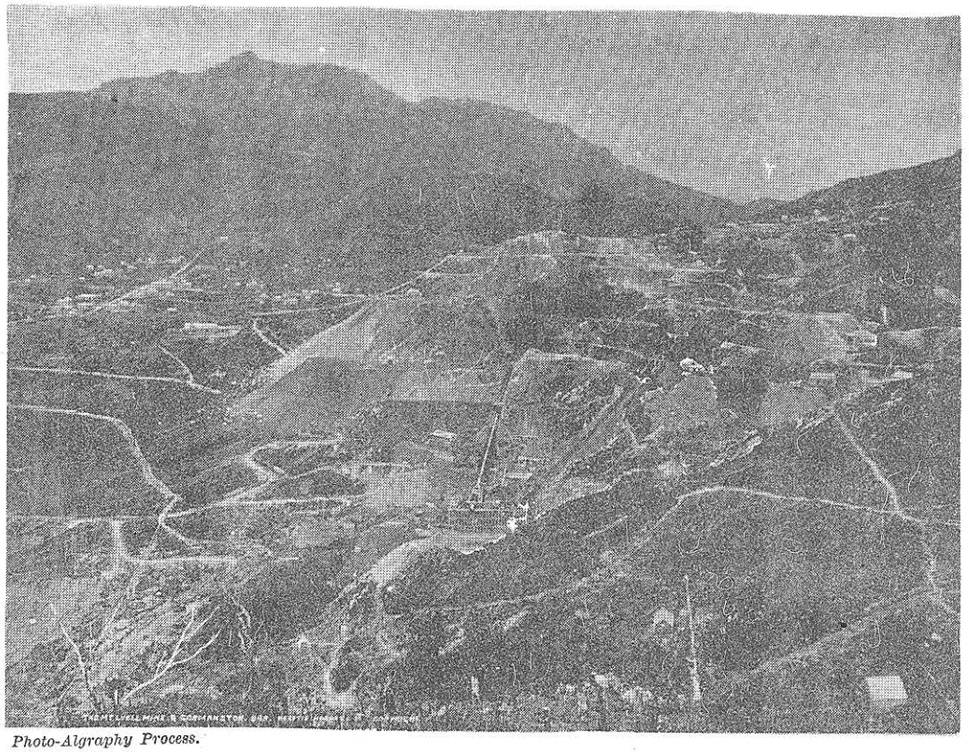


Photo-Algraphy Process.

MOUNT LYELL MINING AND RAILWAY CO.'S MINE

Mine Managers' Examination.

Seven candidates presented themselves at the examination held in March last. Two candidates succeeded in obtaining first class mining managers' certificates, and three obtained second class certificates.

Appended will be found copies of the examination papers set.

Zeehan School of Mines.

The number of Students attending the School during the year ending 30th July, 1900, has averaged 37.

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

Mathematics	12	Students.
Mining Mechanics	8	,,
Mineralogy	6	,,
Geology	3	,,
Ore Dressing	3	,,
Engine Driving	3	,,
Mine Surveying	7	,,
Analytical Chemistry	15	,,
Theoretical Chemistry	17	,,
Fire Assaying	8	,,

The Committee is at present making arrangements for a complete course in mining at the School.

The subjects for this course will be the following :— Mathematics, Mechanics, Grades I and II, Mechanical Drawing, Mineralogy and Blowpipe Analysis, General and Mining Geology, Engine Driving, Book-keeping and Mining Law, Mine Surveying, Ore-dressing and sampling, Surface work, Mining, (A) Haulage and Winding, Pump and Pit work : (B)Shafts, Adits, Cross-cuts, levels, etc., Breaking ground, Explosives, Methods of working, Mine-timbering.

During the whole year there has been a larger number of applicants for benches in the Chemical Laboratory than the accommodation at present available could provide for, and quite a number of students have had to be refused admittance.

I am pleased to be able to report that in both the Mining and Metallurgical Departments of the School there is an increasing interest being taken in the work, and the Committee feels confident that as soon as the new mining course has been definitely fixed, and it is in a position to hold classes in all the subjects contained therein, that the number of students in attendance will be very largely increased.

Mineral Products.

The following Return shows the quantity and value of the Minerals and Metals obtained during the year :—

Gold	83,784½	ounces *	£333,980
Silver-lead ore	29,169	tons	266,618
Tin ore	3330	,,	312,376
Coal	46,537	,,	41,883
Blister copper	9843	,,	810,005†
Copper ore	184	,,	1835
Iron ore	5358	,,	5137
Wolfram	39½	,,	1537
Asbestos	284	,,	432
			£1,773,803

* Including 28,500 ounces obtained from the Blister Copper from the Mount Lyell Mine.

† The value of the Gold obtained from the Blister Copper has been deducted from this amount.

This shows an increase in the value of £496,063 on the previous year.

The total amount paid in dividends and bonuses was £596,571.

Underground Surveys of Mines.

The Surveyor-General's Report for 1899-1900 contains some remarks upon underground mine surveys carried out under the Mines Department. Observations coming from this important source merit attention, the more so, as in this case they would appear to be founded on some misapprehension.

The sources of misapprehension may be defined as follow :—

1. That mine surveys come within the sphere of the Land Survey Office.
2. That mining accidents have been unusually numerous this year, and are almost certain to be more frequent in the future.
3. That authorised land surveyors are the sole persons entrusted by the Mining Act with the duty of effecting surveys of underground workings.
4. That greater safeguards should be provided by the Mines Department against mining accidents arising from faulty surveys, by entrusting mine surveys to land surveyors of recognised high standing.

All these contentions may be traversed, and needless fears dispelled by a calm examination of the facts :—

1. It is hardly necessary to refer to the fact that the conduct of underground mining operations is altogether outside of the inspection and control of the Surveyor-General. It is especially, and of set purpose, regulated by the Mining Act, and solely under the supervision of the officers of the Mines Department.
2. Instead of there having been a great number of mining accidents during the year just closed, the number has greatly decreased, being only 23, compared with 47 in the preceding year, and this in spite of 6834 workmen being engaged in mining, against 6180 the year before. The death rate from accidents has been reduced to 1·024 per thousand from 1·618 per thousand the previous year, and 2·351 in 1897-8.

The standard mortality ratio of a dangerous and hazardous occupation may be taken as 1 per 1000 ; consequently, in lieu of indulging in apprehension and alarm, we have fair reason to congratulate ourselves upon the results shown by our returns, and with increased inspection the figures may be expected to still exhibit a slight improvement. If we take the published returns of all casualties in the mines of Great Britain and Ireland, we find that the average yearly death-rate from accidents was 2·18 per 1000 during the decade 1873 to 1882, and 1·78 per 1000 from 1883 to 1892 ; in 1893, it was 1·56 ; in 1894, 1·58 ; in 1895, 1·49 ; in 1896, 1·46 ; in 1897, 1·34 ; in 1898, 1·27 ; in 1899, 1·27.

In France it was 2·21 per 1000 from 1871 to 1880, and 1·57 from 1880 to 1888. In Prussia it was 4·90 per 1000 from 1871 to 1880, and 2·96 from 1880 to 1888. In Belgium it was 2·45 per 1000 from 1871 to 1880, and 2·13 from 1880 to 1888. In Victoria, the average in gold-mining for 20 years, from 1879 to 1898, was 1·44 per 1000. In Tasmania, from 1892-93 to 1899-1900, it was only1·58 per 1000. Consequently, the allusion to accidents in Tasmanian mines loses its point, and, indeed, may be regarded as entirely discredited, when we consider that *none of them have been due to, or had any connection with*, incorrect surveys.

3. The Mining Act provides that underground surveys shall be effected by a duly authorised

surveyor, or by a mining manager who holds a certificate of competency under the said Act. This is very different from supposing that the land surveyor has the exclusive duty or privilege of carrying out these surveys. He has been admitted to share this right, but mine-surveying forms no essential part of his qualifications, and it is, to say the least, questionable whether, in strictness, he should not first be required to submit himself to the examinations in mining-surveying prescribed by the Board of Examiners of the Mines Department. Land surveying is the basis of mine-surveying, but the latter presents applications and practical difficulties not often encountered by the land surveyor, and which the special experience of the underground surveyor is more fitted to cope with. The Civil and Mining Engineering professions are well represented on the Board of Examiners for Mining Managers' Certificates, and the representation of land surveyors thereon seems unnecessary.

4. There is an inherent difficulty in attempting to restrict the conduct of underground surveys to land surveyors of "recognised high standing." What is the token by which "high standing" is recognised? There is, too, a danger of concentrating the work among the district surveyors, many of whom are already overburdened with practice, and from this cause are constantly occasioning delay in the presentation of mine plans to the department.

It may be furthur noted that even these experts are not necessarily versed in the practical application of their art to underground practice. An efficient mining surveyor, professionally equipped by instruction in a good school of mines, and experienced in underground work, with all its awkward and puzzling situations, is the ideal man for this task. The plans and sectional drawings of the workings of the mines of the Colony, together with the recorded data on which they are founded, are submitted to strict scrutiny: detected inaccuracies result in the return of plan, and possibly resurvey: and every step is taken to carry out the requirements of the Act. Owing to insufficient assistance in past years this work was not always attended to with the strictness which has recently become possible. On the whole, additional safeguards in this direction do not appear to be urgently needed at present.

It is needless to say that the above criticisms only apply to the suggestions contained in the Report under consideration, and have no reference to its respected author.

Departmental Staff.

The only changes which have taken place during the year have been the appointment of H. J. O'Brien, Junior Clerk, Hobart Office, F. S. Grove, Clerk and Draftsman, Government Geologist's Office, Launceston, A. L. Fitzherbert, Junior Clerk, Launceston Office, and G. Crosby Gilmore, Esq., Commissioner of Mines, Queenstown.

The work of the department has increased very considerably during the year. 5,827 letters have been received and replied to, and 980 instructions for surveys have been prepared and forwarded to the Surveyor-General for issue to the surveyors. In the drafting room, in which three draftsmen only are employed, 33 plans have been prepared for the lithographer, 14 of which were new compilations, and 937 diagrams in duplicate have been drawn on leases, which have been engrossed by the two engrossing clerks.

I have much pleasure in once more recording my sincere thanks to the officers of the department for their loyal support during the year, also to the Government Printer and Mr. Scott, photo-lithographer, for the plates accompanying this Report, which are produced by the new photo-algraphy process, the first work of the kind successfully attempted in the Australasian Colonies; and to Mr. R. M. Johnston for the diagram prepared by him showing the relative and increasing proportion of the mineral products to the total exports of Tasmania since the year 1870.

Mount Cameron Water Race Board.

The Report of the Board is annexed.

Diamond Drills.

Appended will be found details of the work done by these machines.

In conclusion, I have much pleasure in stating that there has been a decided improvement, as predicted in my last Annual Report, which will be apparent by a glance at the Returns and printed diagrams attached, and greater activity in Mining and Prospecting operations has been displayed.

The wars in South Africa and China have retarded for a time the introduction of English capital for the development of some large tin properties at the Blue Tier and on the East Coast, but, should the present price of tin be maintained, it will doubtless only be a matter of a very little while when these properties will once more be systematically working and producing large quantities of tin ore.

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

W. H. WALLACE,
Secretary for Mines.

The Hon. The Minister of Mines.

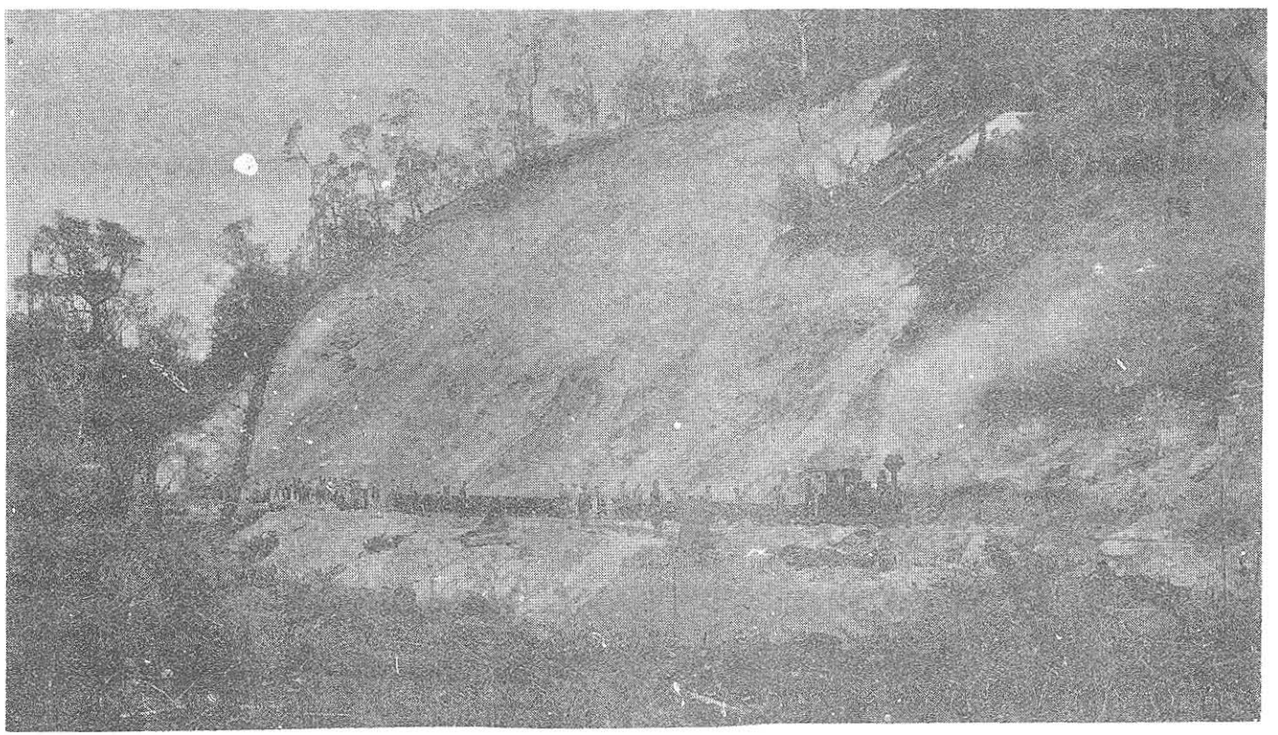


Photo-Algraphy Process.

QUARTZ QUARRY, MOUNT LYELL

DIAMOND DRILLS.

Statement of Work done to 30th June, 1900.

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, *and the first Half-year of* 1900.

Year.	Quantity.	Value
	ozs. dwts.	£
1880	52,595 0	201,297
1881	56,693 0	216,901
1882	49,122 6	187,337
1883	46,577 10	176,442
1884	42,339 19	160,404
1885	41,240 19	155,309
1886	31,014 10	117,250
1887	42,609 3	158,533
1888	39,610 19	147,154
1889	32,332 13	119,703
1890	20,510 0	75,888
1891	38,789 0	145,458
1892	42,378 0	158,917
1893	37,687 0	141,326
1894	57,873 0	217,024
1895	54,964 0	206,115
1896	62,591 0	237,574
1897	77,131 0	296,660
1898	74,233 0	291,496
1899	83,992 0	327,545
1900, for the first Half-year	39,643 10	157,902
	1,023,927 9	3,896,236

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, *and the first Half-year of* 1900.

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, for the first Half-year	38,991½	155,376
	889,586½	3,364,593

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, *and the first Half-year of* 1900.

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, for the first Half-year	23,769	21,393
	597,035	514,483

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, *and for the first Half-year of* 1900, *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, for the first Half-year	911¾	122,768
	67,395¾	6,014,803

5 cm

Diagram showing Total Quantity & Value of Coal exported from Tasmania for the years 1880 to 1899.

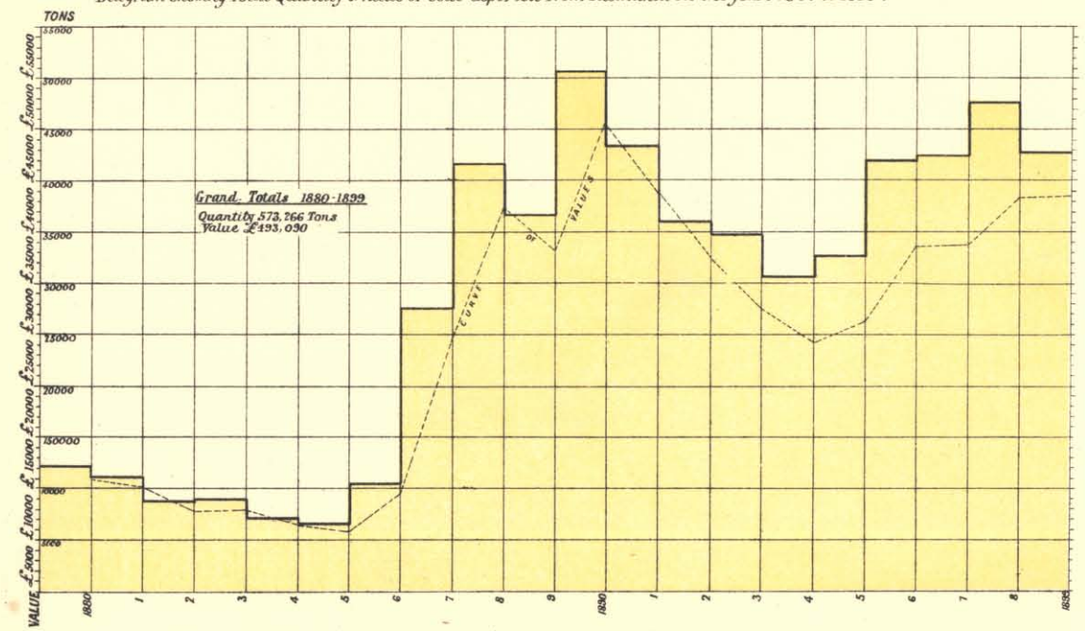


Diagram showing Total Quantity & Value of Tin exported from Tasmania for the years 1880 to 1899

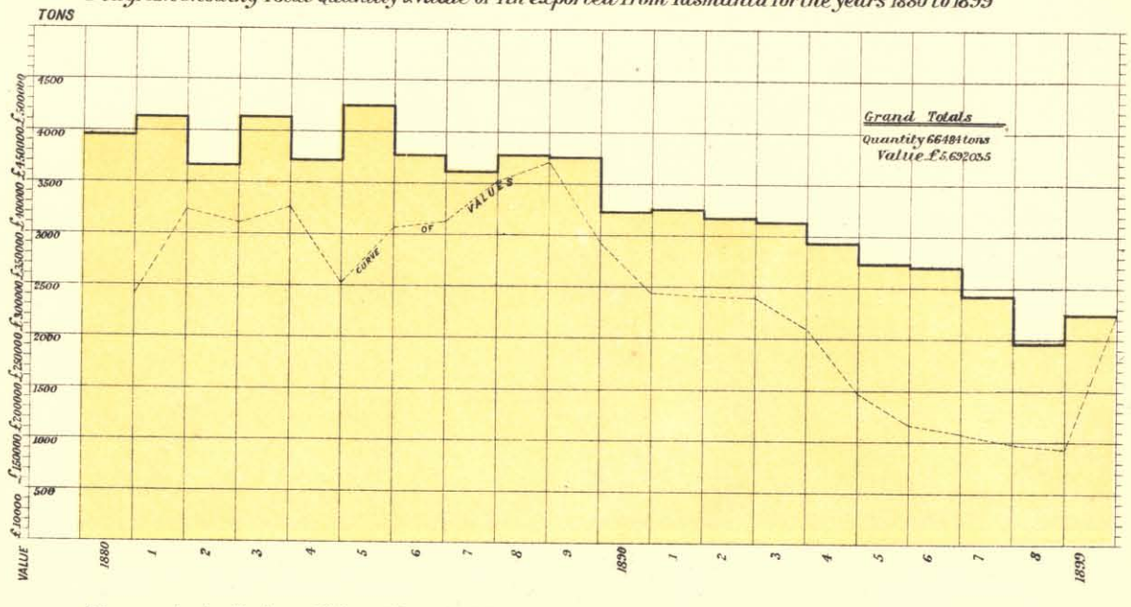


Diagram showing Total Quantity & Value of Gold won in Tasmania for the years 1880-1899

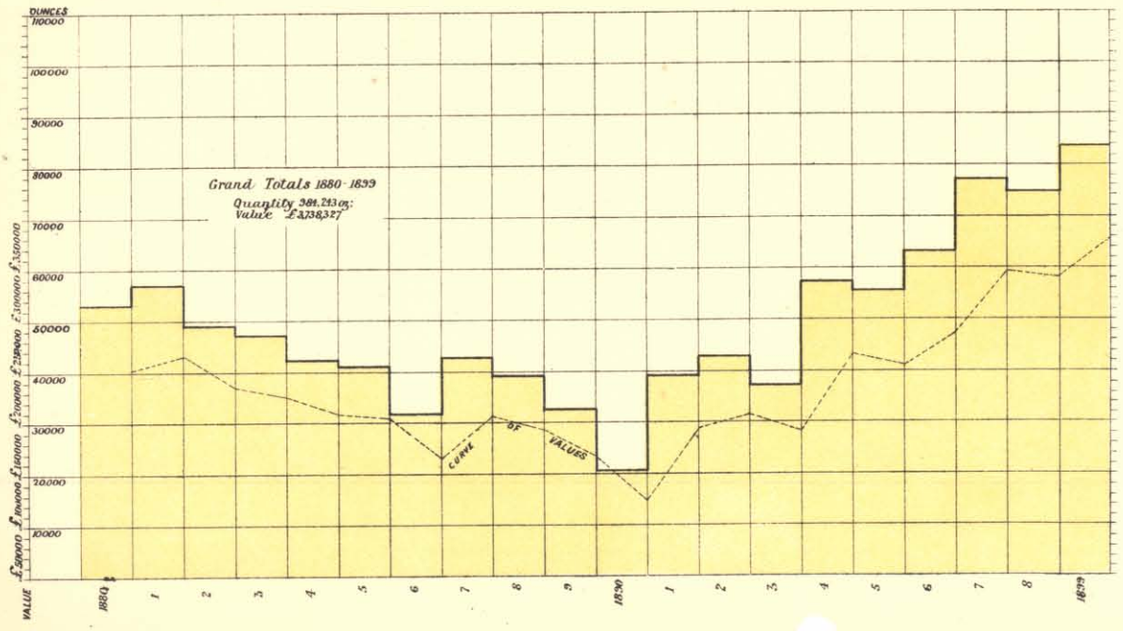
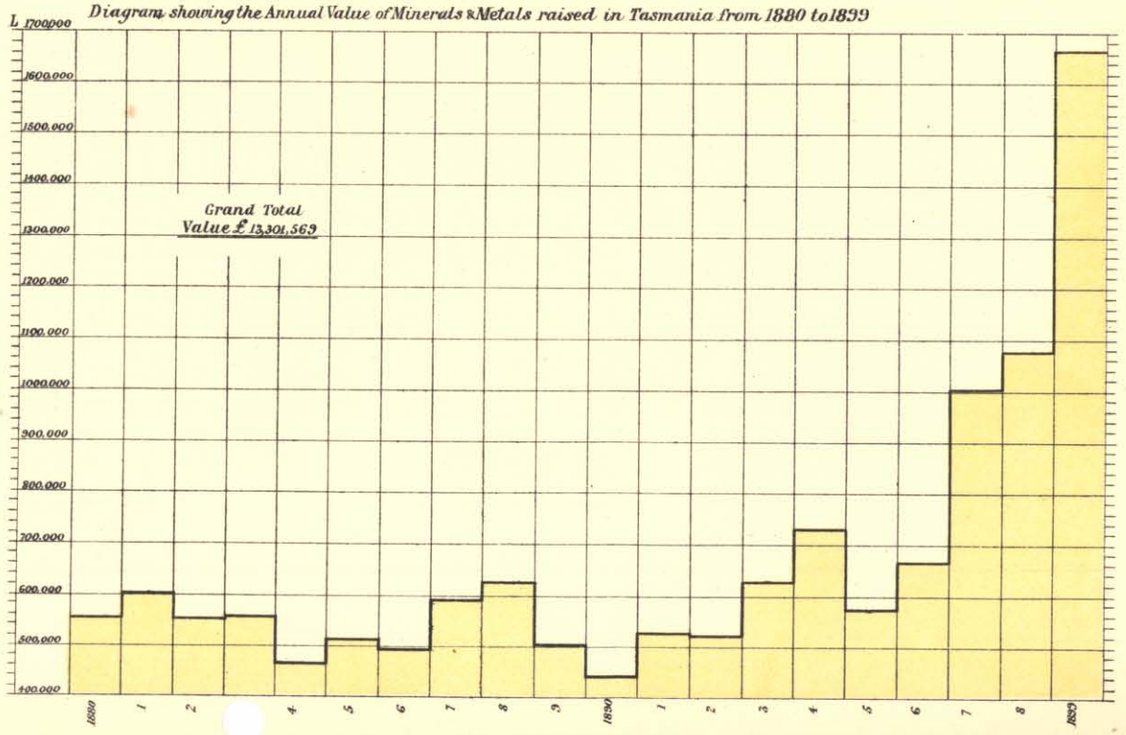


Diagram showing the Annual Value of Minerals & Metals raised in Tasmania from 1880 to 1899



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, *and the first Half-year of* 1900.

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, for the first Half-year	13,276½	124,028
	170,014	1,797,843

No. 6.

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

Year.	Quantity.	Value.
	tons.	£
1896	41½	1245
1897	4700	322,500
1898	4955½	400,668
1899	8598	735,305
1900, for the first Half-year	4780	465,681
	23,075	1,925,399

No. 7.

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

Year.	Quantity.	Value.
	tons.	£
1896	34	1020
1897	75	2250
1898	394	8128
1899	1695	26,833
1900, for the first Half-year	34½	389
	2232½	38,620

No. 8.

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

Year.	Quantity.	Value.
	Tons.	£
1897	894	812
1898	1598	1598
1899	3577	3474
1900, for the first Half-year	2813	2593
	8882	8477

No. 9.

RETURN showing the Quantity and Value of Asbestos exported.

Year.	Quantity.	Value.
	Tons.	£
1899	200	363
1900, for first Half-year	84	69
	284	432

No. 10.

RETURN showing the Quantity and Value of Wolfram exported.

Year.	Quantity.	Value.
	Tons.	£
1899	3½	99
1900, for first Half-year	36	1438
	39½	1537

No. 11.

RETURN showing the Number of Persons engaged in Mining during the Years 1880 *to* 1899 *inclusive, and first Half-year of* 1900.

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, first Half-year	6908
1890	2868		

No. 12.

RETURN showing the Number and Area of Leases held under "The Mining Act, 1893," *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.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.
		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
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
For Gold, at a rental of 20*s.* an acre	455	4366	602	5712½	615	5789	702	7190	652	6725	647	6623
Water Rights, Mineral and Gold	176	755 sluice-heads.	160	808 sluice-heads.	155	774 sluice-heads.	159	784 sluice-heads.	200	933 sluice-heads.	225	1004 sluice-heads.

No. 13.

RETURN of the Number and Area of Leases under the "Mining Act, 1893," *in force on the 1st July*, 1899, *issued during the Year ending 30th June*, 1900, *cancelled during the Year ending 30th June*, 1900, *and remaining in force on 30th June*, 1900.

Nature of Lease.	In force on 1st July, 1899.		Issued during Year ending 30th June, 1900.		Cancelled during Year ending 30th June, 1900.		In force on 30th June, 1900.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.
		Acres.		Acres.		Acres.		Acres.
For Tin, &c., at a rental of 5*s.* an acre.....	1207	64,339	783	37,538	501	30,960	1487	70,500
For Coal and Slate, at a rental of 2*s.* 6*d.* an acre	39	6002	13	1026	2	187	52	7258
For Gold, at a rental of 20*s.* an acre	652	6725	143	1308	148	1410	647	6623
Water Rights, Mineral and Gold	200	933 sluice-heads.	39	124 sluice-heads.	14	53 sluice-heads.	225	1004 sluice-heads.

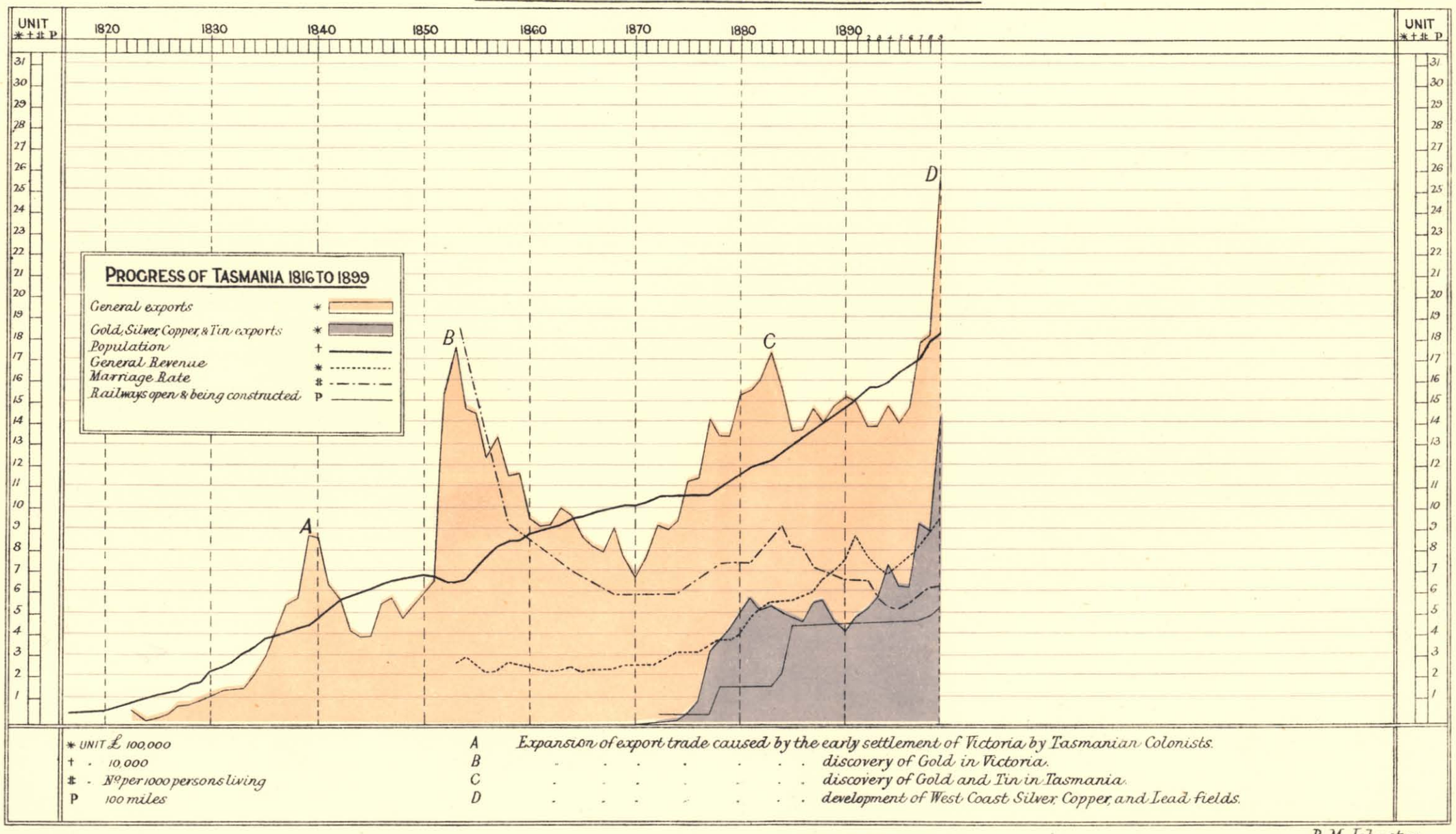
No. 14.

COMPARATIVE Statement of Net Revenue from Mines, being Rents, Fees, &c., paid to the Treasury for the Years ending 30th June, from 1880 *to* 1900.

Year.	Amount.	Year.	Amount.
	£ *s.* *d.*		£ *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		

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.

PROGRESS OF TASMANIA 1816 TO 1899



* UNIT £ 100,000
† . 10,000
‡ . Nº per 1000 persons living
P 100 miles

A Expansion of export trade caused by the early settlement of Victoria by Tasmanian Colonists.
B . . . . . discovery of Gold in Victoria.
C . . . . . discovery of Gold and Tin in Tasmania.
D . . . . . development of West Coast Silver, Copper, and Lead fields.

R. M. Johnston

5 cm

No. 15.

TOTAL Number and Area of Leases in force on 30th June, 1900.

Minerals.	Number.	Area.
		Acres.
Gold	647	6623
Minerals	474	26,522
Silver	365	18,015
Copper	161	9072
Tin	462	15,518
Coal	31	3993
Limestone	16	1816
Iron	10	537
Slate	2	715
Wolfram	7	340
Asbestos	5	316
Precious Stones	1	80
Lithographic Stone	2	417
Marble	1	317
Graphite	2	100
TOTAL	2186	84,381

No. 16.

AVERAGE Number of Miners employed during the Year ended 30th June, 1900.

	Europeans.	Chinese.
Northern and Southern Division	920	...
North-Eastern Division	336	173
Eastern Division	755	76
North-Western Division	324	...
Western Division	4250	...
	6585	249

No. 17.

MINING Companies registered during the Year ending 30th June, 1900.

Number of Companies.	Capital.
50	£340,430

In addition to the above, 31 Agents for Foreign Companies, and 12 Syndicates, under 60 Vict., No. 51, were registered.

No. 18.

TOTAL Area of Land applied for during the Year ending 30th June, 1900.

Mineral.	No. of Applications.	Area.
		Acres.
Asbestos	8	322
Bismuth	1	40
Coal	16	2471
Copper	89	5440
Galena	8	539
Gold	119	1172
Iron	9	381
Limestone	7	560
Mineral	293	16,377
Silver	27	1677
Tin	318	9977
Wolfram	13	694
Machinery sites	12	56
TOTAL	920	39,706

In addition to the above, 38 applications for Mining Easements, 27 applications for Dam Sites (492 acres), 86 applications for Dredging Claims, and 140 applications for Water Rights (812 sluice-heads) were received.

No. 19.

TOTAL Amount of Rents, Fees, &c., received by the Mines Department during the Year ending 30th June, 1900.

Head of Revenue.	Amount.
	£ s. d.
Rent under "The Mining Act, 1893," for Gold	5329 16 10
Fees " " "	539 17 6
Rent " " for Minerals	19,812 2 11
Fees " " "	2689 1 4
Survey Fees	6036 1 11
Rent of Diamond Drills	9 13 3
TOTAL	£34,416 13 9

No. 20.

RETURN showing the Amounts paid in Dividends and Bonuses by Mining Companies during the Year ending 30th June, 1900.

Mines.	Dividends.	Bonuses.	Total.
	£	£	£
Copper	206,250	13,750	220,000
Gold	56,800	—	56,800
Tin	123,631	150,000	273,631
Silver	46,140	—	46,140
	432,821	163,750	596,571

REPORT OF THE MOUNT CAMERON WATER-RACE BOARD FOR THE YEAR ENDING 30TH JUNE, 1900.

25th July, 1900.

SIR,

WE have the honour to present the Report of the Board for the year ending 30th June, 1900.

The Board has held two meetings during the year.

Mr. W. H. Twelvetrees, Government Geologist, was appointed a member of the Board during the year, in place of the late Mr. James Harcourt Smith, Government Geologist.

The total receipts for the year amount to £1538 6*s.* 9*d.*, as against £1017 5*s.* 11*d.*, and the expenditure to £737 12*s.* 6*d.*, as against £614 0*s.* 3*d.* during the preceding year.

The water supply was fairly good during the first six months, averaging 93 heads per week, the greatest number of heads available in any one week being 102; since then it has not been so good, the supply going down as low as 70 heads per week at one time, in March. The supply was again very low in May, owing to the dry weather, and the royalty customers were unable to obtain their full supply. A good rainfall in June has brought the present supply up to 105 sluice-heads per week, which is ample for present requirements.

Fixed Scale.

The charges under this scale were altered and reduced, the rate being now equal to 6*s.* 8*d.* per sluice-head when the English-quoted price of tin is £100, and for every £1 that the price of tin rises above, or falls below, £60, the sum of 1*d.* per sluice-head is added or deducted; thus, the present cash price of water, with tin at £138, is 9*s.* 10*d.* per sluice-head.

Race.

The race received a thorough cleaning in February last. It is now in good order so far as the earth-channel and banks are concerned, but the flumings at the southern extension and the syphon-pipes at the northern extension are gradually going from bad to worse. The pipes have given less trouble during last month than usual, but they cannot be depended upon to last for any great length of time. The flumings are in a very decayed state; the loss of water through leakage cannot be far short of 18 sluice-heads per week.

The manager has furnished estimates of the probable cost of renewals to the Race—24 flumings (southern extension), £2788 7*s.*, and syphon-pipes (6), £5488 18*s.*; total cost, £8277 5*s.*

The statistics for the year are as follow:—

Average per week of claims supplied	15
Greatest number supplied in any one week...	18
Present number supplied	14
Total number of heads of water supplied	4091

Tons of tin ore raised—62 tons 6 cwt. 3 qrs. 24 lbs.

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

	£	*s.*	*d.*
Total receipts for the year ....,.....	1538	6	9
Cost of maintenance and management	737	12	6
Paid to Public Debts Sinking Fund, 1899, including moiety of rents of mineral land served by the Race, £20 17*s.* 6*d.*.....	857	17	0
Total amount paid to Public Debts Sinking Fund	6262	3	
Rate of interest for the year upon the cost of purchase and construction...	2·42 %		

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

C. O'REILLY,
W. H. TWELVETREES,
S. HAWKES,
JOHN SIMPSON,
} *Members.*

The Hon. the Minister of Mines.

MINE MANAGERS' EXAMINATION.

MARCH 28TH, 29TH, AND 30TH, 1900.

Questions set.

SECTION A.—MINING.

1. Assuming a rise is being put up to connect with the underground workings of an old mine which is full of water, what precautions would you take in protecting the lives of employees and the company's property?
2. Describe the different systems of ventilation as applied to mining generally.
3. Make pen-and-ink sketch, showing the methods of timbering a drive to effect a natural ventilation.
4. Make sketches, showing safety appliances used in connection with haulage in incline shafts.
5. How would you construct a dam with timber in underground workings to keep back water from an adjoining mine?
6. Supposing the outcrop of the lode to have been discovered within the area of a mining lease or claim, in what manner should the inspection and exploration of the ground be proceeded with so as to ascertain whether the mineral contents of the lode are likely to be commercially of a profitable nature?
7. Assuming that the inspection of the lode was of an encouraging character, state thoroughly the following:—
   (*a.*) Manner and plan in which the opening up and development of the underground workings of the mine should be undertaken.
   (*b.*) Describe with pen-and-ink sketch the system of timbering the main levels in small and in wide lodes.
   (*c.*) The manner in which stoping may be safely carried on, especially in wide lodes with a heavy hanging-wall.
8. —(*a.*) State the dimensions of a vertical shaft which you consider suitable for an output of 100 tons per 24 hours, and the installation of a fourteen-inch Cornish Pump.
   (*b.*) Give a sketch-plan of position of main rods and plunger-bottom as placed in the shaft.
   (*c.*) State what, in your opinion, are the most suitable distances apart that plungers of a Cornish Lift should be placed, and reasons why.
   (*d.*) Give pen-and-ink sketches of safety appliances you have seen in use in connection with the Cornish Pump.
9. Describe the different systems of shaft-timbering which you are acquainted with; also some of the advantages and disadvantages of each system.

SECTION B.—ORE DRESSING AND SAMPLING.

1. How would you determine if an ore was suitable for Concentration?
2. What are the principal factors to be considered in successfully concentrating complex ores?
3. What is Hydraulic Classification; describe appliances used?
4. What has to be considered in designing a Concentrating Plant?
5. How would you sample a heap of ore containing 2000 tons?

SECTION C.—MINING GEOLOGY.

1. A veinstone contains by volume quartz, 60 per cent.; blende, 10 per cent; and galena, 30 per cent.: What are the weights of lead and zinc ore contained per ton of stuff?
2. Name the different ores of copper, and state their composition.
3. Define the following rocks:—Quartzite, schist, slate, granite, diorite, basalt, syenite, diabase.
4. Define the various classes of ore deposits, and state briefly how you consider them to have been formed.
5. Define the terms—dip, strike, anticline, breccia, conglomerate, dyke, heave, metamorphic, metasomatic, plutonic, sedimentary.
6. State the composition of the following ores:—Molybdenite, wolfram, blende, siderite, galena, crocoisite, cassiterite, pyromorphite.
7. Two levels on a quartz-reef are 100 feet apart on the underlay: If the reef is 4 feet wide, how many tons of quartz are contained between the two levels in a length of 200 feet?
8. State common tests for the identification of—(*a*) Copper ores; (*b*) Argentiferous galena; (*c*) Cassiterite; (*d*) Manganese ores.

SECTION D.—MINING SURVEYING.

1. Describe how you would connect the underground with the surface survey through a vertical shaft.
2. Explain the principle of (*a*) the vernier scale, (*b*) a diagonal scale of equal parts.
3. *A* and *B* are outcrops of two parallel lodes in the same horizontal plane, 800 feet apart. *A* dips 64° from the horizon. *B* underlies *A*, and dips at an angle of 32°. Find the depth at which the lodes meet, and the shortest distance from *A* at which to sink a shaft vertically over the line of their intersection.
4. Describe the adjustments which must be made every time a theodolite is used.
5. The following angular bearings and distances were taken:—

0 to 1	N.E.	75° 12′	318 feet.
1 to 2	N.W.	345° 12′	67 feet.
2 to 3	S.W.	255° 10′	62 feet.
3 to 4	N.W.	343° 48′	69 feet.

   Calculate their latitude and departure.
6. The total latitude of a traverse is 653·3 feet N., and the departure is 138·7 feet E. Calculate the direct bearing and distance.

7. An inclined shaft measures 250 feet on the underlay. Its angle of inclination is 70° from the horizon. Find its vertical depth by calculation.
8. A B C = the three angles of a triangle; a b c = the three sides. The angle at C (namely a C b) is 54° 10′. The angle at B (namely a B c) is 65° 50′. The side b measures 940 feet. What is the angle at A, and what are the lengths of the sides a and c.
9. Describe briefly the sets of drawings necessary to represent a metalliferous mine.

Section E.—Surface Work.

1. A crab winch is double-geared, the pinion on handle-shaft has 15 teeth, and the wheel it engages has 40 teeth—the pinion on this second shaft has 15 teeth and engages a wheel on the barrel-shaft having 70 teeth—the barrel is 9 inches diameter. If a man exerts a constant pressure of 50 lbs. at a radius of 18 inches on the handle-shaft, what weight can be wound up at the barrel with a single wire rope—neglecting friction?
2. Show how you would find what size winding engine you would require to lift 1200 lbs. from a shaft 500 feet deep, at a good ordinary working speed. Two cages. Supply all data, such as size of rope, &c., yourself.
3. Explain fully, with sketches, the construction and working of any well-known steam trap, and say where it is advisable to have them fixed.
4. Your directors wish you to buy a steel Cornish boiler and the shell of this particular boiler is the weakest part of it. The plates are $\frac{3}{8}$ inch thick; longitudinal butt joints, with double butt straps, $\frac{5}{16}$ inch thick; rivets, $\frac{3}{4}''$ diam. × $3''$ pitch, double zigzag riveting; circumferential joints, $2\frac{1}{4}''$ pitch, lap jointed, single riveted. The diameter of the shell is $6'$ $6''$. Show how you would arrive at the safe working pressure for this boiler (fully worked out).
5. You have a pair of sheer legs 20 feet high vertically over a weight of 5 tons. You wish to pick this weight up and traverse it horizontally a distance of 10 feet. To do this, after picking the weight up, you slack away one guy and incline the sheer legs the necessary amount in the direction you wish. After being inclined, the sheer legs make an angle with the perpendicular of 30 degrees, and the taut guy also an angle of 30 degrees with the ground. Calculate what stress will come upon the guy when in this position.
6. What do you consider maximum grades and radii of curves permissible on 2-ft. guage tramways, and why so?
7. In setting out surface arrangements for a quartz mine calculated to produce 100 tons per day from main shaft—
   (*a*) What buildings would you require? Give dimensions and reasons for same.
   (*b*) What shaft-head arrangements for handling output?
8. Give sketches of dam, 30 ft. deep at centre, by 60 ft. long, with all details and calculations as to strength.
9. Describe arrangement of men and material for mixing and putting in place concrete (cement) foundation for engine, 20 ft. long by 10 ft. wide by 8 ft. deep, with alley-way for fly-wheel 4 ft. deep by 9 ft. long from centre of one end. Estimate cost of same complete.

Subject F.—Book-keeping and Mine Accounts.

1. Calculate the value per ton of silver-lead ore which produces 73 per cent. lead and 37 ounces of silver per ton, the price of lead being £16 10*s*., and of silver Two Shillings per ounce.
2. You are in charge of a mine with a crushing mill or concentrating works. You receive your stores and cash for wages, repairs, and construction of buildings, and current expenses from Hobart. What accounts will you open in your ledger at the mine, and how will you keep mining and milling costs separate in your books?

Subject G.—Mining Law.

1. What are the provisions under Section 102 of "The Mining Act, 1893," with regard to sinking a shaft in rock formation, where blasting operations are necessary?
2. What are the provisions under Section 102 of "The Mining Act, 1893," with regard to workings in a mine approaching a place likely to contain a dangerous accumulation of water?
3. What is the limit in regard to speed of winding machinery?
4. What are the provisions of "The Mining Act, 1893," with respect to the employment of labour on Gold and Mineral Sections?
5. What is the course of procedure to be followed when objecting to the issue of a Lease?
6. What course of procedure is to be followed in order to obtain a Water Right?

ANNUAL REPORT OF THE GOVERNMENT GEOLOGIST.

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

SIR,

I HAVE the honour to present my Annual Report, as Government Geologist, for the year ending 30th June, 1900.

I was appointed to the duties of my lamented predecessor, Mr. J. Harcourt Smith, B.A., on the 5th August, 1899, and was at once instructed to inspect the deep shaft of the Volunteer Gold Mine, Lefroy. The greater part of the year has been spent in the field. Numerous mining districts have been visited, and I have submitted the following Reports :—

1. On the Volunteer Gold Mine, Lefroy; 25th August, 1899.
2. On some tin mines in the St. Paul's River Valley, near Avoca ; 28th October, 1899.
3. On gold mines near Hogan's Track; 3rd November, 1899.
4. On the strata in the shaft of the New Sovereign Mine, Mangana ; 6th November, 1899.
5. On the asbestos deposits, Anderson's Creek, near Beaconsfield ; 20th November, 1899.
6. On the Arba Extended Tin sections, at Branxholm ; 25th November, 1899.
7. On the North Mt. Victoria Gold Field; 19th January, 1900.
8. On the Queen of the Earth Gold Mine, and neighbourhood ; 15th February, 1900.
9. On the Deep Lead of the Ringarooma Valley, near Derby ; 26th February, 1900.
10. On the mineral fields between Waratah and Corinna ; 30th June, 1900.

Besides the above, I have, pursuant to instructions, prepared a few special reports for departmental use.

These visits have resulted in the elucidation of not a few problems connected with the different mines, and some of the questions have a direct useful bearing on the prospects of the mining fields.

Referring briefly to the most important of my inspections, in the order of date, an examination of the Volunteer Gold Mine, at Lefroy, now, unfortunately, shut down, led me to conclude that no valid reason exists for doubting the existence of gold at a greater depth than has already been attained; and this conclusion applies to the Lefroy field as a whole.

The gold mines on Hogan's Track, east of Mathinna, have been unfortunate. One or two of them are not without prospects, but, generally speaking, the quartz at surface, though sometimes highly auriferous, is patchy, and there is not much encouragement, at present, for any outlay designed to yield an immediate return. The field is essentially a prospecting one.

At the New Sovereign Mine, Mangana, the proprietors are engaged in a deep-sinking enterprise. They will do well to continue their present policy, and, if successful, the Mangana goldfield will revive.

I visited the asbestos mine at Anderson's Creek, near Beaconsfield, just as it was starting, and the indications which I saw of a legitimate enterprise are now being justified by actual work. The owners are proceeding cautiously, making sure of their market before expending much on the mine. It is to be hoped that this new industry will prove successful.

The gold mines on North Mt. Victoria, many of which I found neglected, have absorbed a good deal of misdirected capital in past times, but some of them are doing well now, and there is reason to anticipate that a sound revival will take place here.

Accompanied by Mr. S. Hawkes, who was deputed by the department to assist me with his local knowledge, I made a preliminary examination of the high basaltic plateaux and stanniferous gravels near Derby, with a view of tracing the direction of the buried lead which followed the old bed of the Ringarooma River. Some measure of success was met with in approximately determining the general direction of the old stream and its bounding rocks, but considering its great depth, the nature of the drift, and its probable percentage of tin ore, it was felt that serious underground mining in these gravels, while too heavy a task for ordinary mining companies, would be attended with too great risks for the Government to undertake, but that the encouragement of individual enterprise, under proper safeguards, was a question for consideration.

Since the end of February I have been on the West Coast fields. Mount Bischoff Mine still maintains its output of tin ore, but the Magnet Silver-lead Mine is the only other producing mine in that neighbourhood. There are signs, however, that old mines in the Whyte River and Heazlewood districts are to be resuscitated. These districts are not without rich mineral, and it is to be hoped that some of the mines may retrieve the disasters of the past. At the Heazlewood are some neglected nickel ore deposits. The improved demand for iridium has led to renewed search for the metal on the Savage and other rivers, and some of the seekers have been fairly successful. This metal is found in the sands of rivers which, in some part of their course, have flowed over serpentine country.

Gold mining on the Long Plain pursues a fitful course. Discoveries of specimen gold may at any time cause a rush here. The gold of this part of the country has not all been derived from one source, and the metal is likely to be won in very variable quantities.

The copper ore deposits of the Rocky River, Rio Tinto, Cape Copper Mine, &c., are confined to a particular belt of country, and await further development and trial before any decided opinion of their value can be expressed.

Since my visit to Corinna a wolfram lode has been reported from near the mouth of the Pieman River. Thus, looking at the whole line of country from Waratah to the Ocean, the rocks are plainly the depositories of of widely different economic minerals, and deserve thorough examination.

At the head streams of the Pieman the Mount Farrell district is assuming importance. The North Farrell Mine is producing silver-lead ore : other mines, both galena and copper, are in an undeveloped state, so far. The slate country here is very favourable for galena, and the large cupriferous zone of the West Coast range joins on to the east and south of the field.

Zeehan is a settled field, and a steady ore producer. Some of its mines from time to time drop out of the list: others come in to take their place. The mines cannot be said, as yet, to have attained any great depth. Zeehan's ore reserves are below the present workings. The Comstock district, west of Zeehan, has been

strangely neglected, but, when brought into better communication with Zeehan, will add to the output of the field, while in the other direction the country south, on the King line of lode, is, I believe, destined, in the future, to swell the Zeehan output of ore. The smelters of the Tasmanian Smelting Company have now got steadily to work, and are absorbing a fair share of the production of this part of the West Coast.

Mines in the Dundas district show symptoms of recovery. The British Mount Reid is turning its ore into marketable metal, and preparing for further future treatment. The Hercules has found its zinciferous silver-lead ore turning to copper in depth, and is contemplating the erection of a smelter in connection with a vigorous development of the new discoveries. Some renewed trial work is proceeding at Red Hills in search of the ore bodies suggested by the irregularly disseminated copper pyrites. Mount Tyndall Mine has also been resumed.

A little progressive work is proceeding on the Renison Bell tin property; and a fresh start has been made at the New West Cumberland Tin Mine, on Mount Heemskirk.

Boring is being conducted for coal near Eden, a few miles from Zeehan, in the lower coal measures, where indications of a good quality coal were observed at surface.

I did not inspect the flourishing group of mines at Mount Lyell, except where necessary for geological purposes, but confined my visit practically to Mounts Huxley, Jukes, and Darwin, all geologically identical. These mountains form a great belt of felsitic eruptive rock, which, from Mount Farrell, in the north, to Mount Darwin, in the south, is the home of widely disseminated copper pyrites. This mineral is scattered in the country rock throughout the zone, indicating the neighbourhood of ore-bodies which, up to the present, have not been discovered. This belt (apart from the cupriferous schists on the eastern flanks of the range) forms a preponderating proportion of the area now being taken up for copper-mining, and it can, therefore, readily be seen what important issues are involved in the investigation of its geological structure. Only well-directed mining is likely to have a chance here. The zone requires judicious and very extensive prospecting.

Returning to Launceston in June, I visited the deposit of red hematite at the Blyth River, near Burnie, known as the Blyth Iron Mine. This huge deposit, which embraces an immense quantity of iron ore, much of it of singular purity, is about to be worked by an influential company. The enterprise partakes more of the nature of an industrial one than a mining venture.

I have not embraced in these remarks any references to mining-fields not covered by my reports during the last year. My inspection of the districts visited may be epitomised by the expression of my conviction that our mining industry is, as yet, only on the threshold of its career. It suffers under the drawbacks attendant on mountainous, timbered country, with a sparse population, and other economic disadvantages. Its progress is, consequently, not always commensurate with the enthusiasm and hopes of those most directly interested in it, but, upon comparing one decade with another, the improvement is strikingly apparent.

Schools of Mines.

In April and May I investigated the working of the Zeehan School of Mines and Metallurgy, and have presented to you my Report thereon. This school was founded by local effort in 1894, and in 1896 Messrs. Waller Bros. were appointed permanent instructors, and have continued to conduct the school-work up to date. The average attendance has been, in 1896, 50 students; in 1897, 38 students; in 1898, 40 students; in 1899, 32 students; and this year, 40 students.

Certificates are issued to students by the Mines Department upon the awards of the Government examiners. The Government grant in aid is at present £500 per annum. The progress made has been such that the school has outgrown its accommodation, and needs a larger and more suitable building. The school committee has obtained a ministerial promise to recommend a grant for this purpose of £1000, provided £500 be raised locally, and efforts are now being made in Zeehan to secure the required contributions.

A revised curriculum has been prepared with the special view of qualifying students for the Government Mine Managers' Certificates, but increased teaching power is urgently needed. In view of the excellent service rendered by this school to the community, I strongly recommend it for further Government aid.

Some similar mining instruction, but on a smaller scale, is being asked for at Beaconsfield, and arrangements for it might possibly be made by the University and the Launceston Technical School authorities.

Office.

Improvements have been made during the year, and a start made with the organisation of routine work on a proper basis. Mr. Frank Sneyd Grove was appointed clerk and draughtsman on the 10th February, and has proved an efficient officer. The office has been renovated, and furnished with bookshelves and a cabinet for minerals. Some mining and metallurgical books of reference have been acquired, and these will form the nucleus of a small library, indispensable for current work. It is highly desirable to gradually augment this library and keep it up to date by a small yearly grant. The improvements begun cannot, however, be carried out thoroughly until an additional room is secured, as at present we are sadly cramped. A grant of a third room is also really needed for the reception and trimming of mineral specimens, which are being received constantly, and which, for want of space, create dust and untidiness.

Progress Reports on the Mineral Industry.

Owing to my frequent absence in the field, these quarterly reports have been prepared by the Secretary for Mines. I have been able, however, to assist in the preparation of the one for the quarter ending 30th June.

Geological Survey.

One of the important tasks looming ahead is that of the geological survey of the Colony. As the triangulation of the Island has been suspended, and there are no topographical survey maps available, it is not yet possible to commence a geological survey properly. Still, as things are now, there is a strong demand for geological maps of our mining-fields, and surprise is felt that there are none to be had. The only maps now being published are the sketch maps accompanying the various geological reports. The construction of topographic maps for the purposes of geological survey falls properly within the province of the Surveyor-General, but in countries where no such maps exist geologists have to make their

own, and they are under great disadvantage where they are unable to establish connection with trigonometrical stations. They have often to do their best under these circumstances, and a topographical surveyor is employed to prepare maps for their use. Geological surveyors ought not to spend their time in making the field-maps necessary for them in their special work. As regards our own immediate requirements, I think steps might very well be taken to prepare topographical maps of the Zeehan and Lyell mining-fields with a view of enabling geological surveyors to make a detailed survey of them. Once a start is made with the mapping, extensions can be made, Zeehan and Lyell connected, and thus, by degrees, a good block of West Coast country would be brought under survey. This work would furnish an idea of the length of time required for the geological survey of the whole Island. Judging by other countries, and taking into consideration the mountainous and timbered nature of a large portion of the Colony, I do not think, with a moderate staff, that it could be done in less than 50 years.

The commencement of geological survey-work would involve some such organisation as follows :—

The present geological branch of the department to be called the Geological Survey of Tasmania, with the fol lowing officers :—

1. Government Geologist, director of the survey.
2. Assistant Government Geologist.
3. Clerk and Draughtsman.
4. Mineralogist and Curator of Geological Museum.
5. Geological Surveyor (topographical maps being supplied from the Surveyor-General's office).

A geological survey is considered essential in all civilised countries, and is of double importance in Tasmania, which derives so great a proportion of its wealth from its mineral resources. The matters with which such a survey is expected to deal are two-fold,—scientific and economic,—the first bearing, at first, indirectly, but, in its ultimate result, decisively, upon the latter. Its aims would be—

1. The preparation of a geological map of the Colony, and detail maps of mining districts.
2. The description and illustration of Tasmanian rocks and fossils, and their correlation with those of other countries. This will include both the stratigraphical and eruptive geology of the Island.
3. The examination and description of ore-deposits and mining-fields, of water, stone and soils useful in agriculture, science, and art.
4. The diffusion of useful information in geological subjects affecting scientific education, mining, and other industries.

A mineral and geological museum attached to the survey is an essential part of the organisation. The general museums in Hobart and Launceston are not suitable for this purpose ; it is inconvenient for them to allow an overwhelming preponderance of space to any one class of exhibit. Besides this, the collections in a geological museum are primarily for reference, not for public display, their first object being to elucidate the geological structure and mineralogy of a district, embracing, in this way, specimens of very insignificant appearance, but all-important in their geological or mineralogical relations. All materials of economic use found during the survey, whether metals or substances useful in industries, stone for buildings and roads, &c., ought to be preserved by the Survey Department in a suitable collection. In this museum the cores from the diamond-drill bores would be preserved, as well as geological photographs, classified collections of all ores, coals, minerals, rocks, and whatever else might illustrate the mineral resources of the Colony. It would be a museum of practical and economic geology.

Attached to the survey should be a laboratory, and that close at hand. At present the most important samples are sent to the Government Analyst for assay and analysis ; but there is a mass of material constantly coming into my hands which would overwhelm the Government laboratories with work, and, besides, could be more profitably examined under my supervision, on the spot. A cutting and grinding lathe, for the preparation of rock sections, ought to be part of the equipment of the laboratory or museum. The use of the lathe can be learned easily, and, though the sections may not be equal in finish to many of those prepared professionally, there is great advantage in making our own slides.

The above is, I believe, a modest estimate of what is required to put the geological branch of the department upon a basis corresponding with the needs of the Colony. This branch is, unquestionably, destined before long to develop into some such organisation as I have now foreshadowed, and I have ventured to submit these remarks with a view of indicating the lines upon which the development may be expected to proceed.

Examination of Substances for the Public.

Minerals and rocks are from time to time received at the office for determination. These are invariably examined, and the results reported to the senders. It is as well to remind senders, however, that assays of ores cannot be undertaken. Annexed I beg to supply return of these for the past year.

Diamond-drills.

The only one which has been in use during the year was that at the Anchor Mine, now returned to Hobart.

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, 1900.

Sender.	Locality.	Substance Examined.
1. H. C. Littler	Near St. Leonards	Diabase rock.
2. Mr. Lohrey	Abbotsford	Silicified slate.
3. T. Andrews	New Golden Gate	Manganese dendrites.
4. A. J. Ritchie	Lefroy	Granite.
5. Wm. Warrener	W. Devonport	Quartz conglomerate.
6. Paul Beahr	East Coast	Sandstone, coloured blue, with iron phosphate
7. Miss Lodder	Near Ulverstone	Basaltic clay.
8. A. J. Bolton	Rocky River Mine	Micaceous hematite.
9. Wm. Warrener	W. Devonport	Vein quartz.
10. Ditto	Ditto	Mica schist.
11. Ditto	Ditto	Metamorphic slate.
12. Ditto	Ditto	Quartzite.
13. Ditto	Ditto	Ferruginous grip.
14. Ditto	Ditto	Quartz sand.
15. Rev. W. Hogg	Latrobe	Carbonaceous clay.
16. E. A. Woodberry	Deloraine	Tertiary cement, with lignite.
17. Ditto	Ditto	Manganese oxide.
18. Ditto	Ditto	Clay.
19. Harry White	East Coast	Orthoclase felspar.

ANNUAL REPORT OF THE CHIEF INSPECTOR OF MINES.

Inspector of Mines Office,
Launceston, 30th June, 1900.

SIR,

I BEG to present my Annual Report on the inspection of mines for the twelve months ending 30th June this year. I enclose the Annual Reports of Mr. M. J. Griffin, Inspector of Mines for the northern and eastern mining districts, and Mr. Jas. Harrison, Inspector of Mines for the West Coast.

The number of accidents which have occurred in and at the mines of the Colony, underground and at surface, has been much less this year, viz., 23, as against 47 the year previous, notwithstanding that the number of workers this year exceeded that of last year by 654. The number averaged 6585 Europeans and 249 Chinese, a total of 6834; consequently, the average accident-rate for the year per thousand men employed has been 3·38, and, as seven of these accidents proved fatal (compared with 10 the year before), the average annual death-rate per thousand has been 1·024. I give the following table to show the numbers in previous years:—

RETURN showing Average Accident-rate, and resultant Death-rate, per 1000 Men employed.

Year.	Number Employed.	Total Number of Accidents.	Fatal Accidents.	Non-fatal Accidents.	Death-rate per 1000.	Total Accident-rate per 1000.
1892–1893...	3295	29	4	25	1·214	8·8001
1893–1894...	3403	27	7	20	2·057	7· 934
1894–1895...	3789	28	4	24	1·058	7· 390
1895–1896...	4160	23	7	16	1·682	5· 529
1896–1897...	4303	38	7	31	1·627	8· 831
1897–1898...	5530	46	13	33	2·351	8· 318
1898–1899...	6180	47	10	37	1·618	7· 605

In British mines any accident is treated as a fatal one which causes the death of the individual injured within a year and a day of the date of the accident. The fatal accidents in Tasmania have been so few, and so few persons have been employed in mining, that cases of protracted illness and subsequent death have, doubtless, never escaped notice; but it is as well to bear the possibility in mind. It is unfortunate that it has been the habit to mix up surface hands with underground miners in the returns, as, for proper tables, the death-rate for each class ought to be calculated separately. For the past year the accidents may be tabulated as under:—

Cause.	Killed.	Injured.	Total.
Machinery	—	4	4
Falls of rock and earth	7	4	11
Explosives	—	4	4
Accidents in shafts	—	2	2
Other accidents	—	2	2
	7	16	23

Falls of earth and rock are responsible for all the fatal accidents this year, and for nearly half the other injuries. Of the seven deaths six were occasioned by falls in open faces, surface drives, and trenches; so that underground mining has been carried on with only the loss of a single life. During my visit to the West Coast I observed, with pleasure, that Inspector Harrison had seen particularly to the formation of the benches at the open-cast mines of the Lyell district, and Inspector Griffin has done what he could with the open mines on the East Coast. The Mount Bischoff Company has made some additional provisions for the greater security of its workmen after the unfortunate loss of a life through the fall of stuff at the Brown Face in March. The proposed power in the new Mining Bill to make regulations with reference to open-face workings is expected to secure increased safety for the men employed at such mines.

Of the 16 non-fatal injuries four were from careless handling of machinery and from inattention, and four were wounds sustained through overcharging in bulling a deep hole at the Mount Lyell Mine.

Inspection of Mines.

My long absences interfering with my regular visits to the mines at Beaconsfield and Lefroy, the Hon. the Minister for Mines, in April last, relieved me from further routine inspection, and Inspector Griffin has added the above mines to his round. On the West Coast the Waratah-Corinna mining-fields have been added to Inspector Harrison's list of visits, but, with these and the new districts of Mount Farrell, Mounts Jukes and Darwin, besides increased mining activity at Lyell and Zeehan, this Inspector's tasks have become too heavy for a single individual to perform. I have therefore noted, with satisfaction, the decision of the Government to give Mr. Harrison the services of an assistant inspector.

The Mining Act, 1893.

The appointment of Mr. Frank S. Grove has enabled much better attention to be paid in my office to the plans and the registration of mining managers. An improvement has been effected in getting in the plans required by Section 97 of the Act, but some legal managers are still extremely dilatory in effecting the said registrations, and continual reminders are necessary. In future, if reminders fail to have the desired effect, legal proceedings for non-compliance with Section 91 of the Act will be taken. Legal managers would save this office a great deal of work if they would make it a standing instruction in their offices to be particular in advising promptly all appointments and changes of mining managers.

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.

ANNUAL REPORTS OF THE INSPECTORS OF MINES.

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

IN submitting my Annual Report, I will take the liberty of curtailing it as much as possible. Mr. Twelvetrees, Government Geologist, having just completed a lengthy inspection of this Western District, I feel sure he will be giving a most exhaustive report on same.

Accidents :—I am pleased to state that the accident list is far less than on the previous year, being 6 fatal and 11 injured, as against 8 fatal and 12 injured.

Ropes and Cages.—Ropes and Cages have been attended, and, where necessary, either repaired or condemned.

Ventilation.—Ventilation of our mines is, on the whole, good, but as sinking goes on, and deeper levels get opened up, this matter will require more attention. During the year we had a visit from a number of delegates from various branches of the A.M.A. in Victoria, when the subject of ventilation was well discussed.

Magazines.—A Public Magazine is badly required at Gormanston ; explosives are at present stored in a damp tunnel ; this has a tendency to damage the article, and increase the danger of using it.

Legal Proceedings.—Legal proceedings were taken in two instances :—one against a packer for carrying explosives without a permit : the other was against a mining manager for carelessness, whereby a miner lost his leg ; in both cases a verdict was obtained against the defendant.

Prospects of the District.—Although the statistics will show a considerable improvement on any previous year, I feel confident that the coming year will be far and away ahead of this one.

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

I have the honour to submit my Annual Report as Inspector of Mines for the Northern and Eastern Mining Districts to 30th June of the current year.

Accidents.—I am glad to report that the accident list is not a large one, only six being reported for the year, one fatal and five non-fatal. Of the men injured, two were Europeans, and two Chinese. The fatal accident was to a Chinaman, named Ah Chee, whose death was caused by a fall of earth while working in an open-cut face at the M'Gregor Tin Mine. Of the non-serious accidents a Chinaman received slight injuries through being partly covered by a fall of loose earth at the Weld River Tin Mine. Thomas Ward was working in a surface adit at the New Golden Gate Mine when a lump of sandstone, feathered to a thin edge, fell from the roof, striking him on the side and ankle—injuries not serious. A boy, while feeding a battery, inadvertently put his hand on a stamper shank, and had his fingers badly lacerated by being caught by the cam. At the Tasmanian Gold Mine a lad, while oiling the skip-bob, stretched across the winding-shaft, and was jammed by the descending cage, sustaining a cut on the head and bruises. At the same mine a surface driver had his leg broken through being jammed by some timber he was drawing. Of the foregoing accidents, one may be said to be unavoidable ; the other three were caused through the incautiousness of the injured men themselves.

Inspection.—During the year the whole of the underground mines in these districts, as also all deep-faced open-cut mines, have been inspected at regular intervals, special visits being made when occasion required. Only a few complaints have been received, some of which were of a frivolous nature. One, however, was well grounded, the cause being defective ventilation ; and this matter was investigated and remedied, so far as the Inspector, under our present Act, has power to interfere.

Equipment.—The mines generally are well equipped with hauling machinery and safety appliances. Ropes and chains have been tested and inspected, several of the former being condemned. One old working shaft of a depth of 230 feet, and from which men were employed crosscutting, had to be condemned as unsafe, owing to the very decayed state of the case-lining and centres. It was also found necessary, in another instance, to condemn the poppet-heads of a shaft, 200 feet in depth, as these were of insufficient height and structure for safe working.

Explosives —There is less cause for complaint in the storing and handling of explosives than hitherto ; still there is yet room for improvement. If the miners generally would only take the trouble to read the printed rules posted at the mines for their guidance, the Inspector would not be so often met with the lame excuse : "I did not know it was wrong."

Ventilation.—The ventilation of the majority of the mines is good. This is effected generally by natural means, and without requiring any additional outlay on the part of the owners of the mines. There are some, however, where ventilating by natural means is not successful, and where the owners show a disinclination to improve matters by artificial means. The requirements of our Mining Act, as per Section 102, Subsection 1., referring to ventilation, are insufficient, and I would respectfully suggest that further enactment is required in this direction. It should be clearly defined what is meant by "an adequate amount of ventilation." If the quantity of air in cubic feet per minute required to be supplied to each man and boy and for each horse employed in a mine is defined, and the Inspector is equipped with an anemometer, or instrument for measuring the velocity of the air passing in the drives and levels of such mine, then the enforcement of compliance with the Act and Regulations can be carried out. As matters stand at present, I must confess that I see no way of compelling mine-owners to improve the ventilation of their mines, no matter however great the necessity for doing so may be. That there is urgent need for improvement in many of our mines at the present time can be shown beyond doubt.

The Victorian Mining Act of 1897 provides (under General Rules) :—" 1. An adequate amount of ventilation : that is to say, not less than *one hundred cubic feet* of air per minute for each man and boy, and 150 cubic feet per minute for each horse, employed underground in a mine, excepting in cases where noxious gases exist to a

dangerous degree, when the quantity of air required shall be increased to five hundred cubic feet respectively, shall be constantly produced in every mine to such an extent that the shafts, winzes, levels, and underground stables and working shall be in a fit state for working and passing therein." The investigations of the "Mine Ventilation Bonus Board" of that Colony go to show that not even one-fourth of the quantity of air as required by the Act quoted was found to circulate in some of the mines there.

The tin-mining industry in these districts has not made such rapid progress as might reasonably be expected, considering that the price of the metal in the English market has been maintained for nearly the whole year at figures ranging from £130 to £145 per ton; only once, and that for a very brief period, did the price recede to £103 per ton.

Derby.

Two of the big mines, the Briseis and Bros. Home Extended, have passed into the hands of new companies during the year. The change of ownership of the Briseis took place in December last, since which time development work required to open up the mine for working on an extensive scale has been carried on. To facilitate the getting rid of the over-burden, a tunnel is being driven through the hard granite for a distance of 800 feet from the Cascade River: this will tap the tin drift deposit some few feet below the basaltic overburden. The survey of a head-race, 21 miles in length, to bring in a supply of water from the Ringarooma River, somewhere about the junction, with its confluent, the Maurice, has just been finished. It is anticipated that a minimum supply of 60 heads of water will be derived from this source. Electric lighting for the whole of the mine and workings is already provided, and work will be carried on continuously. Mr. Edgar Rickard, late of "Cripple Creek," California, is the Mine Manager, Mr. Ferd. Kayser, of Mt. Bischoff, acting as General Manager to the Company. The Old Brothers' Home (Krushka's) Tin Mine has been purchased by the "Briseis Mines, Limited," for £35,000. The old workings at this mine afford a good approach, at the lowest possible level, to the Briseis Mine.

New Bros. Home No. 1.—Little or no work has been done here for the past six months. The mine is under option for sale to an English company.

Bros. Home Extended.—This mine was recently sold to an English company for £14,000, and active operations are to be commenced on arrival of Mr. T. H. H. Clouston, to whom the management of the mine is entrusted. Good tin is known to exist in the "Triangle," portion of this mine; however, as the mine is to be worked in a northerly direction, which means working down the gutter of the deep lead with an ever-increasing overburden to contend with, the chances of success are not very great.

Branxholm.

Arba Tin Mine.—Arrangements have been made to work this mine by means of an inclined tramway, at the lower end of which are constructed large bins to receive the sand and gravel sluiced down in the ordinary way by means of a hydrant. The trucks are so constructed, in cylindrical shape, as to retain their contents of sludgy tin drift and gravel while being hauled up the incline, which rises at an angle of about 40° from the horizontal. The filling of the trucks from the bins below, and discharge of their contents into the sluices at the top of the incline, are effected with a minimum of labour. The greater portion of the overburden of this mine can be sluiced off in the ordinary way by gravitation. A fairly good (in winter time, very good) water supply is obtained by means of a substantial head-race of seven miles length from the Dorset River.

Pioneer.

Pioneer Tin Mine.—This well-known old mine is being reopened and worked by the present proprietors, who purchased from the original company, after obtaining an option to prospect, which was carried out by means of boring, and has revealed the existance of a rich tin lead—probably the original channel of the Wyniford River—trending in a westerly and north-westerly direction to junction with the Ringarooma deep lead from Derby. The average depth of the ground to be worked (a very large area), as proved by 38 bores, is 55 feet; greatest depth 88 feet. The sand-pump in use is an 11-inch centrifugal, with 12¼-inch delivery pipe; suction, about 15 feet; uptake, 28 feet, worked by steam-power. The breaking-down nozzle, when the pipe (26-inch diameter) is extended to the top of the hill, will have a pressure head of 230 feet. Total pipe length, 1600 feet. The present supply of water is obtained from the Wyniford River. The main supply, however, will be obtained from the Weld and Frome rivers, and brought on to the mine by several miles of race, contouring the hills to the south of the Ringarooma, to a point about one and a half miles from the mine; thence by 3000 feet of syphon-pipe (19-inch diameter) to north side of river, where a half-mile of race will connect it with pipe to breaking-down nozzle already referred to. The company has already done a considerable amount of preliminary work, and are now enabled to commence tin-getting with the supply of water available, the construction of the main race to go on at same time. The opening up of this mine is being carried out in an intelligent and systematic manner; that, taken in conjunction with the evidently rich nature of the tin drift deposit, augurs will for its future success as a tin producer.

Weldborough.

Frome River Tin Mine.—About a year ago this property was purchased from Mr. Sharpe by a Melbourne company. The machinery of the Appalachian Tin Mine, consisting of a 10-head battery Pelton wheel, jiggers, vanners, &c., was secured by the new company, and removed and erected at the beginning of this year. The tin-bearing rock to be operated on is like the Anchor and other lode ore formations in the vicinity of Blue Tier—extensive, but not to say rich in tin. Operations, so far, have not been very successful. The means of getting the stuff from the open-cut face to the battery is by a tramway. 30 chains in length; nearly half of this is a self-acting incline, the balance rising in two steps of about 16 feet each, the line from the top of No. 2 hopper running horizontally to the working-level of face. It is now found that this latter portion of the tram, about 8 chains, is altogether too high for the working of the best tin rock, and, as a consequence, the mine is sorely hampered in the transit of the stuff to the battery. The machinery is worked by two Pelton water-wheels, operated on by 8 heads of water from a height of 72 feet.

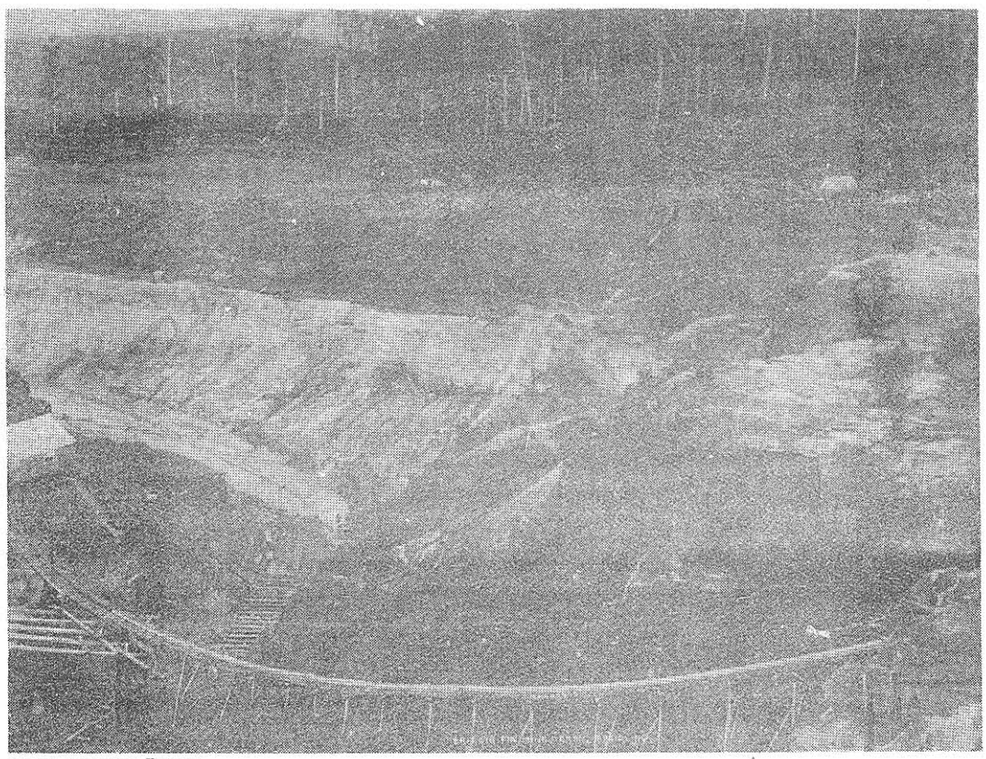


Photo-Algraphy Process.

BRIESIS TIN MINE, DERBY

Lottah.

The Australian Mine has, owing to its motive power being steam, been able to maintain a regular output since January. The stone has improved in richness and extent. It is a pity the battery is not below instead of being above the level of the open-cut face.

The Anchor Tin Mine.—Scarcity of water from January to June has made things slow at this mine. The average number of stamps running during the three months to 2nd of June was 20; total number of tons crushed in 14 weeks, 6746, which yielded an average of 9 lbs. of tin ore to the ton of stone crushed. The survey of the head-race to bring water from the Columbia Falls, George's River, has been completed, and a commencement was made to construct the channel; this, however, is not progressing favourably, and for certain reasons work on the race has been suspended. The future success of the Anchor Mine depends solely on a good and sufficient water supply being obtained at a sufficient elevation to ensure the continuous running of the 100-head battery. All this can be obtained from the above source if only reasonable engineering skill be applied to the construction of the water-race; failing this, the prospects of a mine capable of being developed into a dividend-paying concern will be jeopardised.

Tin Smelter.—The erection of a tin smelting-plant for this company is now being carried out at St. Helens, on a site fronting on deep water. The stack, 75 feet in height, is being constructed for two furnaces, should the need for two be required; for the present, however, only one furnace will be erected, which, when in full work, will be capable of treating 35 tons of ore per week, including a second, of slag. A first-class assay office, fitted with the most modern improvements, in which assays and analyses for the public can be made, if desired, is nearing completion. There are also substantial buildings for blacksmith's shop and three-stalled stable in course of erection; the whole of the work being carried out under the management and supervision of Mr. E. W. Woodgate, formerly assayer for the Mount Bischoff Company, and more recently manager and chemist for the "Jingera Bismuth Mines," owned by Eliot Bros., Limited, of Sydney. The opening of this smelting works is looked forward to with interest by the tin miners of the Coast, as a means of obtaining fuller values for their tin.

Liberator Tin Mine.—This mine is working, but progress is slow, owing to the want of water. The ore-body is improving, and the company has now decided to construct about seven miles of head-race to bring water from a creek estimated to give a sufficient supply to work the 20-head battery and dressing plant.

With regard to the small alluvial tin mines in the district, much hardship has been felt by many of the owners and tributors, owing to the scarcity of water, the dry season continuing up to the middle of June.

Scamander.—Not much doing in this locality. Some ground has been taken up and worked for tin, but he results are not very satisfactory. The Eastern Proprietary Copper Mine will be reopened and further prospected by the new owners.

Coal Mines.

The Mt. Nicholas Colliery is still working on the old 4-ft. seam, out north and west. Sandstone has taken the place of an inferior seam of coal which for so long a time formed the roof of the long-wall workings; this is by no means an improvement, as it makes the working more difficult. The country in the north-eastern part of the mine is badly faulted, so much so that working the seam in this direction became unprofitable. The main heading is now being extended to test the nature of the country ahead. The 6-feet seam, 20 feet or so above the 4-feet, is also being worked. Preparations are being made to do the hauling by steam-power; an engine is already on the ground, and will be applied to haul, by means of head and tail ropes, over a distance of 1700 yards from the north-west part of the 4-feet seam. The daily output of coal at the present time is about 70 tons; 60 men are employed. The ventilation of this mine is not as good as it should be.

Cornwall Colliery.—This mine is being opened up at new or western workings in a thoroughly systematic way. The down-throw faults, a succession of which were encountered at the outset, are now passed, and the country seems more settled. The engine tram-line, between the entrance of the main tunnel and the top of the self-acting incline, is being altered and improved; some of the quick curves will be eased off. The mine is in good order throughout.

Mangana Gold Reefs, Limited.—The shaft is now down 423 feet. No. 5 level opened at 409 feet; crosscut extended 66 feet from shaft; about 34 feet to go to cut lode. Length of crosscut at No. 4 level, 55 feet; drive north on lode at same level, 100 feet; lode channel, 5 feet wide, partly filled with mullock; some good clean quartz to be seen at this point, carrying gold; a rise is being put up to test lode overhead. Underlie of lode to east, $2\frac{1}{2}$ horizontal to 6 vertical. Mine and machinery in good order. There appears to be a better time coming for this mine.

Golden Stone Company (Goodall's new find).—On hill to east of Mangana Gold Reefs Mine. About 15 inches thickness of quartz showing in trenches at top of hill; underlie to east. Outcrop of reef traced further south, showing 6 to 9 inches of stone. The prospects of gold said to be obtained from this reef are excellent; the work done so far, however, is merely surface-scratching. The very steep hillsides afford great facilities for working by tunnelling. The property has recently been purchased from the prospectors by a Melbourne company, of which Mr. J. P. Madden, 320, Collins-street, is legal manager.

Mathinna.

New Golden Gate.—Alterations and improvements to the plant and general equipment of this mine have been made during the year. A new boiler, 26ft. by 6ft. 6in., mild steel $\frac{9}{16}$-in. plates, 9 Galloway tubes, tested to 240 lbs. to the inch, have been obtained, and fixed in position to connect with the winding-engine. This necessitated the building of a new stack in an altered position to where the old one stood, thus giving more room about the poppet-heads and brace of shaft, and also improving position of boiler to engine-room. Two new $1\frac{1}{4}$-in. diam. wire ropes were put on to replace the old ones in May of this year. These ropes, each 2200 feet in length, are composed of six strands, each seven wires, made of Black Langley improved, mild, plough-steel, with hemp hearting; weight of each rope, 30 cwts. 3 qrs. 10 lbs.; cost, 50*s.* per cwt. The old ropes replaced were in constant use for four years, strands or wires worn quite thin before breaking. Both old and new ropes made by Bullivant. The main shaft has been sunk to a further depth of over 100 feet, and plats cut at the 1400-feet level. Cyanide plant.—Additions have been made to this in the shape of four large agitating vats, each 15 feet in diameter by 6 feet depth. These are so arranged as to catch the over-

flow slimes from the ordinary cyanide vats. The agitation is effected by horizontal arms, attached to a vertical shaft, in the centre of each vat, and rotated by means of rope gearing from underneath, the motive power being compressed air. The mixing of the slimes with the cyanide solution in this way appears to be very effective. Values of slimes treated, as follows:—Assay, before treatment, from 4 dwts.; after, from 15 to 19 grains; which shows about five-sixths of the gold contents of the slimes saved by the process. The whole of the mine machinery and workings are in good order, all reasonable precautions being taken for the safety of the men employed.

Hickson's Gold Mine.—The shaft is now down 200 feet. The machinery recently erected consists of a double-action 5½-in. plunger-pump, vertical boiler, and 10-in. cylinder-engine. The old 6-head battery has been removed from "O'Brien's," and is being re-erected on the mine. Haulage is by means of a steam-winch, one cage only being used, to which safety gearing is attached. The poppet-heads are of insufficient height and strength for safe working; pit-head pullies are also too small. I have, therefore, ordered that these be replaced by a more substantial structure.

Davern's Claim.—This is situated two miles to the north of Hickson's, or, say, 10 miles from Mathinna. A 10-head battery is in course of erection at the foot of the hill. Preparations are also being made for the construction of an aërial tram, to bring the stone down from the adit driven on the course of the lode; the difference of level between mine and mill is something like 800 feet. The tram-line will be a half-mile in length. It would seem that the erection of battery and tramway is premature in this instance, so little having been done to prove the value of the lode. An old adit, driven some years ago, has been extended a little further of late; the quartz, varying from 6 to 18 inches in thickness, is said to be rich in gold. One favourable feature is the presence of a soft black slate in conjunction with the lode. This is preferred as against the short-grained sandstone of the surrounding country. Davern is certainly deserving of success for his pluck and enterprise.

New City of Melbourne.—Now working "Old Golden Stairs" section, Mathinna. Shaft down 33 feet on lode, 5 feet in thickness; about 2 feet of this is clean solid stone, about 18 feet driven on lode. The old shaft is 230 feet in depth. Present works, on new make of stone, said to be better than anything previously worked on the mine.

Salmon Gold Syndicate (Miami).—A 10-head battery, to be driven by a 14-horse portable engine, has been erected for some time, but crushing could not be commenced owing to the scarcity of water. Late rains have started the creek running at the head, but the water has not yet reached the dam. A large sum of money has been expended in opening up this mine, by surface adits down to 200 feet, and by shaft and winze for an additional depth of 200 feet. Some really good stone has been obtained from the upper adit levels, and a large quantity is now at grass ready for crushing when water is plentiful. Very little work is being done in the mine at present.

Ben Lomond.

Tasmanian Ben Lomond Tungsten Mine (Storey's Creek).—The plant consists of a 10-horse engine, Hope stone-breaker; also, 3-screen trommel, two classifiers, and four jiggers. Four samples of ore are produced, from very coarse to fine; the latter carries a little fine tin. The process is scarcely satisfactory; the stone-crusher is not suitable for first reduction, and there is a loss of ore through particles adhering to the matrix. Rollers would be more suitable for reducing this stuff. Some miles further west there is, on Gipp's Creek, another Tungsten lode now being opened up and worked by the Ben Lomond Tungsten Co. (head office, 31, Queen-street, Melbourne). The ore is in quartz, same as the lode at Storey's Creek. The lode is flat, dipping at an angle of 16° from the horizontal; it averages about 2 ft. 6 in. in thickness, and is rich in tungsten ore. The mode of working, so far, is by open cut, following the lode down from the outcrop. There is, however, a limit to this, as, even with a dip of only 16° from the horizontal, the overburden will soon become too heavy to remove from so small an ore-body. Machinery—stone-crusher, classifiers, and a Wilfley concentrator—is being constructed to treat the stuff.

In addition to the two mines mentioned, there is yet another tungsten company, "The Baden-Powell," about to commence operations on a new find, situated about seven miles S.S.W. from St. Helens township, or 25 miles from the Ben Lomond mines.

Mount Rex Tin Mine.—A main working shaft 12 ft. by 4 ft. is being sunk in hard granite, 80 ft. east of the big lode chamber. Taking underlie of eastern hanging wall of main ore-body, the shaft will have to be sunk to a depth of 230 feet from the surface before touching the lode; the first plat will be cut at 100 feet, a crosscut from this will cut the ore-body 50 feet below the bottom of the big chamber. Plant—A 20-head battery and concentrating machinery same as the Anchor Company's plant, is to be erected, also calcining ovens for roasting the ore after first concentration, and, before it is finally passed over, finishing vanners, or Wilfley tables. The battery and concentrating plant will be driven by Pelton wheels under a water pressure of 300 feet head. For winding, an 18-horse steam-engine will be employed. A large conserving dam is in course of construction on "Egan's Creek," a little way above its junction with "Buffalo Creek." The height of this dam, when finished, will be 45 feet above the creek bed; length over top, 1300 feet. The structure is coffer, back and front, each having timber walls of large logs bolted to the bed-rock, each successive layer being bolted with 1¼-in. round iron to the one beneath it. These coffers, having a space between their timbers, at bases, of about 22 feet each, are filled in with stone. The hearting between the coffers is of earth and clay, filled in in regular layers, and well consolidated by hand-ramming and traffic of drays. The site for storing water is first-class, as, above the dam, the creek banks are low, opening out on either side into flat country known as the "Ben Lomond Marshes." The fall on the creek for 30 chains above the dam is 13 feet, so that when the dam is filled, to say 40 feet at the embankment, the water will be thrown back for over a mile. A dam will also be erected on "Buffalo Creek" in line with, and only a few chains distant from, the first-described; this work will be necessary, as the water, when backed up to a certain height on "Egan's Creek," will flow across a low saddle into the Buffalo. A head race four miles in length, graded to 10 feet fall per mile, and with a sectional area equal to 5¼ square feet, is being constructed to bring the water from the dam to the mine at an elevation of 300 feet above the battery site. This company, by the means employed, is opening up and equipping what promises to be one of the best tin-lode mines in the Colonies.

South Esk Tin-Mining Co. (Gilligan's Flat).—This mine comprises an extensive flat on the north bank of South Esk River, about 3 miles above Avoca. The

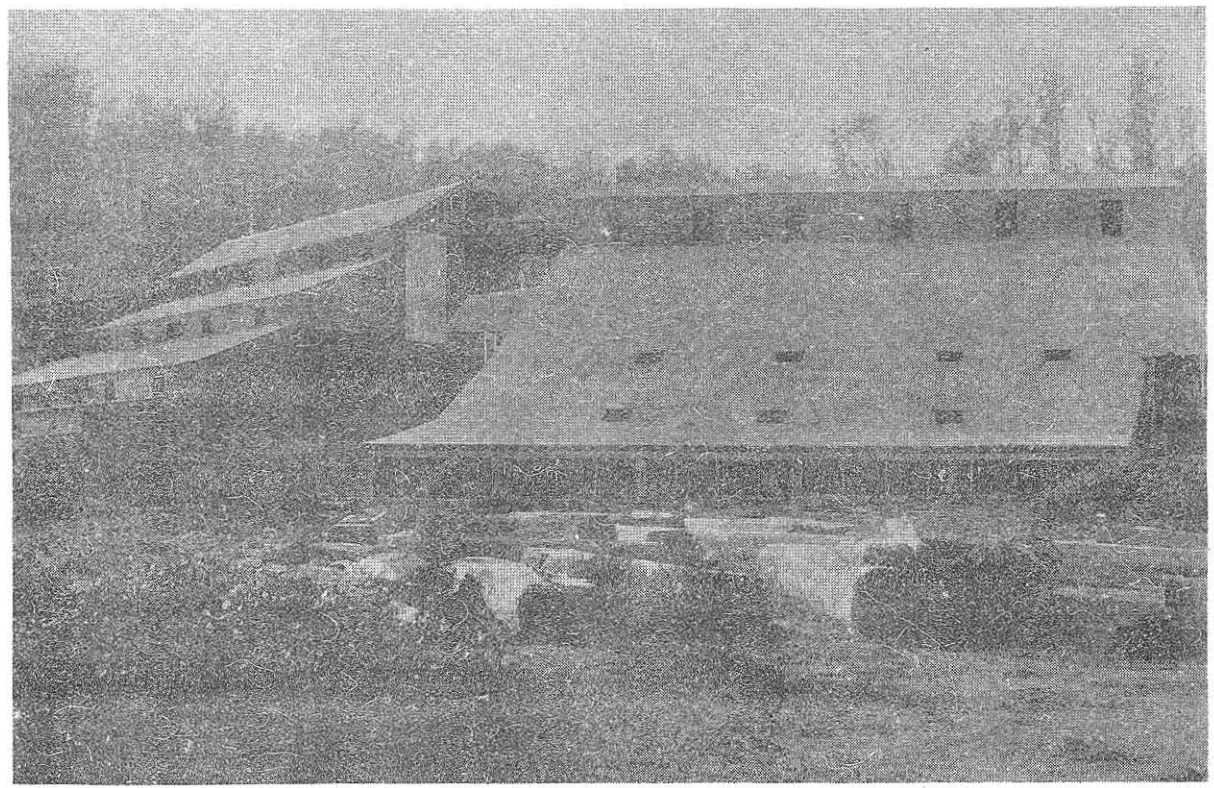


Photo-Algraphy Process.

ANCHOR CO.'S BATTERY SHEDS, BLUE TIER

depth of wash is about 7 feet, with a stripping or overburden of 20 feet of sandy loam, which is being removed by means of a "blower," or hydraulic elevator. The water supply is obtained from Storey's Creek, and gives a head at the mine of 150 feet. Twice this head or pressure is required, and could be obtained, for removing the overburden in the most expeditious way. The prospects of tin ore obtainable from the wash already exposed are really good, and this mine should, when thoroughly opened up, prove a dividend-paying concern. It is the first to commence sluicing into the South Esk River; others will no doubt follow suit, unless prohibited from doing so by the Government. The putting of sand and gravel in large quantities into a river like the Esk, traversing, as it does, from Avoca, over 60 miles of grazing and agricultural lands, is bound to be fraught with bad results. I would, therefore, respectfully suggest that the sluicing of sand and gravel into this river be not allowed. Owners of sluicing claims can, without any great additional expense, arrange to stack the heavy stuff on their claims, or on easements secured for the purpose. The dirty water may be allowed to pass into the river, as the fine silt it carries in suspension would, in all probability, settle in the long reaches of the stream, and if subsequently forced out by flood on to adjacent flats, would not do any harm, as silt from alluvial workings is not a bad fertilizer. It is not so many years since the heavy gravels and tailings from all the alluvial mines on the "Coast" had to be stacked and kept within the bounds of the claims they were taken from.

Beaconsfield.

Tasmania Gold Mine.—Mine and workings generally in good order; tested safety cages; those at main shaft did not work satisfactorily, and were ordered to be replaced by spare one on hand. Cages at Florence, also at new shaft, in good working order; ventilation in western part of mine is not as good as it ought to be, especially so between the 400 and 600 feet levels. The temperature in this pyritic portion of the mine is generally high, but could be greatly improved by proper bratticing to regulate the air current circulating between the Florence and Venus shafts at the 400-feet level.

Tasmania United.—Shaft down 150 feet; crosscut extended 106 feet; lode not yet cut; steam-winding plant; twisting with bucket; no safety cage; ladderway in good order.

Tasmania West Extended.—Shaft (10′ × 4′) down 184 feet; winding by means of steam winch; shaft being cut down to make room for pump (9-inch plunge and draw-lift) to be placed in position soon. A stationary boiler, and 25 horse-power engine are being fitted up for pumping. Workings in good order.

Moonlight-Cum Wonder.—Shaft down 500 feet; sinking still going on to reach a depth of 700 feet. New poppet-heads erected, also engine-house and steam-winding engine; everything in good order. This company is making a move in the right direction, as the general opinion expressed by those competent to judge is that deep sinking, 700 or 800 feet at least, is the only hope for outside shows at Beaconsfield.

Amalgamated West Tasmania.—Shaft down 375 feet; drive from level at 360 feet, 39 feet; hauling by means of horse whim; ladderway in good order; explosives found in blacksmith's shop, otherwise, nothing to complain of.

North Tasmania Gold Mine, also *Australasian Asbestos Mine.*—Visited in June; no work doing at either place at that particular time.

Lefroy.

New Pinafore Gold Mine.—Government aid, under "The Deep Sinking Encouragement Act, 1899," on the £ for £ principle, was obtained by this company at the beginning of May of this year, to enable it to further prospect the lodes north and south of the 1200-feet level. A crosscut, 777 feet in a northerly direction, was already extended to cut the "Chums" line of reefs. Four small reefs were passed through, and No. 5 cut at the above distance; the lode-matter of this latter, consisting of about two feet of fairly clean quartz on the footwall, the remainder being strings of quartz and very hard country-rock. Fourteen feet further driving failed to reach hanging-wall. On the south side of shaft a crosscut was extended 190 feet. At 176 feet the Pinafore North reef was cut and driven on 136 feet easterly; there is about two feet thickness of quartz. Driving on both this and the No. 5 reef (east and west on each) has been carried on under the aid obtained, but without payable results, so far.

White Pinafore.—Tested safety cages in June, found same in good order; other works satisfactory; stoping between lower and intermediate levels being carried on.

New Monarch Gold Mine.—Inspected 4th May; found everything in good order; test of safety-cage satisfactory.

Alberton.

Ringarooma Gold Mine.—The new electric pumping and winding plant, contracted for by Edge and Edge, Electrical Engineers, of Sydney, was started at the beginning of this year, and is working satisfactorily. The motor attached to the winding drum is "Series wound," constructed for 440 volts pressure, and of ample capacity for hauling 1½ tons at rate of 150 feet per minute. The pump motor is 17½ B.H. power; when supplied with 440 volts pressure it will have a speed of 710 revolutions, reduced by spur-wheel gearing to 16 revolutions at crank. Both motors are fitted with automatic switches to prevent damage at any time should circuit become broken, the switch returning to its starting position. The bare copper wire from the generator to the entrance to the tunnel (about one-third of a mile) is supported on poles, in fluid insulators. The shaft down on "Gum-sucker" lode from chamber at inner end of long tunnel is about 70 feet deep, and is, therefore, not sufficient to test the pumping or winding plant to its full capacity. The objectionable feature in the pumping motor is the gearing down by spur wheels, the wear on which is considerable. The winding gear seems good enough for shallow workings, but 150 feet per minute is rather slow. Very little work has been done on the mine for several months prior to the first of June, as there was not enough water to work the batteries, especially the one at the New River portion of the mine.

Central Ringarooma.—Progress on this mine has been rather slow of late, owing to the difficulty of getting the stone crushed at the Ringarooma (New River) battery. Great difficulty is experienced in following the lode on account of the country being so badly faulted; the stone obtained, however, is giving good results, and this compensates for other drawbacks.

Dredging for Tin.—I am sorry to say this has not been a success so far. The dredge at Derby is still stuck in the river, and likely to remain so.

The Ringarooma Dredging Plant is also idle. The failure of this is, in a great measure, due to the unsuitableness of the appliances for saving tin; the ground is not rich, but could be made to pay, if worked with proper appliances.

REPORTS OF THE COMMISSIONERS.

Mr. Commissioner GLOVER (Launceston) reports :—

I HAVE the honour to report the principal events which have occurred on the Northern Mining Fields for the twelve months ended 30th June, 1900.

At Beaconsfield the chief mining industry has continued to be confined within the boundaries of the Tasmania Mine, although persistent efforts have been carried on, in two small undertakings, to discover the celebrated reef outside those boundaries. One of these operations was a new undertaking, with Victorian capital ; the other, a renewed effort which had been in operation for several years, but suspended at intervals. Up to the present no success has attended these labours. The four other mining industries at Beaconsfield have continued to prosecute their work with more or less activity throughout the year, but without result. One, known as North Tasmania, the developments in which have revealed copper and silver as well as gold, has been devoting its labours to prospecting the lode at the depth attained, namely, 500 feet from the surface. My last annual report recorded the inception of an Australian enterprise to deal with the large deposits of asbestos, near Beaconsfield. Great interest was excited therein, as an undertaking likely to develop an important and lucrative industry. But nothing, practically, has been accomplished on the ground, with the exception of some few hundred tons of the mineral being excavated, and sent to Australia for a test. It was reported that the management was engaged in the endeavour to establish markets for the product in America and Europe, but the real position and prospects of the undertaking cannot be ascertained locally, and there have been, generally, only two men on site. The great demand for iron now prevailing, together with the example of the great iron-producing enterprise recently commenced at the Blythe River, N.W. Coast, during the latter part of the past year, is likely to cause effectual means at length to be taken to renew the long-dormant enterprise in that direction, at Ilfracombe, near Beaconsfield, where iron of highly valuable quality was, some 20 years ago, the subject of mining activity. A very large expenditure was then incurred, but the project, as is well known, failed through the then insurmountable chemical difficulty, which has since been overcome by science. There are now four several associations, representing several mineral leases at Ilfracombe, which are making arrangements to commence operations. The Blythe River project will doubtless prove an example of success, as well as of enterprise, seeing that it is possessed of the *sine qua non* in all mining efforts, namely, ample pecuniary resources, with a working capital of £30,000 in cash deposited, with £200,000 available for railway and other appliances of future requirement. The quantity of gold yielded by Lefroy for the year was 30,336 ounces, value £114,082.

The cloud of depression, which has hung over Lefroy ever since "calls" have been substituted for dividends in the three principal mines, has been somewhat lightened by the discovery of a reef, now known as the "White Pinafore," small crushings from which have assayed about an ounce to the ton, realising over £800. On this new mine work is proceeding actively, and with justifiable hope. The mine on the New Pinafore reef, which some time ago abandoned further sinking, has confined its operations to prospecting at the depth attained—1200 feet from the surface, having the aid of the gold recovered from the battery tailings of various mines of the past, by the cyanide process, which has yielded from 60 to 70 ounces per month. The assistance of the Parliamentary vote in aid of deep mining, about to be availed of by this company, affords another source of hope for the future of Lefroy, considering the magnitude of the interests depending on the discovery of payable yields of gold at greater depths in the several mines at Lefroy, which failed at less than 400 feet in depth. The party of Queensland miners who, some two years ago, engaged in the project of recovering the fine gold from the sand tailings accumulated on Crown land, at Sludge Creek, from the operations of several mines for many years, have continued their labours with fair success. There are but few prospectors on the Lefroy field, which, including the Back Creek region, is almost unprospected. At the old worked-out alluvial field of Lisle, in addition to the average of 40 diggers who continue by that employment to supplement their income from small cultivation, certain associations have been making arrangements for entering on the pursuit of dredging for gold on humid localities at Lisle, but they are still in the preparatory state.

At Middlesex Plains, &c., though there are several prospectors engaged, there is scarcely any alluvial gold-digging carried on. The operation of principal consequence is at the Upper Forth River, where the bismuth and tin mine, known as Shepherd and Murphy's claim, is situate. Since the recent construction of a practicable track to the locality, the necessary machinery has been introduced and erected on this mine, and ore-dressing operations are commenced. The lode contains, according to assays, 15 per cent. bismuth, 40 per cen. tin, and 10 per cent. tungstic acid. The other two mines have been inoperative, awaiting the construction of the said road, and the results of the operations mentioned.

Mr. Commissioner O'REILLY (Scottsdale), reports :—

I HAVE the honour to submit my report for the year ending 30th June, 1900, upon the state of mining in the North Eastern Mining District.

GOLD.

At Mount Victoria the prospects of several of the principal claims continue satisfactory, and although there has not been any increase in the quantity of gold won as compared with the previous year, a good deal of *bonâ fide* development work has been done of a substantial character. For a period of five months since the new year, mining operations have been generally retarded through the absence of water supply for the batteries, consequent upon the unusually dry season experienced, and this necessitated an almost total suspension of crushing operations, and also, in a large measure, caused a reduction in the number of men employed during that period, as also of the quantity of gold won. The recent rains have now supplied sufficient water to enable crushing operations to be resumed, and as a large quantity of

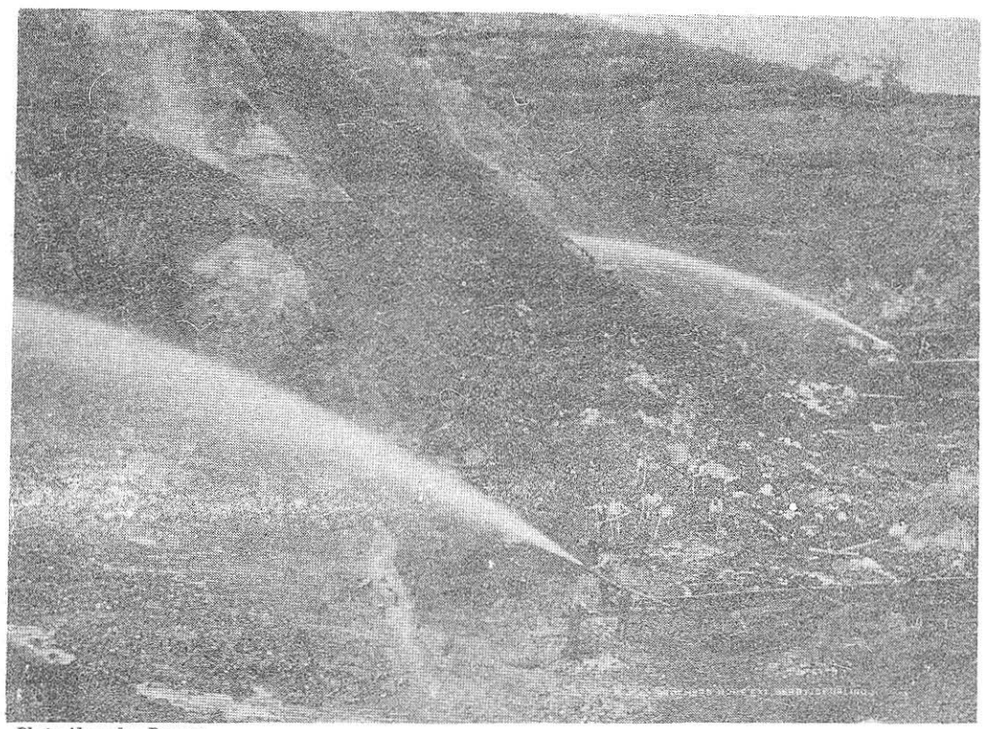


Photo-Algraphy Process.

BROTHERS' HOME EXTENDED TIN MINE, DERBY

stone has been raised during the dry period, and ready for crushing, a large increase in the quantity of gold produced may be looked for.

The Ringarooma Gold Mining Company has furnished its battery at this mine with the most modern appliances for saving gold, and electricity is provided for lighting the battery and mine, and also for driving power in connection with the working of the mine. This company's mine at New River continues to be developed in a satisfactory manner, a good deal of substantial preparatory work having been done, and the returns from crushings having proved payable.

The prospects of the Central Ringarooma Company's mine appear very encouraging, and the returns from crushings have proved very satisfactory so far, being sufficient to enable the development work of the mine to be continued without additional capital being subscribed. Good and substantial work is being done on the mine under an able and experienced mine manager, and enlarged operations are proposed to be entered on for the purpose of opening up the mine. There are also other claims doing fairly well, and new ground being prospected.

At New River alluvial gold-mining has been continued, with satisfactory returns, about 14 men being employed by one claimholder.

Very little has been done on the Warrentinna goldfield since my last annual report. I am informed that mining operations are about being resumed on a few of the principal claims there.

Tin.

In the Ringarooma locality and Cascade there is a considerable number of tin claims held under Miners' Rights, the holders of which are obtaining satisfactory returns for their labour in mining them; also at Mount Maurice. In this locality there are several Miners' Right and leasehold claims being mined for tin.

Much enterprise is exhibited in prospecting a lode formation in the neighbourhood of Ringarooma of considerable width, samples from which have been analysed by a competent analyst, who has reported them to contain gold, silver, tin, and copper in the same lode or formation. He considers the prospect very encouraging, and recommends a further expenditure in opening up the lode. A small battery is to be erected on this claim for crushing purposes and to test the value of the formation as regards tin.

A considerable expenditure has been incurred by the Arba Tin Mining Co. at Branxholm, during the past year, in reconstructing water-races, constructing new head and tail races, and in removing a large quantity of the overburden on the tin deposit, and for which latter ample facilities are now afforded by a good supply of water. Machinery has also been erected for hauling up the tin-wash for treatment, steam being used for driving-power. Everything now appears to be almost complete for a commencement to raise tin-ore, and satisfactory returns of tin won should soon be looked for. Sixteen men have been employed on the works of the mine.

There are a number of small claims, held under lease, and also Miners' Rights, in the locality of Ruby Flat and the surrounding country, which are making good progress and obtaining profitable returns.

At Derby the purchase of the Briseis Company's mine, as also that of Messrs. Krushka Bros., at satisfactory prices to the vendors, by the Briseis Tin Mines, Limited, and the proposed large expenditure by the new proprietors in fully providing their mine with every requirement considered necessary to its profitable development, have given considerable impetus to mining in this district. Surveys have been effected for providing an additional supply of water from the upper part of the Ringarooma River, and also by the construction of large reservoirs, the latter being a most necessary work in connection with mining operations in this district, owing to the unusually dry seasons experienced of late years. A tunnel of about 800 feet in length, mostly through hard granite rock, is being constructed from the proposed workings on the mine to the Cascade River, which, when completed, will be used for sluicing through it the overburden, or wash-dirt. The mine is now provided with electric light, used for nightwork in the mine. It will require much time still to complete the proposed works to put the mine into a condition necessary for its being worked with economy. Eighty-three men are now employed on the works in connection with the mine.

The Tasmanian Dredging Company so far, has not been successful in getting the dredge on its claim in the Ringarooma River into working order. Many unforeseen difficulties have had to be contended with, and frequent alterations found necessary in machinery, &c. The prolonged very low state of the flow of water in the river has also much impeded progress of work.

The Brothers' Home Extended Company has disposed of its mining leases to an Edinburgh mining company at a satisfactory price. The purchasers propose working the mine on an extensive scale, and ample capital will be provided for that purpose. Water will be pumped by steam-power from the Ringarooma River for hydraulic mining purposes, and this water-supply, with that already available at high elevations by water-races, should enable a large quantity of stuff to be removed. Work has already commenced, making preparations for machinery and the construction of easements. The prospects of this mine are considered very good.

The Brothers' Home No. 1 Company has not carried on mining operations for some time, as, I understand, arrangements are being made to work the mine upon a more extensive scale, and for this purpose an additional water-supply is to be provided.

The mining town of Derby exhibits signs of marked improvement and prosperity in the erection of new and substantial buildings. Several new residences and places of business are in course of erection.

At Belmont, situate on the Cascade range of hills, between Derby and Ringarooma, a promising lode formation of considerable width is being prospected, and, so far, prospects appear very encouraging. A small battery and appliances are provided for crushing and treating the lode.

Other tin-lodes of much promise are known to exist along the Cascade range of hills, but there is a want of sufficient capital for their being properly prospected or mined.

In the locality of Moorina a good deal of activity prevails in carrying on mining operations, and the returns of tin ore raised are considered highly remunerative. Preparatory work is also being carried on on several of the large claims.

At Bradshaw's Creek, the Pioneer Tin Mining Company's leases have been thoroughly prospected in a systematic manner by boring-rods, experienced expert men, engaged in Victoria, being employed under the superintendence of a mining engineer. The result of these operations have proved the deep lead of tin ore to exist in payable quantities over a large extent of the

ground, which will take many years to exhaust, even under the extensive plan of mining operations proposed to be adopted. Preparatory work has been for some time actively carried on, machinery and mining plant being provided, and a new water-race is being now constructed to the mine from the Frome River, which, with other supplies from different sources, will afford an ample quantity of water for hydraulic mining on a large scale. When the preparatory work on this mine is completed a large output of tin ore may be looked for from it.

There are many small claims in full work at the Wyniford River, also South Mount Cameron and vicinity, which are yielding profitable returns.

A few months back, the Ringarooma Tin Dredging Company commenced dredging operations upon an extensive river flat near the Ringarooma River, in the locality of South Mount Cameron. As might be expected in starting a wholly new system of tin-mining by dredging, difficulties in the practical working of the machinery had to be contended with, and after several material alterations had been effected, it is gratifying now to learn that the dredge is working very well. The site in which dredging operations were commenced is situate on the outer border of the flat, where dredge was constructed, and where the ground is not so rich in tin deposit as other portions of this flat have been known to be on being previously prospected, but it is considered when the dredge works its way to the richer ground, that the returns of tin ore and gold won should prove remunerative. I have no doubt that a good deal still remains to be done towards making more perfect the appliances or machinery for saving the tin ore and alluvial gold. Most probably a more perfect system will be found in due time, when larger experience is obtained in the saving of those metals by this method of mining. The success of this venture would largely influence beneficially the prospects of mining in this district, as there are large areas of river flats containing deposits of tin ore of not sufficient richness to pay by the ordinary means of hydraulic mining, but which should produce profitable returns if mined in an economical system such as dredging is represented to afford. Too much praise cannot be tendered to this company for its spirited enterprise in undertaking, at a large cost, its mining venture, and it is deserving of every encouragement and best wishes for its success.

Beyond those claims supplied with water from the Mount Cameron Water Race, there are a large number of claims situate in the vicinity of Gladstone and Mount Cameron which depend alone upon a supply of storm water for carrying on mining operations. These claims have not been mined for many months through the absence of water-supply, but it is to be hoped that during the remaining winter and spring months there will be sufficient rainfall to provide an abundant supply of water for these mines. The high ground or terraces on the lower slopes of the Mount Cameron Range country are reported to be rich in tin deposit, but the present difficulty of obtaining water at a sufficiently high elevation renders mining operations there impracticable. There is a considerable extent of stanniferous ground in the locality of Mount Horror and also near Boobyalla river, which is being prospected. Several rich finds of tin deposit have been made, but there has not been sufficient work done to determine their value.

During the past year 865 tons 7 cwts. of tin ore have been forwarded from this district, the average number of men employed being 250 Europeans and 173 Chinese. This output, considering the scarcity of water experienced, and also that several of the large claims had suspended mining operations pending preparatory work being done, is very satisfactory.

On the whole, it appears to me that the prospects of this mining district have never been more promising than at the present time. A great deal of preparatory work is being done that may reasonably lead to large yields of tin ore being won from the deep leads known to exist, and the introduction of foreign capital for investment in this enterprise has given an impetus to the industry not before experienced since the early days of mining here.

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

Tin.

The last 12 months has been the driest year that has occurred for the last 20 years, which has retarded the raising of tin-ore throughout the whole district for the want of water. Our two largest companies, the Anchor and Australian, have not been able to work their full number of stampers, with the exception of the last month. The long drought now seems to be broken up. The companies are now working a full-head of stampers. The Ben Lomond and Avoca sections are looking promising, both as to tin and wolfram. Without being too sanguine, I believe this part of my district is coming to the fore. The high price of tin is causing prospecting to be actively carried on in several parts of the district, more especially with men holding Miner's Rights.

Gold.

The Golden Gate Mine at Mathinna still keeps going steadily along, and the yield of gold, both from the batteries and the cyanide process, I am informed, continues uniform and satisfactory. There is also a second company carrying on the cyanide process upon old tailings, with satisfactory results.

The Salmon Estate Company, situated on the road to Mathinna, commence crushing at once, so I shall soon be able to know with what result.

A new find of quartz has been found at Mangana, close to the township. The tests have proved satisfactory, and it is reported that the finders have sold their interests to a Melbourne syndicate.

Coal.

This industry has been for some time fully established. The quality of the coal keeps uniformly good, and the supply is equal to the demand.

Silver and Copper.

The Eastern Company on the Scamander has again commenced to further develop its ground for copper and silver. Several mining men from Victoria have been prospecting on the Scamander with very promising results, both as to copper and tin. Several sections have already been applied for.

The Echo Mines (H. Grant), has been floated in Melbourne into a company for £50,000. The Echo now consists of 2 sections of 80 acres in addition to Grant's 2 sections of 60 acres and 20 acres. I hear that mining operations are to commence at once.

In the vicinity of the Echo, about 5 miles from St. Helens, there are several wolfram shows that are now being prospected.

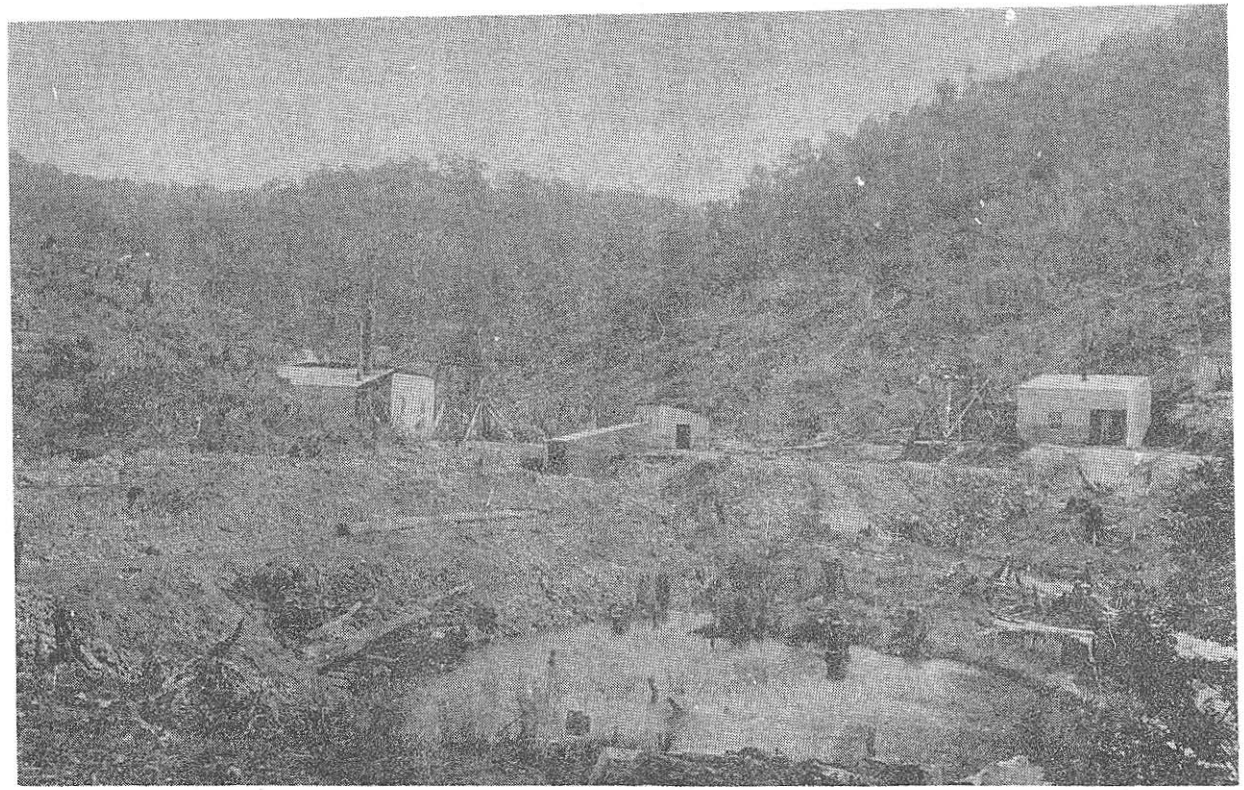


Photo-Algraphy Process.

ARGENT COMPANY ZEEHAN

Dredging.

Several sections have been taken up both above and below the bridge at George's Bay. The proprietors are making their arrangements for the necessary machinery to work these claims.

Smelting Works.

Close to the bridge at the bay, the Anchor Company is having extensive smelting works erected. The chimney, 75 feet high, is now finished, and also the test-house, and the main building is well forward. The whole is expected to be finished in about 6 weeks, ready for smelting.

After carefully considering *pros* and *cons* relating to the mining interest of this district, I am of opinion that matters are decidedly healthy in relation to legitimate mining. The days of bogus mining companies are past. All the mining ventures that are now being carried on in this district appear to me to be *bonâ fide*.

I am certain that financially the district is in a sounder tate than it has been for the last 20 years.

Note.—During the last month 380 acres of ground have been taken up between here and the Scamander, and 240 acres last month at the Blue Tier. Also fresh applications for gold, wolfram, and tin.

Mr. Commissioner Hall (Zeehan) reports :—

There has been a satisfactory increase in the amount and value of silver-lead ore raised in the district for the past twelve months, as compared with the previous year. For the year ending 30th June, 1899, 23,387 tons (value, approximately, £207,300) passed away from Zeehan railway station, while, for the year ending 30th June, 1900, there has been exported from the district 9435 tons, of a gross value of £207,500; and there has been purchased by the Tasmanian Smelting Company, for treatment locally, 19,080 tons, or a total of 28,515 tons raised in the district. The increase is, no doubt, due to the advantage of local smelting, which enables lower-grade ores, unprofitable to mine for export, to be treated on the field at a profit.

The Tasmanian Smelting Company have been smelting a little over twelve months. They have completed the erection of a second smelter, but, at present, only one is running. The following are quarterly returns supplied by the company :—

Quarter ending 30th September, 1899—
Ore purchased, 4388 tons; value, £17,296 net.
Bullion produced, 830 tons; value, £25,962. All the bullion, and 234 tons zinc blende, were exported.

Quarter ending the 31st December, 1899.
Ore received, 9,919,918 lbs., containing, by assay, 2,821,750 lbs. lead, 1,947,796·64 oz. silver, 19,721 ozs. copper, and 196·511 ozs. gold.
Bullion exported, 1,622,230 lbs., containing 713·349 tons lead, 140,721·72 ozs. silver, 211·411 ozs. gold.
Ore export, December, 926,965 lbs., containing 587,938 lbs. lead, 34,783·83 ozs. silver.
Copper matte, export, December, 200,218 lbs., containing 103,112 lbs. copper, 43,091·56 ozs. silver.

Quarter ending 31st March, 1900—
Ore purchased—Lead, 3,400,000 lbs.; silver, 170,000 ozs.; gold, 460 ozs., at a cost of £26,000, from mine.
Export, 1,900,000 lbs. lead, 139,000 ozs. silver, and 440 ozs. gold.

Quarter ending 30th June, 1900—
Ore purchased—Lead, 2,762,000 lbs.; silver, 126,000 ozs.; gold, 410 ozs., at a cost of £19,700 from mine.
Bullion shipped—Lead, 1290 tons; silver, 154,000 ozs.; gold, 360 ozs.
The approximate value of the ore and middle products on hand on 1st July was £40,000.

One of the principal ore-producing mines has been a tribute on the Silver King, known as the South King or Fahey's Tribute. For some time prior to September, 1899, the Silver King was not producing ore, but since then this tribute has come to the fore, and has produced 4717 tons, valued at £59,215. The success attending its development has induced the Silver King Company to renew operations. The machinery and plant of the M'Kimmie Silver Mining Company at Dundas have been purchased, and are now in course of removal to the Silver King Mine. Within the next half year the removal and re-erection should be fully completed.

The Western Mine, during the last six months, has exported 1642 tons of ore, containing, by assay, 135,566 ounces silver and 842 tons of lead, of a gross value of £29,560. During the year the company has been busy erecting a new pumping plant. This was completed and started about six weeks ago. The lower levels of the mine have been unwatered, and work will be at once resumed in them. Foundations for two new Babcock boilers have been laid, and the boilers are being put together.

The Western Extended Mine has shut down, but, I understand, only temporarily, and arrangements are being made to obtain more capital to start again.

The Montana Mine has continued steadily at work, and has put out for the year 3188 tons, of an approximate value of £63,812. The total output of ore to the end of 1899 was 14,545 tons, for which £104,000 was received. The dividends paid up to that time amounted to £50,189, and about £3000 has been paid in dividends since.

The Oonah Mine has not been so successful this year as last. The returns for the past twelve months are 1299 tons, value, approximately, £23,904. During the last quarter the mine has returned 134½ tons stannite, containing 19¾ tons copper, and 11,581 tons of silver, of a value of £2771; and 110½ tons galena, containing 57½ tons lead, and 16,683 ozs. silver, of a value of £2864. A recent discovery in No. 3 level, 200 feet below the surface, showing clean ore six to twelve inches wide, assaying 74 per cent. lead and 134 ozs. silver per ton, very much improves the prospects of the mine.

The Silver Queen Mine has closed down all the underground workings, and only keeps a few men engaged in surface workings.

The Mount Zeehan (Tasmania) Mine has, for the year, raised 1087 tons, containing 105,525 ozs. silver, and 778 tons lead, of a value of £19,125. This shows a fair increase over the preceding year. The tribute on Smith's section was taken over some few months ago, and the mine shut down. The lessees are endeavouring to float a company to resume mining.

The Colonel North Mine has made good progress in the last six months. Work has been resumed underground in the various levels, and the concentrator overhauled and started. Last month 127 tons of ore, value £1645, were sent away.

Several small tribute parties are working on different sections in the Comstock district, prospecting the big formations that are known to exist there. It has been found profitable to mine and sell parcels of zinc ore, and there is every probability of this portion of the district adding considerably to the mineral output.

Work has been started at the Mount Tyndall Copper Mine, the main shaft having been sunk 70 feet, and preparations made to open out at that depth.

Development is being continued at the Hercules Mine, and the ore-bodies have been uncovered to a large extent. The self-acting tram is used to deliver the Mount Reid ore at the Williamsford Station. The company is considering the advisability of erecting reduction works in the vicinity of Williamsford, and has secured necessary water rights, and is obtaining reports as to the most suitable position.

At the Mount Reid Mine about 30 men are employed in mining ore for the Tasmanian Smelting Company, and about 40 in preparing tramway line and machinery site, about half a mile from the Williamsford Station. The machinery site, which is distant three quarters of a mile from the mine, is being cleared for the erection of an air compressor, to drive rock drills at the mine. Reduction works will afterwards be erected. The mine is sending regular supplies of ore to the Tasmanian Smelting Company. During June, 530 tons of sulphide were sent, and there are about 300 tons of gossan stacked at the mine.

Very little mining is being done at Rosebery. Most of the companies are waiting for the Tasmanian Copper Company to show the way. The latter company has been making exhaustive tests as to the best method of treating its ore-bodies. The latest process brought under their notice is the "Phœnix": tests of this process have been very satisfactory. A final test is to be made next month, and if the results are up to expectation, a complete plant will be immediately erected. At the Mount Black Mine the concentrators are nearing completion, and preparations are being made to resume mining. A little work is being done at the Fahl Ore Mine, and on some of the adjacent sections, more in the nature of prospecting, than otherwise. High-grade ores are being mined and stacked in small quantities, and will probably be included in the output for the coming year.

For the last half year the Comet Mine sold to the Tasmanian Smelting Company 189 tons 16 cwts. of galena, for £1200; 29 tons 2 cwts. gossan, for £17 9*s.* 7*d.*; and 14 cwts. lead, for £4 11*s.* The concentrators, which have not been in use for some time, have been overhauled, and started again. The prospects of the mine have improved lately.

The Great South Comet Mine has been worked by a small party of tributors for the past sixteen months. During that time they have, at a cost of about £2000, made a tram 2 miles 2 chains long, connecting the mine with the Adelaide branch railway, and have, in addition, done a good deal of tunnelling and stoping on the section. For the half-year, 368½ tons of ore have been sent to the Tasmanian Smelting Company. The assay value was £5 per ton, but after deducting charges and expenses it only realised £1 5*s.* per ton to the party. It is intended, if possible, to erect a small concentrator to treat ore that, at present, is put on one side as valueless. A good deal of prospecting is being done at the Renison Bell Mine. Four ore-bodies running through the property, carrying principally tin, are being driven on or otherwise explored.

The Federation Tin Mining Company has, since October last, spent about £2600 upon its property at Heemskirk in repairs to dam and water-race, additions and repairs to battery shed, machinery and plant, tramway, &c. Since January last 15 men have been regularly employed. The dead-work is finished, and it is anticipated that regular supplies of tin ore will be sent to the battery from the middle of July onwards. At first, until everything is running smoothly, only one shift per day will be worked, and it is expected to mine and treat 100 tons of tin-stone per week. Other sections in the vicinity are held, awaiting the result of the first crushings from the Federation Mine. In other parts of Heemskirk, small parties, totalling between 30 and 40, are working alluvial tin, and just about making wages.

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 twelve months ending, June, 1900.

On the undermentioned properties steady work has been done, mostly of an exploratory nature, and generally with highly satisfactory results.

Mount Lyell Mine.—A regular output of ore has been treated; the converting plant has been enlarged, and besides treating the ore from the mine, the Lyell Tharsis, and North Mount Lyell Mines, are also delivering, and very shortly the Mount Lyell Blocks will do so. At the mine a large amount of over-burden has been removed, and at the same time exploratory work has been carried on, proving the ore-body to fully bear out the expectations of Dr. Peters.

Prince Lyell.—The main tunnel is in 449 feet, with the face in hard quartzite, carrying copper and iron pyrites; very rich patches of ore have been met with whilst driving, and great hopes are entertained that the ore-body will soon be met with.

Lyell Tharsis.—One hundred men are employed on this mine, and during the half year ending 31st May, about 14,000 tons, averaging about 5 per cent. copper, have been treated. At the present time the overburden rock is being broken down, and the aërial ropeway is delivering the usual output to the smelters.

South Tharsis.—The concentrating mill is working steadily and well, the manager has had to encounter considerable difficulty from the variety of ores passed through not being of like gravity; but this will, doubtless, soon be overcome, and I anticipate great benefit will result to all claims producing low-grade ores.

North Mount Lyell.—This company has done a considerable amount of work during the last twelve months; besides sending ore to the smelters, it is preparing to deliver it from its mines, the Comstock and South Lyell, to its own smelters, which are to be erected on the other side of the King River. The railway line from Kelly Basin to the Linda Valley is all but completed, and will be extended to the Comstock and South Lyell directly.

Mount Lyell Blocks.—The aërial ropeway is completed, and within a very short time ore will be delivered by it to the Tharsis loading station, and from thence to the smelters. The other mines are engaged in exploratory work, and are—The West Lyell having employed, on an average, 20 men; the North Lyell Consolidated, 8 men; Anaconda, 5 men; North Crown, 4 men; Queen Lyell, 4 men; Royal Tharsis, 10 men; Crown, 34 men; Crown Lyell and Tasman Extended, 5 men; Duke Lyell, 3 men.

South Mount Lyell.—The south-west drive from the 600-feet level is being continued along the contact of the ore-body, and 120-feet level. From the same level the N.W. drive is in 115 feet, and the N.E. 91 feet, proving that the ore-body is of very large size, and further proving the immense value of the Mount Lyell ore-body.

and that it is richer with depth. Work is also proceeding on the Glen Lyell, Great Southern, and Mount Lyell Reserve.

At Mounts Darwin and Jukes considerable prospecting has been done, with favourable results, especially so at Lake Jukes and Mount Juke Proprietary; the other mines working in this neighbourhood are the Jukes, Comstock, Darwin Hecla, Mount Lyell Consols, and South Mount Lyell. As soon as the North Mount Lyell railway is sufficiently completed to carry machinery, &c., there can be little doubt work will be pushed on vigorously, but until then not much more than is being done can be expected.

Gold-mining is proceeding very slowly, although several properties in the neighbourhood of Lynchford deserve attention, the present holders have not sufficient capital to do more than what may be termed surface prospecting. Alluvial gold-mining has fallen off very considerably during the last twelve months, so far as I can obtain information; but I am strongly of opinion that more gold is obtained and sent direct to the Mint than is supposed. From the above statement it may justly be concluded that the mining industry in this portion of the district is steadily progressing, and better results may be looked forward to as the country is opened up by tracks and railways. A track from Birch's Inlet to Port Davey has recently been laid out by Mr. P. B. Moore. This will give access to a large extent of mineral country, being on the same line as Mounts Lyell, Huxley, Darwin, and Jukes. A rich find of copper ore is reported on the coast, situate about 20 miles south of Cape Sorell.

The North Mount Lyell Railway Line will greatly assist prospectors in getting out to the present almost unknown country between Darwin and the Frenchman's Cap, so that the coming summer will probably be taken advantage of by prospectors, especially as by that time the railway and Public Works will not require men, and therefore there is a greater chance of their going into the bush.

Mr. Registrar FIDLER, (Waratah), reports:—

I BEG leave to report on the mining industry for the past year as follows:—

GOLD.

Very little has been done in gold in this division. The Long Plains Gold and Copper Company is awaiting the return of expert's opinion; the Whyte River Dredging Company has its Dredge at Corinna, and the carter is now taking it to the place of operations. The Lucy Spur and Specimen Reef have each a few men employed prospecting. Twenty-two dredging claims have been taken up on the Hellyer and Arthur rivers, but no work started on them. There are about 20 men employed in this division fossicking for gold.

SILVER.

The Magnet Mine continues its usual output of 100 tons of ore per month. The company is surveying for a railway from the mine to Waratah; when it is completed it expects to increase its output to at least 1000 tons per month. The mine is still looking splendid. The North and West Magnet companies are still prospecting.

At Heazlewood, the Whyte River Company is carrying on prospecting, with very encouraging results; the Confidence, also, has a few men employed prospecting. All other claims are idle.

At Mount Farrell, considerable development has taken place during the past year. On the North Mount Farrell, about 40 men are employed; on other mines, about 50 men.

COPPER.

The Rocky River and *Cape Copper* companies, near Corinna, are employing about 40 men, at prospecting chiefly. The former company is surveying for a tram line from the mine to Corinna. All other copper shows are lying idle.

TIN.

The Mount Bischoff Mine, as usual, has maintained its usual output of tin, and likely to for some time to come.

A very promising show of tin has been discovered at Whyte River. Ten miles from Waratah, a lode formation is being prospected by the Khaki Tin Mining Company. About three tons of alluvial tin has been raised by other parties on adjoining sections, of first class quality, assaying up to 74 per cent. Two parties of tin-dressers are employed in the Waratah Valley, and are doing well. Other claims farther down the river are about to start work shortly.

IRIDIUM.

A company has taken up twenty sections on the Savage River, and is testing the ground for this mineral with very good results.

GENERAL.

On the whole, mining in this division is looking much more promising than for some time past. There are very few men unemployed; all strangers arriving soon find work, and it is seldom any one has to retrace their steps if able and willing to work.

THE SMELTING OF TIN ORE AT THE MOUNT BISCHOFF TIN SMELTING WORKS, LAUNCESTON.

By Geo. J. Latta, *Manager of the Works.*

The ores received at the Mount Bischoff works for the half-year ending 30th June, 1899, are given below, and this is about an average of each half-year's work :—

820	tons, Mount Bischoff, first quality (crushed ore), assaying	72·1 per cent.
69	tons, Mount Bischoff, 2nd quality (crushed ore), assaying.....	67·5 ,,
541	tons ores smelted for the public (chiefly alluvial) assaying.....	71·7 ,,
1430		

From a smelter's point of view these ores are, as a rule, remarkably pure, there being no impurities in them to prevent the metal being refined up to market quality. The impurity in the Mount Bischoff ores is principally iron, and that in the alluvial ores is silica, and it is a mutual advantage to smelt both together, the iron in the former combining with the silica in the latter to form slag. When the alluvial ores are smelted by themselves it is often necessary to add iron in some form.

The furnaces used are of the reverberatory type, the draught being supplied by a chimney. A charge is made by mixing 50 cwt. of the various ores with about 10 cwt. of small coal ; this is thrown into a hot furnace and the doors carefully closed to exclude air. The time taken to completely reduce the charge is eight hours, during which time it is subjected to several rabblings or mixings. When properly smelted the metal sinks to the bottom of the furnace, and the slags or impurities float on the top ; the metal is then tapped into a float or brick-lined vessel and allowed to cool for some time, and the slags are skimmed out and reserved for further treatment ; another charge is thrown in, and the operation repeated. The metal in the float is ladled into a large kettle, where it is refined by sinking billets of green wood under the surface ; the heat of the metal converts the moisture or sap of the wood into steam, and causes the contents of the kettle to be violently agitated ; this has the effect of releasing any entangled portions of oxide or dross, which float to the surface and are skimmed off. Samples are taken at various times, and, when sufficiently refined, the metal is ladled into moulds. This metal assays 99·80 per cent.

The slags from the ore vary in richness, according to the quality of the ores smelted and the working of the furnace. These slags are broken up and mixed with small coal and lime and again smelted, the metal produced from them being very impure from the large amount of iron present. The iron is got rid of by smelting with the next charge of ore.

A few small parcels of ore contain traces of arsenic and copper, and sometimes lead, antimony, and zinc. These have to be treated separately. When arsenic is present every trace must be got rid of by roasting before smelting, otherwise, it causes the metal to be hard, and there are no means of eliminating it once it is alloyed with the tin.

Metal is sent from the works in the form of ingots, weighing 75 lbs. : this is for shipment to England. Smaller ingots are also made for consumption in the colonies.

From the ore sent to the works for smelting for private people or companies a deduction of 2 per cent. is made to cover loss in smelting ; that is, for 20 cwts. of ore, at 72 per cent., 14 cwts. of metal, or 70 per cent., would be returned to them. This allowance is for ores of 70 per cent. or over ; when the quality falls below that, a larger reduction is made, as the loss in smelting increases rapidly as the ores get poorer.

30th June, 1900.

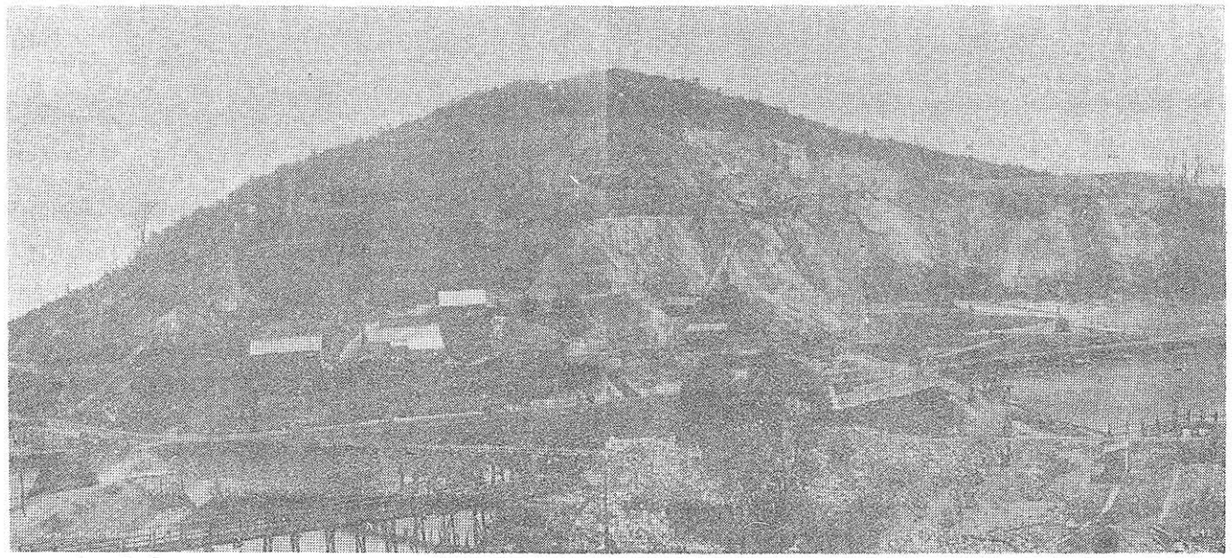


Photo-Algraphy Process.

MOUNT BISCHOFF TIN MINE

DESCRIPTION OF THE CYANIDE PROCESS AT THE NEW GOLDEN GATE GOLD MINING COMPANY, MATHINNA.

By T. J. Andrews, *Assayer in Charge.*

Chemistry of the Process.

The fact that gold is soluble in a solution of an alkaline cyanide has been known to chemists for a considerable period, but it is only of late years that this knowledge has been brought into daily use for the saving of gold on a commercial scale. The actual chemical reaction that occurs is not exactly known. The reaction accepted by chemists is one suggested by Elsner, viz.—

$$4\,Au + KCN + O_2 + 2\,H_2O = 4\,Au\,KCN_2 + 4\,KHO.$$

The principal methods of precipitating gold from a solution of cyanide are by the use of (1) zinc shavings; (2) charcoal; (3) the Siemens-Halske process, in which sheets of lead and iron are alternately placed in the extractor boxes, and the whole connected with a dynamo. The action of the electric current from the dynamo precipitates the gold on to the lead, the iron going into solution.

The method principally used is that of precipitation with zinc shavings. Cyanide having more affinity for zinc than gold, the zinc replaces the gold in solution, the latter forming a black slimy material. This reaction is represented by the equation—

$$2\,K\,Au\,CN_2 + Zn = 2\,Au + K_2\,Zn\,CN_4.$$

Charcoal, as a precipitant, is also largely used in these Colonies.

When the plant working at this mine was first erected, a charcoal-precipitating plant was also placed in; but it was found that the charcoal in this district was not suitable, a great percentage being of very little use on account of its hardness. This plant was then replaced by the zinc-extractors, which are still in use.

To precipitate the gold from solution, the solution must contain free cyanide. In this plant I find the best precipitating solution is one whose strength varies from ·15 to ·18 per cent. If the strength fall much below this, the zinc shavings get covered with a white substance, which, I believe, is a form of cyanide of zinc. This substance can be removed by slightly strengthening the solution before it enters the zinc-extractors.

General Description of Plants at the New Golden Gate.

There are, or will be, shortly, three plants at work on this company's property viz., the No. 1 or battery-plant; the No. 2 plant, treating a heap of accumulated tailings; the No. 3, or slime-plant, to treat the slimes coming from the battery, and also an accumulated heap.

The No. 1 Plant.

This plant was erected in 1897, commencing work in August of that year, but for some months without success. It has a a treating capacity of 400 tons per week, and consists of twelve Oregon pine vats of different sizes, arranged as follows:—Top row, or distributing vats, consisting of four vats, each 26 feet in diameter and six feet deep. Staves and bottoms of vats are 12 inches wide by three inches thick. Each vat is strengthened with five hoops of one-inch round iron, made in four pieces, and joined with cast-iron strainers. Each vat is fitted with a filter-bottom, made as follows:—Lengths of hardwood, 4 by 2, are laid parallel on the two-inch edge on the bottom of the vat, about 12 inches apart. The underside of each of these pieces has circular cuts taken out at regular intervals to allow free circulation on the bottom. Across these pieces are placed 8 by 1 boards almost side by side, the faces being bored with one-inch holes at regular intervals. Over these boards coir matting is stretched, and, on the matting, 3 by 1 battens are laid three inches apart. These battens are to keep the matting in its place, and also to protect it when the vat is being emptied. The vats are emptied through cast-iron side-doors, large enough to allow the passage of a half-ton truck. These doors are bolted to cast-iron frames, which are bolted through the sides of the vats, a strip of packing between the door and the frame making this water-tight. The tailings flow into the vat through a Butter's distributor fixed over the centre of the vat. The overflow of water and slimes is taken off from three sides of the vat, the latter being finally drained dry through a pipe under the false bottom.

Each vat is erected on nine brick piers, four feet square. These carry six 12 by 9 Oregon pine bearers 14 feet long. On the bearers are 9 by 3 joists, on their edge, carrying the vat. Immediately in front, parallel to and lower than these distributing vats, are four leaching vats. These are exactly similar to the distributing vats, with the exception, of course, of the overflow and distributors.

In front of the leaching vats, and below them, is a small vat, eight feet in diameter and four feet deep. This is the intermediate vat: into it are led the drain-pipes from the leaching vats. It is used as a settler for any slime, &c., that may come through with the solutions. The outlet pipe from the intermediate is carried up inside from the bottom of the vat to nine inches of the top. By this means the vat is always full, and a regular pressure maintained through the extractors.

Next in order to the intermediate vat the extractor-boxes are placed. There are four boxes for each of the two sand plants and one for the slime plant. These are pine boxes, each 11 feet long, two feet wide, and two feet deep. Each box is divided into five compartments, by double partitions, in such a manner that the solution is forced to flow down between the partitions and up through each compartment. The zinc shavings are placed on iron mesh-trays, about seven inches from the bottom of the boxes. The solution flowing up through each compartment has to pass through the shavings, making the contact as perfect as possible.

Next to the extractors are the solution sumps. These are three in number, three-inch Oregon pine, 20 feet diameter, and five feet deep, and are placed below the extractors to allow the solutions, after passing the extractors, to gravitate into them. These sumps contain different strength solutions, No. 1 the first or strongest, No. 2 a weaker solution, and No. 3 the water-wash. These solutions are pumped from the sumps to the leaching-vats, through a three-inch cast-iron pipe, by a double-cylinder Worthington cyanide pump.

Method of Working No. 1 Plant.

The tailings crushed in the battery, through a 200-hole grating, are passed over frue vanners: then flow to an 16-inch plunger-pole, which forces them to the distributing vats. When about 90 tons have settled in one vat the flow is turned into the next in order. The vat filled is allowed to drain dry through the filter-bottom, and is then emptied into the leaching vat immediately in front. Tailings settling in water are too compact to allow good percolation; the breaking up caused by tipping into another vat allows the solutions to percolate freely, the expense of removing the tailings being more than covered by the higher extraction gained. The leaching vat being filled and levelled, the first solution is pumped on. This solution has a strength of ·28 per cent. cyanide. This is allowed to stand on for 24 hours, then the drain-pipes are opened and the solution drawn off through the zinc shavings, then flowing back into No. 1 sump. Quantity of first solution is 33 short tuns, and the time taken to run completely off averages 13 hours. When run dry a second solution from No. 2 sump is pumped on. Strength of this solution varies from ·15 to ·17 per cent. This solution is kept percolating fairly fast for 12 hours; weight of solution used 34 tuns. After the second solution has all passed through the zinc, a water-wash is pumped on to wash out final traces of cyanide. When the tailings have drained the doors are taken off, and the leached tailings trucked out over the tip. Average assay of tailings before leaching is 2 dwts. 4 grs. per ton, and, after leaching, 12 grs. per ton, or almost 77 per cent. extraction. When the first solution is drawn off it has lost a trifle of its volume and 38 per cent. of its strength. The loss in volume is made up with the first part of the second solution, it being, in turn, made up with the first part of the water-wash, which always carries a little cyanide; the quantity of solution in use by these means always remaining the same. The loss in strength is made up by adding potassium cyanide, the quantity of this salt so used being a little under one pound weight for every ton treated. The strength of the second solution remains constant, gaining sufficient cyanide from the remains of the first solution left in the tailings to keep it so.

The No. 2 Plant.

This plant was erected at the beginning of the present year to treat a large quantity of tailings which accumulated previous to the No. 1 plant starting to work. This plant consists of four leaching-vats, Oregon pine, three inches thick, 27 feet 6 inches in diameter, and six feet deep, fitted with filter-bottoms, drain-pipes, strengthening hoops, and side discharge-doors, similar to the No. 1 plant. Each of these vats hold 100 tons of tailings, and the 40 tuns of solution required to cover them. The vats are each erected on seven stone piers, carrying 12 by 12 Oregon pine bearers, 9 by 3 joists taking up the bottom of the vat. The drain-pipes lead to an intermediate vat, similar in size, &c., to that used in the No. 1 plant; then follow the zinc-extractors, similar also in size and number to the No. 1 plant. Last of all, the three solution sumps, 20 feet diameter and six feet deep.

The tailings are drawn up to the leaching vats in trucks, holding slightly under one half-ton, over an incline tramway, by means of a double six-inch cylinder-winch, driven with compressed air. These tailings having been exposed to the weather for some time, a small amount of free sulphuric acid, ferrous sulphate, and ferric sulphate has been formed from the sulphides escaping the concentrators. It is found necessary to give these tailings a preliminary treatment before the leaching proper. This is done by adding lime to the tailings, or, sometimes, a caustic soda-wash; after this the treatment takes the same form as in No. 1 plant, with the exception that as we use a greater quantity of solution we can use a correspondingly weaker solution, quantity of cyanide used being a little over one pound weight per ton of tailings treated. The average assay value of the whole of the heap is 2 dwts. 12 grs. per ton; but there is a large quantity of slimes, assaying over 4 dwts. per ton, which cannot be treated by ordinary percolation. This reduces the value of the tailings suitable for treatment to 2 dwts. 4 grs. per ton, out of which we get an extraction of 70 per cent.

The No. 3 or Slime Plant.

In the overflow from the No. 1 plant distributing vats there are carried away about 27 tons of slimes per week, and during the time the mine has been working several thousand tons of these slimes have accumulated. This material cannot be treated by ordinary percolation, the slimes being impervious to the solution. To effect contact of the gold and solution, the slimes and solution have to be agitated for some hours; the slimes are then allowed to settle, and the solution is decanted off from the slimes.

The slime plant is now in course of erection, so no working results can yet be given. The slimes average assay value is 4½dwts. per ton, and, by experiment, an extraction of 3 dwts. per ton has been obtained. Slime gold is very fine, and, therefore, easily dissolved by a solution of cyanide; and I have no doubt that, with better means of agitation than already tried, a larger extraction can be obtained. I hope to be able to prove this within the next few months.

The Clean-up.

The zinc-extractors are cleaned up every fourth week. The zinc shavings which are discoloured with gold slime are taken out and rubbed to wash off any loose-adhering slime; the solution is then syphoned out of the extractors to within a few inches from the bottom. The gold-slimes, which have fallen through the mesh-tray are then washed through an inch-pipe, let into the bottom of the box, into a launder, and thence into a tub. The slimes are allowed to settle in this tub, the solution decanted off, and the slimes taken out and dried in camp-ovens. These dry slimes are placed in a large iron tray, about six inches deep, a little nitre added, and are roasted for about two hours over a wood fire to oxidise the zinc. The oxidised slimes are then fluxed with borax, soda, and sand, and fused in salamander crucibles. The resulting bullion is worth from £2 17*s.* to £3 3*s.* per ounce.

Since the cyanide process was started at this mine bullion, valued at over £15,000, has been won by its use, being equal to 6*s.* 11½*d.* per ton of tailings treated, at a cost of a fraction over 3*s.* per ton of tailings. The quantity of zinc used varies a good deal from month to month. Average cost of zinc per ton of tailings treated being 1·38*d.*

Experiments on Cyaniding Pyrites.

The tailings at this mine pass over concentrators after leaving the battery. Samples of the pyrites obtained were taken and treated with solutions of cyanide for a period extending over five days. The average assay value of the samples was a little over five ounces per ton, and, after treatment, the residues contained nearly two ounces per ton. This experiment was tried to prove whether concentration before cyanide was profitable. Taking into consideration the extra time and cyanide required to treat these sulphides, and the value of the residues, I believe that it is more profitable to concentrate before cyaniding.

Mathinna, 15th November, 1899.

DESCRIPTION OF THE TREATMENT OF TAILINGS BY THE NEW PINAFORE GOLD MINING COMPANY, LEFROY.

By J. T. Stubbs, *General Mine Manager.*

The heap of tailings and slimes undergoing treatment by the cyanide method at the above company's battery is the result of some 22 years' crushing at the 40-head battery originally built by the New Native Youth Gold Mining Company, and now the property of the above company.

Had the whole of the tailings been saved, it would have meant something more than 120,000 tons, but in the early days, and up to a very few years ago, tailings were looked upon as an encumbrance, and it was only with a view to conserving the water for the use of battery in dry weather that the tailings were pumped up into a large dam, and the water used over again. When water was plentiful, everything was washed into the creek, which meant a saving of pumping tailings, and of a labourer to look after the sand dam. The result is a heap of about 30,000 tons, 20,000 tons of which may be termed suitable for the percolation system of treatment. The company has now been successfully treating these since 3rd March, 1897, and, thanks to the cyanide method, has been enabled to do a considerable amount of prospecting at the mine from the profits derived therefrom. Every mine in the district which has produced quartz has contributed its quota of tailings, so that it may be termed a fair average sample of the tailings from the field. It was by no means an ideal heap for the process, but, on the contrary, was considered by many experts as quite unsuitable. However, after meeting with numerous obstacles in the preliminary tests, the results were sufficiently good to warrant the erection of a small plant, which has turned out quite as well as it was anticipated it would do.

The plant at present consists of 3 steel vats, 16′ diameter x 4′ deep, 1 wooden vat, 20′ x 5′, and 2 wooden vats, 18′ x 4′ and 15′ x 5′ respectively. These two latter were erected in the first place as an agitating plant for the treatment of slimes, but, not proving successful, were turned into leaching vats for tailings. There are also 3 sumps and 2 solution vats, the whole of which were constructed out of old condemned boilers from the mine and battery. The method of making was by separating the flue from shell and closing each of the ends with bricks and cement. The interior and exterior were then given a good coating of lime (applied hot), the result being an everlasting tank, free from leaks and loss of gold-bearing solution, which cannot always be said of wooden vats. A 12 h.p. portable engine is used for hauling the sand up to vats, and for working a centrifugal pump for pumping solutions to storage tank; and two small steam-ejectors are used to supply solution for filters. A large trommel, worked by a donkey engine, is used for screening sand and mixing lime therewith before treatment in the vats. The precipitation plant consists of 33 charcoal filters, of about 4 cubic ft. capacity each. The charcoal is prepared by passing it through a charcoal crusher at the mine, and a reverberatory furnace 12′ x 4′ is used for reducing it to an ash. Two smelting furnaces, and a well-equipped assay office complete the plant.

The treatment consists of *1st, Preliminary*, or *making the tailings suitable for subsequent cyaniding.* This is effected as follows :—The tailings are trucked up together, with a certain proportion of slimes, according to fineness, and deposited on the feeding-floor of a large trommel fitted with grating, ½-inch mesh. A certain quantity of slacked lime is then added to each truck-load, (the amount of lime necessary is determined previously by a laboratory test.) The mixture is then fed into trommel by a boy, and the sand and slimes passing through the screen being very intimately mixed with the lime, are trucked up an incline tramway and dumped into the percolating vats. Different systems have been tried for this preliminary treatment, with more or less success. 1st. The tailings were, after screening through standing screens, trucked direct from heap into the leaching vats, and subjected to a water-wash to eliminate the acid and soluble iron salts, after which a very strong solution of caustic soda was passed through to neutralise any acid that may be left. Results not at all satisfactory, owing to great length of time and excess of caustic soda required. 2nd. The tailings were screened as before, and on each truck being tipped into the vats, the necessary amount of lime was added, and mixed as well as possible, by boys, in the vats. This method was an improvement on the caustic soda, but results were not always satisfactory, as occasionally the K.Cy. solutions would come off blue, caused through imperfect mixing with the lime, and portions of the solution coming in contact with the acid tailings. This, of course, meant total loss of cyanide, and, consequently, poor extraction. 3rd. Wash-pits, or boxes, capable of holding about 30 tons of sand were constructed. These were fitted with a hopper at the head, and the sand fed into it with a plentiful supply of water. Stops were put in at the tail of the box, similar to a Cornish tye, until it was full. The acid-water and slimes in suspension were passed over canvas tables, and there concentrated for treatment by chlorine. When thoroughly drained down, the sand was trucked up to the vats, as before, when the lime, which was now reduced by more than one-half, was added, as before. This method eliminated 60 per cent. of the acid and soluble iron salts, and was used for a considerable time with great success until scarcity of water compelled the management to adopt other methods. Against its adoption may be quoted the fact that only 80 per cent. of the tailings and slimes fed into the hopper was trucked into leaching vats, the remaining 20 per cent. going away as slimes in suspension. The assay value, after washing, was not increased in proportion, and although some of the gold was caught on the canvas trays in the form of concentrates, the final residues were too high in gold to be termed a complete success. In conjunction with this method an agitation plant was erected with a view of dealing with the slimes, but after many trials, without success, it was abandoned. It, however, may eventually be resorted to.

After being dumped into the leaching vats the sand goes through the usual process of cyaniding, the solutions in use varying from ·2 per cent. K.Cy. to a mere trace of K.Cy., followed with a final water-wash to keep the quantity in use constant. The consumption of cyanide is heavier than is usually the case, owing to the fact of the tailings containing antimony (in the form of stibnite) and copper. Practice and repeated experiments have proved that the stronger the working solutions are made, the

greater the consumption of cyanide, without being attended with a better extraction. It has also been found that the fine slime is much heavier in the consumption of K.Cy. than the coarse tailings. This, I think, is due to the fact that a much greater percentage of fine mineral, especially stibnite, is present in the slimes, and as a proof that copper is present it is only necessary to plunge a pocket-knife into some of the lower seams of tailings, when it immediately becomes coated with metallic copper. The presence of this latter objectionable metal rendered the precipitation of the gold by means of zinc very unsatisfactory in the small tests made in the experimental plant. The precipitation was all that could be desired for a time, but the exceedingly weak solutions passing through the zinc-box caused the copper to be precipitated, after which the solutions were found to contain as much gold after passing through as before going on. Charcoal was then tried, and found to give excellent results, and, in consequence, it was decided to use that agent as a precipitant. With reference to the respective claims of the two precipitants, I would here like to state that there can be no doubt whatever that zinc is admirably suited for clean and sweet tailings free from copper, and has then certain advantages over charcoal. The smaller plant required in the first place, and the smaller amount of trouble in collecting the gold, are arguments that are certainly in its favour. On the other hand, charcoal is suitable for all sorts and conditions of solutions, whether acid or alkaline, with or without copper, and it always leaves the solution in a sweet condition, provided always that the filters are properly attended to, and not allowed to run too long. Experiments have been made with the solutions zinc *v.* charcoal, with the result that the charcoal has been equally successful with strong and weak, clear, and blue solutions, while the zinc has always done good work with strong solutions; but with weak solutions containing copper, or at all acid, it has been a failure, and what has proved a success may easily have been a failure if zinc had been used instead of charcoal in this case. When working full time 40 filters are burnt down per month, resulting in about 80 lbs. ash, which is mixed with suitable fluxes, and smelted in No. 16 Salamander crucibles, the resulting gold being about 900 fine.

When the tailings were comparatively free from slimes the total time of treatment was four days, from time of filling each vat until it was sluiced out into the creek. Now that the percentage of slime is large, one vat is filled and one emptied every day, Sundays excepted. This gives seven days' treatment, with comparatively weak solutions. Actual results in the shape of gold recovered do not always tally with the theoretical extraction, for which many reasons can be adduced—1st. Having no system of weighing each truck the weight is only approximate, added to which the moisture in the tailings varies according to the weather (wet or dry). 2nd. Loss of solution by leakages and insufficient water-wash. 3rd. Losses in burning charcoal in the furnace. This is proved by assaying the soot from smoke issuing from the port-holes, which is always rich in gold, carrying as much as 90 ozs. per ton. 4th. Losses in smelting the ash, in the form of fine dust carried off by the draught into the flues, assays from the sides of which have shown over 20 ozs. gold per ton, and losses in the slag treated after melting down. At the above works the slags and worn out crucibles are ground up with mercury in a berdan, and the residues saved for further treatment, the amalgam obtained being retorted and smelted as usual. Experiments have been made with the charcoal ash with a view to treating it more expeditiously and cheaply than by smelting. It was found that 66 per cent. of the gold was very easily recovered by amalgamation, but the remaining 34 per cent. was obstinately retained by the ash in spite of the amalgamating process being continued for a great length of time.

By agitating with a strong solution of K.Cy., the gold is easily redissolved, but it takes considerable time to wash all the gold from the ash, and similar treatment by chlorine is attended with like results. To test the efficiency of charcoal for precipitating, a small filter, containing 2 cubic feet of charcoal, was slowly fed with rich solution of K.Cy., and samples assayed from time to time, until it ceased to precipitate any more gold. The charcoal was then burnt down, and the ash smelted for 14 ozs. gold, over 900 fine.

Agitation Plant.—The small plant erected for the treatment of slimes beforementioned, consisted of a vat 18′ × 4′, fitted with stirrers, which were set in motion by an overhead pulley, driven by means of an endless wire rope connected with a small donkey engine. The slimes direct from sand heap were fed into this, and enough water added to make it of the consistency of gruel. Lime was then added, until a strong alkaline reaction was observed on testing with litmus paper. The stirrers were then lifted out of slimes, and the whole allowed to settle, when the excess of water was drawn off the top by means of a hose attached to a float. A weak solution of cyanide was then added, and the stirrers again set in motion, and the agitation continued until the gold was dissolved, after which the stirrers were again lifted out, and solution, when clear, decanted from the top, as before. Water was then added and the same process repeated, after which the whole of the contents of the vat were sluiced into the creek. The solutions were passed over charcoal filters in the usual way. This method was fairly successful with slimes of fair quality, say 6 dwts., but when tried with slimes assaying 3 dwts. 6 grs. was found too slow and costly. The acid nature of the slimes may be imagined when as much as 45 lbs. of lime per ton were required to give a faint alkaline reaction.

The quantity of tailings and slimes treated to date is 14,478 tons, for a yield of 2302 ozs. 7 dwts. gold, value approximately, £8748. The assay value, before treatment, has averaged 4 dwts. 21 grs. per ton, and the residues 1 dwt. 12 grs. per ton, the actual extraction being 3 dwts. 4.3 grs. per ton, the difference between actual and theoretical extraction being accounted for as above. The cost of treatment, when in full work, is 4*s.* 9*d.* per ton, and the capacity of the plant, when treating clean tailings, is 900 tons per month. The amount being treated at present, however, is about 600 tons per month. This is due to the fact that a greater percentage of slimes is now being worked up with the free leaching tailings. The erection of the plant, preliminary experiments, and subsequent working of the process have been under the immediate supervision of General Mine Manager (Mr. J. T. Stubs), who was very ably assisted by the Battery Manager (the late Mr. W. H. Stubs), who had full charge of the plant until the time of his regretted death, since which the work has devolved on the General Mine Manager.

Lefroy, December 16th, 1899.

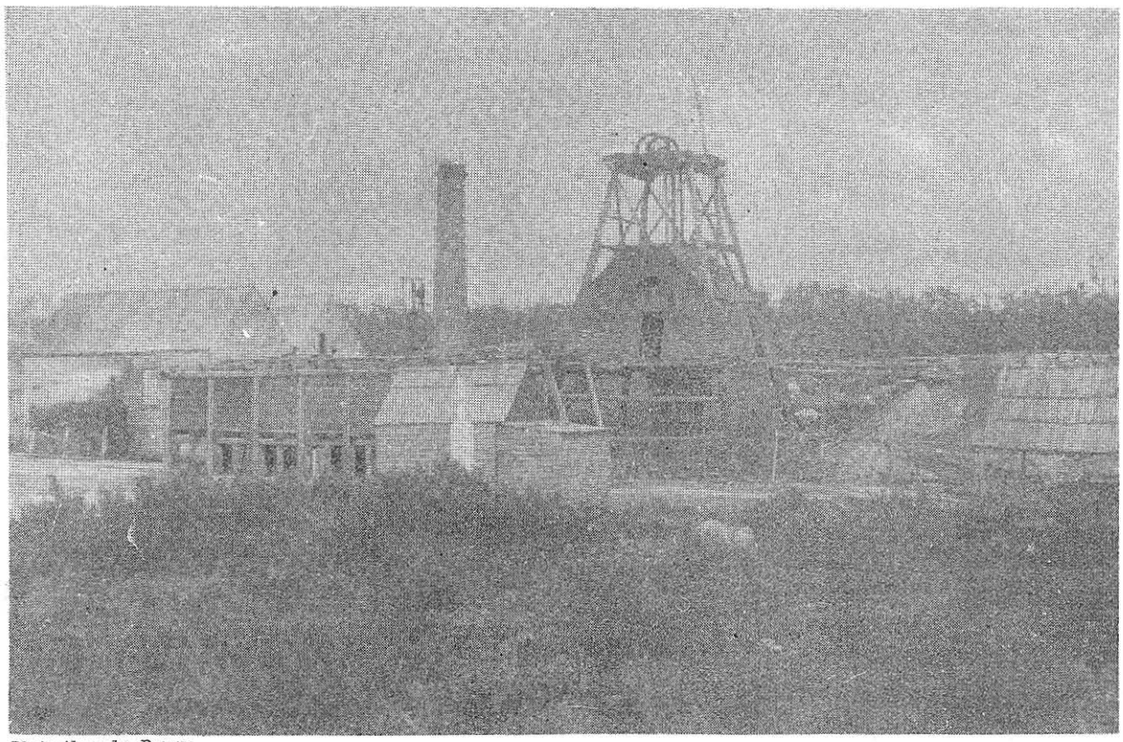


Photo-Algraphy Process.

NEW PINAFORE GOLD MINE, LEFROY

A DESCRIPTION OF THE TASMANIAN SMELTING COMPANY'S WORKS AT ZEEHAN.

By Max Heberlein, *General Manager.*

The Works erected by this influential company are situate about two miles from the town of Zeehan along the Zeehan-Strahan line of railway. A parallel siding connects the smelters with the main line, thereby giving them an elevation of 90 feet above the line. On this siding a Howe's weighbridge receives the trucks of ore delivered to the company. The scales have a self-registering beam by which the gross and tare of each truck is recorded in duplicate on tickets. Errors in weight are thus avoided, and, as the shipper or his representative receives a ticket direct from the scales, disputes of weights are avoided at once. The tickets also form an evident proof if any question of past weights should arise. The track then forks, one line carrying ore to the sampling mill and sulphide ore-bins for the roasters, and the other and lower line passing between the roaster building and blast furnace bins. By this arrangement the fuel for the roaster furnaces is delivered directly at their fire-boxes, while the bins are easily accessible by rectangular tracks (overhead) to it. Good storage ground is thus provided between the upper and lower lines, and this is used for coke and other materials. On the upper line is the automatic sampling mill, a commanding building 60 feet high, by 74 feet long, by 36 feet wide. The operation of automatic sampling is here applied to all ore bought by the company, and the results have been perfectly satisfactory in point of accuracy, as has been verified over and over again, both by the company and the ore vendors. This mill automatically samples the ore and delivers it into hoppers. The sampling operation varies according to the ore treated. The sulphide ores, which need roasting before they are fit for charging into the blast furnaces, are first reduced to a proper size by crushing to ¼-in., and then pass through the Bridgmen sampler. The crushing is done by feeding the coarse material into a fifteen by nine Blake crusher, two sets of reliance rolls, the ore passing through two 72 in. by 30 in. screens. Two elevators of 40 by 60 ft. centre raise the material to such a height as to facilitate the final deposition in bins without labour. The ore passes through this mill in an uninterrupted flow, and the machinery can be adjusted so as to select either $\frac{1}{32}$, $\frac{1}{64}$, or $\frac{1}{128}$ part of the whole quantity passing. The quantity selected is discharged into iron buckets, and then goes to the drying room and sample grinder before being taken to the laboratory for assay. The remainder of the ore falls into the bins, whence it is trucked to the final bins for making the roasting mixture. For the ores which need no roasting there is a coarse 9in. by 15in. Blake crusher and a sampler. The $\frac{1}{5}$ or $\frac{1}{10}$ part can be withdrawn as a sample, and the remainder is taken by trucks to the bins for oxidised ores on the charging floors at the blast furnaces. The selected sample is crushed fine, and then quartered as usual. The E. P. Allis Co., Milwaukee, U.S.A., supplied the sampling plant, and are the manufacturers of the 75 h.p. Reynolds-Corliss engine which drives the mill. The spacious drying floor measures 250 square feet, and is heated by exhaust steam from the engine. The main boiler-house is 300 feet away, and the steam is taken through a pipe line, the expansion being regulated by a joint on the lower end. The condensing steam is withdrawn by an automatic trap, which also minimises the loss of steam.

The roaster-shed is a building measuring 280 ft. long, by 92 ft. wide, and is fitted with seven roasting furnaces 72 by 17 ft., taking a daily charge of twelve tons each. The ore is charged behind, near the main flue, and gradually worked to the front. In this process, with the aid of heat, and by the access of oxygen, the ore loses its sulphur. It is then conveyed to a cooling floor, weighed and sampled, and finally taken to the beds of ore which supply the smelting mixtures for the blast furnaces. The sulphide bins which supply the roasters are level with the feed-hoppers, and Fairbank scales are fixed at suitable distances to weigh the furnace charges in the most efficient and economic manner. The capacity of these bins is 3500 tons. There is a general flue along the back of roasting furnaces, and this connects with a roomy dust and condensing chamber, and then with a tall stack 125 ft. 10 in. high, and 8 ft. inside diameter. This height ensures a good draught, and carries off the noxious fumes at a good elevation above the summits of surrounding hills. The blast furnace bins cover an area of 350 ft. by 150 ft., and are each 125 ft. by 30 ft., and roofed over for protection from the weather. The middle bins are devoted to the bedding of different descriptions of ore in such a way as to form nearly self-fluxing mixtures. At one end flux is stored, and coke at the other. These bins are capable of accommodating 4000 tons of ore, 2000 tons of flux, and 1000 tons of coke. For fine ores and clayey gossans a briquetting plant, consisting of mixer, White's press, manufactured by H. S. Mould Co., of Pittsburg, U.S.A., and 40 h.p. vertical engine, has lately been installed, by which the detrimental influences of the fine material in blast furnaces are overcome. There are three blast furnaces erected, with a daily capacity of 250 tons of ore.

The two lead blast furnaces are of the newest American type, 3 ft. 6 in. by 10 ft., made by the Colarado Iron Works Co., Denver, U.S.A. They are unusually high, 25 ft., with a charge column up to 21 ft., and can treat 80 tons of ore per day each. The fumes from the lead furnaces are discharged above the charge floors by a down-take into the main blast furnace flue, but those from the one copper furnace are drawn underneath the charge floor. The main flue of the blast furnace is large enough to act as a condensing chamber for collecting volatilisation products. It is 200 feet long, and is connected with the blast furnace stack, 125 ft. high. The furnace products, that is to say—silver lead and copper matte—are carried on a 2 ft. tramway to the Austral siding, for consignment to the shipping port, Strahan. A slag dump is being formed on ground falling to 80 ft. below the furnaces, and there is ample room for very large accumulations of slag. The blast furnace building measures 108 ft. by 84 ft. 6 in., and extra furnaces can be added as required without causing any interruption to current work. The engine-room adjoining the blast furnace building is protected against fire by two end walls of brick, and measures 78 ft. in length, by 54 ft. in width. The engines are in duplicate, one being kept in reserve for emergencies. They are Reynolds-Corliss engines of 125 h.p. each, and are furnished with belted condensers. The engines can be driven together or separately. In this room are two No. 7½ Root's improved high-pressure blowers, with self-oiling bearings, and these supply the blast for the furnaces.

They furnish 87 cubic feet of air at each revolution, and are guaranteed to work up to 5 lbs. pressure. The whole is electrically lighted by 250 16-c.p. lamps. There is a fitting shop, with large American lathe and drilling machines. The boiler house, 55 ft. by 39 ft., contains three large multitubular boilers, 125 h.p., working up to a pressure of 100 lbs. The flux haulage line is worked from the level of the roaster building, and brings in limestone from the quarries near by, as well as firewood from the company's timber reserves. Near the quarries is a lime-kiln, with a capacity of 120 bushels a day. A Pennsylvania boiler provides the haulage power. The water necessary for the works is derived from a creek below the smelters, and is pumped by a Worthington pump of the plunger type, with compound double action. It is carried by 5-in. mains to the various departments and the two large tanks made by Salisbury's Foundry Co., Launceston, with a total capacity of 70,000 gallons. These tanks form general reservoirs, and are available in the event of fire. A separate boiler supplies steam for the pump, as well as for the drills in the lime quarry. All roofs and buildings are protected with black acid-proof paint. The Assay office is built of brick, and has five rooms. The two muffle furnaces have muffles 19 inches long, 15 inches wide, and $7\frac{3}{4}$ inches high. They permit the assayer to work very comfortably and economically. A bath-house has been erected for the men, fitted with shower and hip baths, with a view to promote and conserve the health of all employed at these works. Over 4000 tons of lead, and 500,000 ozs. of silver, have been produced by these works during the first year of their operations.

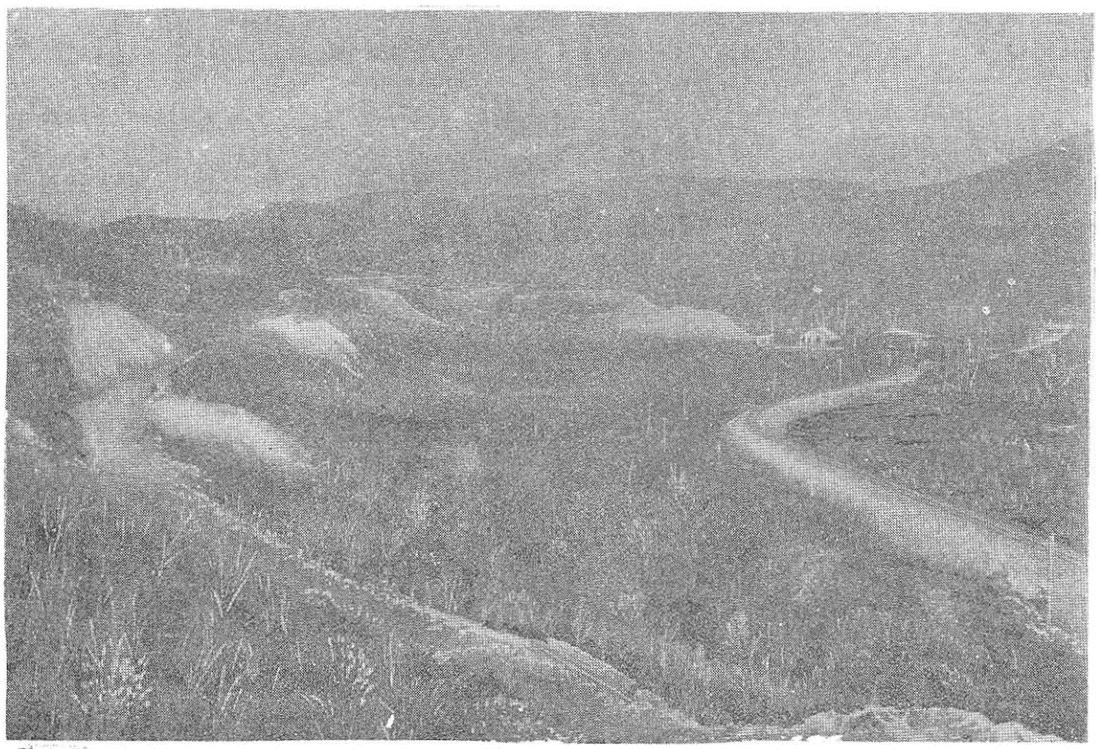
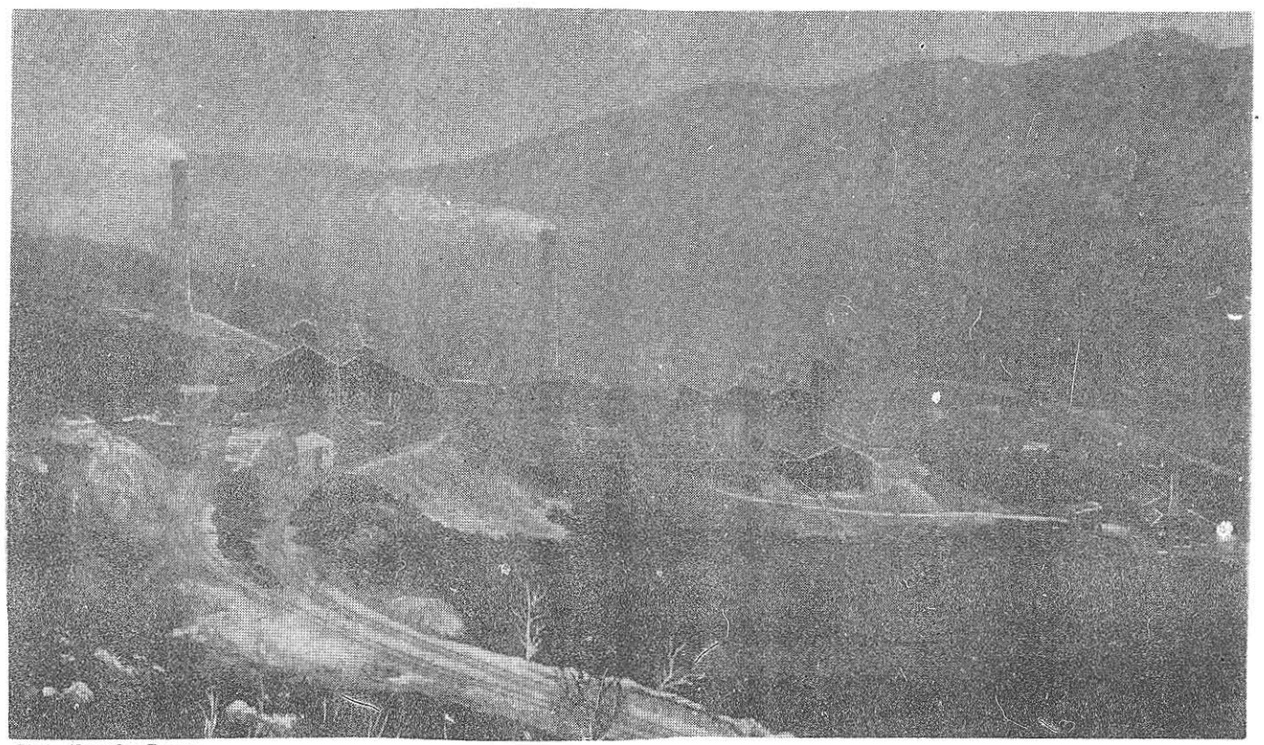


Photo-Algraphy Process.

SITE FOR TASMANIAN SMELTING CO.'S PLANT. ZEEHAN, JUNE, 1898



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IN FULL BLAST !

Tasmanian Smelting Co.'s Plant, Zeehan. June, 1899

DESCRIPTION OF THE TREATMENT OF ORE AT THE WORKS OF THE TASMANIA GOLD MINING AND QUARTZ CRUSHING COMPANY, REGISTERED, AT BEACONSFIELD.

By Joseph Davies, *General Manager.*

The ore, after leaving the mouth of the shaft, is tipped into passes, and delivered as required, to trucks, in a tunnel below. The trucks of ore are taken from this tunnel by means of an electric motor, which conveys them to the reduction works about one mile away. Here the quartz is tipped into three hoppers, each of which is placed immediately over a Gates' rock-breaker. From these hoppers to the rock-breakers the quartz is automatically fed by means of a portable tray, which forms the bottom of the hopper. These trays are perforated, so that only ore requiring breaking goes through the crushers, whilst the fines go directly to a large storage hopper, extending the whole length of the battery. From this large storage-hopper the ore is allowed to fall through doors into automatic feeders, by means of which it is fed into the battery. There it is crushed through fairly fine screens, the pulp then passing over amalgamated copper plates, thence over blankets to the concentrating plant, which is built on the Luhrig system.

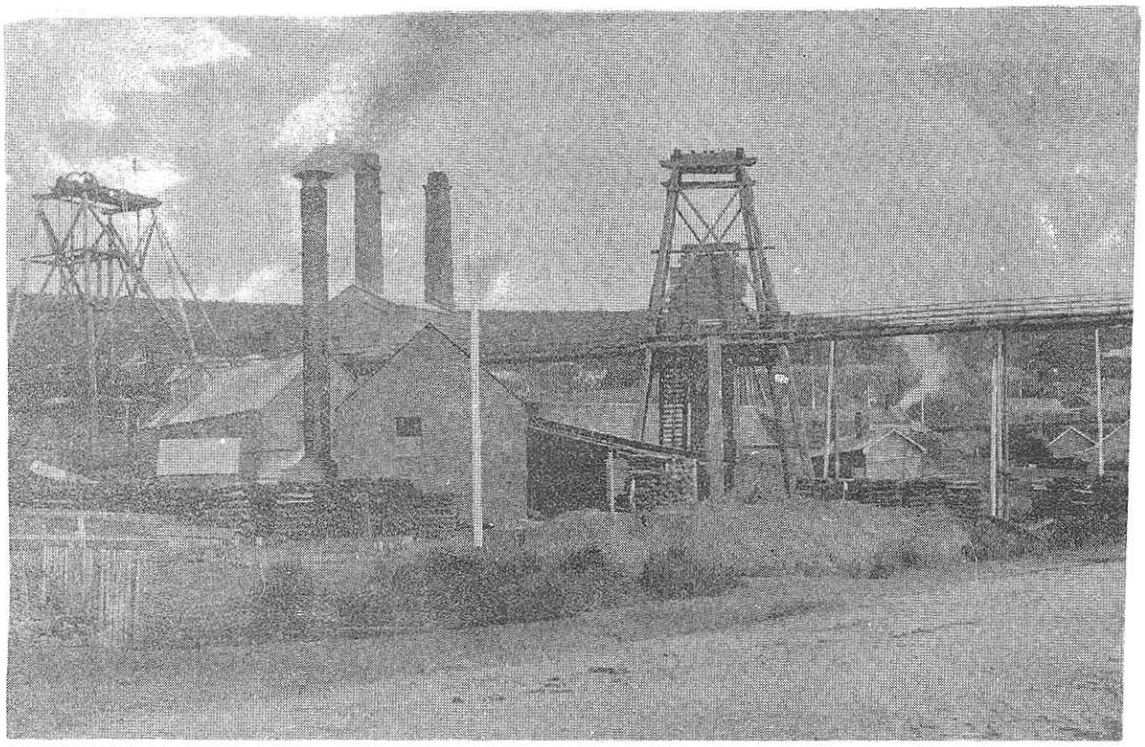
There are 65 heads of stamps running, which, for the purpose of classification of the crushed ore, may be considered to be divided into three systems, of 20, 20, and 25 heads of stamps each. There are two classifiers for each system. No. 1 is a box, triangular in cross-section, being shallow and narrow at the intake end, and wide and deep at the outlet. This shape gives a diminution of velocity as the pulp proceeds through the box, and allows the different grades of sand to settle into the inverted pyramidal-shaped compartments, into which the classifier is divided. From the apex of each so formed pyramid the graded sand is tapped. The finest pulp and slime passes from No. 1 to 2 box, which is a large Spitzkasten, also triangular in section, but the same depth and width throughout. The differences in grade are made by a regulation of the design of the compartments into which the box is divided. The first division of No. 1 classifier in each system divides its pulp to a small classifier, of two compartments, from which the pulp proceeds to jigs, of Luhrig design. These are of the plunger and screen type, and separate the mineral from the gangue in a very efficient manner. Besides these jigs, there are also 40 vanners, each of which takes its supply of graded pulp from an adjacent compartment in one of the classifiers.

The framework for supporting the working parts is of heavy timber, which is bolted to the foundation-logs. Between the uprights is an adjustable percussion frame, suspended in the frame by means of suspension-rods, to the ends of which are attached nuts for adjusting the degree of lateral inclination of the frames. On the upper side of the frame are two large rollers, the shaft of one of which has a small tooth-wheel, which is driven by chain-gearing from a small counter-shaft, while on the lower or under side are three smaller rollers. The percussion-table is arranged to have a lateral inclination, and the apron or belt thereon takes the same inclination. One rod passes through one of the uprights of the framework, on which is placed a percussion-block and plate, and a spiral form of spring attached to one end of the frame. Suitably attached to the end of the rod is a nut, with a washer adapted to bear against the spring. A similar rod is attached to the other end of the frame, and to the upper end of a lever, which is pivoted at its lower end to one of the sills of the framework. Suitably arranged on one end of the frame is a cam, which receives its motion by means of a belt passing over a pulley, located on the cam shaft. The cam is preferably so formed that it shall have one or more projections thereon, which act, when brought into contact with the lever, to depress or push it back, and with it, the frame. This compresses the spring, which, when the lever is relieved by the cam, draws the percussion framework so as to strike the plate with a sharp blow or percussion. A distributor of convenient form is arranged to feed the pulp on the belt at the upper right-hand corner. Along and over the highest side of the belt or apron, extending some distance parallel with it, and then running diagonally across the lower left-hand corner, is a jet pipe full of clarifying water. This water, at or near the distributor, assists in the separation, and, at the lower left-hand corner, removes, or washes off the apron the heaviest and last concentrates. Under the lower edge of the apron is a plate, which delivers the concentrates and separated minerals into a correspondingly divided receiving-trough. In this receiving-box are slides which may be adjusted just as the minerals separate themselves on the belt, and thus direct each particular concentrate into its own division of the receiving-trough, from which it passes on to the collecting-pit.

The ore crushed in the mill, as a rule, contains about 17 per cent. of mineral, which is separated from the sand by either the jigs or vanners. The concentrates so formed are reserved for treatment in the chlorination works, which form an important part of the treatment plant. The purity of the concentrates is regulated at will, to suit the requirements of the roasting furnaces, which, it is found, do the best work when a certain amount of sulphur is present in the ore. The ore is roasted in mechanically-rabbled furnaces, with ordinary reverberatory hearths of rectilinear form. They are Edwards' patent, of a comparatively new design, and work with most economical results. The capacity of each furnace is 50 tons per week. The brickwork of the furnace is carried by means of two iron girders, which are supported near their centres, so that the whole can be placed with any inclination of the hearth required. A system of rabbles, driven by bevel-gearing, is provided, to stir the ore and bring it forward, those at the fire end running somewhat faster than the others to ensure a thorough roast. The rabbles are kept cool by means of a stream of water, which is passed through them continuously. As, to obtain best results from a furnace, it is necessary that the feeding of the ore should be positively uniform, automatic feeders are provided. The feeding is done by means of a pair of archimedian screws (one left-handed and the other right), working at the bottom of a hopper placed at the feed end of the furnace, and extending over the arch at the feed opening. Salt is used, and the ore roasted dead. On the efficiency of the roasting depends the success of the subsequent chlorination of the ore. The roasted ore is

conveyed mechanically to a cooling floor, where it is allowed to take up a certain amount of moisture, and is trucked to the chlorination department. Chlorination takes place in vats 5 feet diameter and 4 ft. 6 in. deep, provided with a filter. The filter-bed is 6 in. deep, and is composed of coarse lumps of quartz, diminishing to fine stuff, and supported on a false bottom of wood, with half-inch perforations. The roasted and damped ore is sieved on to this false bottom until the vat is filled, Chlorine gas is then introduced at the bottom until the ore is impregnated, after which the vat is allowed to stand under gas until the gold is dissolved. The ore is now leached, and the solution run into collecting tanks, from which it is pumped into receivers. The precipitation of the gold is effected by charcoal. The charcoal is prepared by sieving and washing, and is so arranged that the solution containing the gold passes down one column and up another before leaving the filter. Once a month the charcoal is burned, the resulting ash smelted in crucibles, and the gold run into bars.

Beaconsfield, 8*th December*, 1899.



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TASMANIA MINE, BEACONSFIELD

REPORT ON GOLD MINES NEAR HOGAN'S TRACK.

Government Geologist's Office,
Launceston, 3rd November, 1899.

SIR,

IN accordance with your instructions, I visited some of the gold claims on or near this track on the 15th, 16th, and 17th October. Those which I was able to examine were the Brilliant, the Golden Ridge, the New Carthage, and the Double Event. I could not visit the Queen of the Earth, which lies by itself to the southward, and as no one is in charge there and the water would have to be baled out, I should not have gleaned much more about the field than I learned from inspection of the other claims.

Topography.—Access to this goldfield is gained by a fair bush road called Hogan's Track, which starts from the Fingal-Mathinna Road about three miles below Mathinna, and runs N.E. to George's Bay. At 10 or 11 miles along this track the Brilliant and Golden Ridge sections are reached. About a mile past the shaft of the Golden Ridge Syndicate, a two-mile branch-track goes off to the N. and E. down the four-mile hill to the sections worked formerly by the New Carthage Gold Mining Co., No Liability. Those sections are close to a tributary of the head waters of the Scamander River. Two more miles of footpath, now overgrown with fern and scrub, lead northwards across the valley up the hill on which the Double Event mine is situate.

The track from Mathinna to the Brilliant is passable for wagons and spring carts, but there are a few swamps along its course which are very difficult to negotiate in wet weather. Hogan's Track is being put in order right through to George's Bay, and it is to be hoped that it will be maintained in something like a decent state, as it is a convenient path for prospectors. The want of tracks has doubtless contributed to the neglect of this field by miners. Ascending from the flats of the South Esk the hill is very steep, and loaded wagons consequently go round by Marshall's Track, which diverges from the Fingal Road five miles below Mathinna and unites with Hogan's a mile west of the Brilliant. This is a mile further round, but the grade is easier: I went one way and returned the other. The track rises at the Brilliant to 700 feet above Mathinna, and at the Golden Ridge Hill to 900 feet—or 1600 feet and 1800 feet respectively above sea-level. The country is covered with fine iron bark, stringy bark, and peppermint timber with little or no undergrowth, and is an ideal one for prospecting.

Geology.—The broad alluvial fields forming the valley of the South Esk belong to the later Tertiary and recent periods. To the S. and W. of the river are the slates and sandstones through which run the gold-bearing reefs of the Mathinna field. These have so far proved non-fossiliferous, but are with great probability classed as lower Silurian. The dominant strike of the whole series is N.W.—S.E., and the mean dip is N.E., where not reversed by folds. After crossing the South Esk and emerging from the valley, the rising hills are composed of yellow sandstones covered with quartz detritus. These strata still belong to the Silurian series, but at about 300 feet above Mathinna they are overlaid unconformably by grey and reddish grits, sandstones and conglomerates. These can only belong to the Devonian or Permo-Carboniferous systems. I heard that casts of fosil shells had been found in some of the beds, and from the description given I recognised them as spirifers. These grits in places are coarsely crystalline and full of sharply-bounded crystals of brilliant black titanic iron, mistaken sometimes for cassiterite. I believe the beds are the lower members of the Permo-Carboniferous system. Higher up, at the Brilliant and the Golden Ridge, the grey, brown, and yellow Silurian sandstones, nearly vertical, with perhaps a slight dip to the E., form the hills. They are unfossiliferous, and the hill-crests for three miles traverse the strike of a monotonous succession of these sandstone beds. I tried to form an idea as to whether they are younger or older than the auriferous slates, but could not find data sufficient to warrant any definite conclusion. On the whole, however, I think they are younger, though certainly still members of the Silurian system.

The bed-rock of the whole field, though it can only be seen in a part of it, is granite. It is important to fully recognise this fact, as it is connected with a proper interpretation of the gold occurrences. It is of little use to spend time in examining in detail the veins of auriferous quartz, which ramify through the sandstone, and in wondering how they will behave in depth, unless we understand the relations between the sandstone and the rocks which underlie it. On the Brilliant or southern side of the Golden Ridge hill I could see nothing but sandstone and bands of quartzite. But half way down the northern side of this razor-like ridge, granite comes in and fills the bottom of the valley near the head of the Scamander, rising into high hill sW. and N.W., and forming the base of the hill on the east. Granite country is said to extend for ten miles to the north. At the New Carthage I saw it plainly underlying the sandstone. We have, therefore, decisive evidence of the position of the granite. It intruded at great depths into the sandstone sediments, hardening them at the contact, and probably contributing to their tilting. This granite upheaval and intrusion could not affect the Permo-Carboniferous grits and conglomerates, for the latter were subsequently laid down on the upturned edges of the older sandstones.

BRILLIANT MINE.

This claim now comprises three sections, viz., 109-93G, 10 acres, (the Brilliant proper), also known as Terry's Section ; 115-93G, 10 acres, called Marshall's Section ; and 602-93G, 10 acres, known as Shearn's Section. The first two are on the south side of the creek, and the third one on the north side.

East of, and near Mr. Terry's hut on Section 115-93G, is what is called Marshall's Reef, or the White Lode, a band of light grey to whitish quartzite about 5 feet wide, running N. and S., carrying quartz veins said to have yielded, on crushing, from 2 ozs. down to 14 dwts. gold. A pile of quartzite and vein-stuff, from 60 to 100 tons is lying at the mouth of a shaft which has been sunk 40 feet down on this reef. The stone will shortly be put through the battery which is now being erected on the Brilliant section. A horse of country seems to have split the reef, which at surface was 18 in. on western side and 3 ft. 6 in. on the eastern. The legs have united, and drives 10 to 12 feet are

said to have been driven N. and S. on the lode at the bottom of the shaft. The bottom drives were under water, and I did not inspect them. About 10 feet to the south there is an 11-ft. cutting to prove the reef, and at 25 feet to the north there is another shaft 20 feet deep. Still further N. is a small shaft 15 feet deep, showing four feet of mullock between false walls. On the E. side the face is unaltered sandstone, and on the west side, mullocky. The slope of the hill on the line of reef goes down 50 feet (vertical measurement) to the creek which divides the Brilliant properties from the Ridge Hill, but the reef itself is not traceable further north than the last-mentioned shaft. In the opposite direction it has been exposed in the cutting a few feet south of the main shaft, but I did not see any costeaning further south. Its bearing is true N. 12° E. As I could not get into the shaft, I did not take any samples of the stone, but the crushing will very soon prove its value. The name "reef" can only be applied to this course of stone for convenience. The quartz, the quartzite, and the sandstone of the country rock all have the same strike and dip, and the quartzite was no doubt originally sandstone too. I look upon the quartz as an infiltration vein between the bedding-planes of the sedimentary rocks. This infiltration has silicified the sandstone on either side of its path and converted it into quartzite. This is, it will be noted, a very different process from that of fissuring the rock and filling the fissure with reef material. The behaviour of the quartz beyond where it is visible cannot be predicted, nor can its continuance in any given direction be depended upon. The occurrence of gold in it, however, shows that it is continuous in some way or other with a deep-seated source. As far as can be seen, the make does not extend very far horizontally, and this shortness is an unfavourable sign for its behaviour at a depth. At the same time, if the results of the crushing turn out fairly well, the owners should drive on the make as long as they have it, and see what they can stope out. The result will guide them as to further sinking. At the main shaft the hard grey sandstone, which encloses the quartzite, changes, going E., to a softer variety, but, again, it becomes harder where a series of small auriferous veins run through the country. On the east side of the small creek on the Brilliant section the sandstone is light grey with yellow faces, and carries bluish quartz leaders. Some Mathinna people made a cutting here some 60 ft. long into the solid-bedded grey sandstone, which is dense and rather massive. It is still nearly vertical, or with only a slight easterly variation from the perpendicular, and encloses veins of quartz between its planes. A little N.E. of this a trench has been cut down to six feet in yellow and reddish gossanous matter, traversed by veins of bluish quartz, which may be the capping of some lode. However, I took a sample, which Mr. W. F. Ward, Government Analyst, has assayed, and reports to contain neither gold nor silver. This formation also runs with the country, which is hard, massive grey sandstone. Just W. of the Brilliant Creek there is a small soft yellow gossany band, about a foot wide, containing some gold-bearing quartz in grey, laminated sandstone. This is the only vein which I saw on the Brilliant sections tending to diverge from the bearing of the country. It comes in at the N.W. angle of the sink, and seems to make a little easting as it goes out to the south. In the eastern part of Section 109 is the Brilliant lode, bearing true N. 22° E., enclosed in pale grey quartzite standing in vertical beds. This band of quartzite widens out eastwards past the battery, and is, perhaps, altogether 150 yards in width. It carries two or three quartz veins. The reef has been traced some 20 feet south of the shaft, and surface pieces have been picked up in the gully a few hundred yards further south. It is intended to prospect in that direction : that is, indeed, one of the first things to be done by those who intend carrying on work here. About 9 chains S.E. of Marshall's shaft, a shaft has been sunk on the Brilliant lode to a depth of 30 feet. This shaft was unwatered while I was there. I found the lode in the bottom to consist of grey quartzite with strings of bluish quartz. At the north end of shaft this band or lode was 18 inches to 2 feet wide, and appeared to be squeezed out of shaft on the east side. It is thus pinched at the south end to a few inches in with. I doubt whether its disappearance is due to a change of direction. It looks as if the extremely hard quartzite had pinched it out. However, that could soon be tested by a cuddy east. There are no true walls to this reef : the apparent walls are faces of massive quartzite. It is unfortunate that its greatest width is at the N. end, for the ground there slopes down to the creeks. A little driving S. will have to be done to follow the reef into the hill. The shaft collar is about 60 feet below that of Marshall's shaft. A 10-head battery is now being put up. This seems to me to be premature, for I could not see more than 100 tons of stone at the outside ready for it, and no new stone has been broken yet. It will no doubt be welcomed by any other small claims which may be started in the neighbourhood, as this field is a good distance from Mathinna. A loaded wagon takes eight hours to make the journey from the township, and will cost the hirer 25*s*. per day.

What is called Jack's Lode, west of the Brilliant reef, is a band of five or six inches of altered quartzite, with a blue quartz leader an inch or two in width. A small shaft has been sunk on it 10 feet in the solid. The leader keeps to the W. wall and bends a little to the E. The band itself is in more defined quartzite each side.

I traced the sandstone strata eastwards beyond the eastern side-line of the Brilliant section : brown and grey massive sandstone, with cross jointing and small leaders of quartz.

On Shearn's section, 602, north of section 109, several old workings are found, mostly in yellow sandstone, all showing quartz veins, many of which are auriferous. On the saddle of the hill is Grueber's shaft, sunk 50 or 60 feet deep in yellow sandstone country, with a vertical leader 4 inches wide alongside 14 inches of gold-bearing gangue. Near here is Carney's shaft, 10 feet deep, also in yellow sandstone, with quartz veins, said to be auriferous : strike about N. 12° E. : bedding-plane vertical. The widest vein is 4 inches, and the thickness decreases to half an inch. These veins are often horizontal, running across the bedding. Going down the hill on the southern slope are numerous trenches and cuttings exposing quartz stringers, some of which I have found, since my return, yield good prospects. It is unnecessary to mention these in detail. There seems to be ample proof that the beds are everywhere traversed by thin veins and strings of quartz, very often gold-bearing. In the aggregate the quantity of auriferous quartz must be considerable, and it is no wonder that the field has aroused the hopes of gold-seekers.

For the proprietors of the Brilliant sections it is urgent to know whether there is a chance of these veins living down and making into solid bodies or reefs of quartz at a reasonable depth. After examining the country immediately to the N., I believe that the vein-matter is derived from the underlying granite, and that it will be exceptional to find solid reefs on these sections until the granite bed-rock is reached. On the other hand, as the granite is being approached, reefs may be met with. But all the evidence goes to show the sandstone country in this property (and I am speaking of these sections only, and not of the field as a whole, which I do not pretend to be able to judge from a cursory traverse) is not altogether favourable for reefs. The force which fissured the granite and produced, as we shall see, mineral lodes in it, was not sufficient, as a rule, to fissure the superincumbent slates also, and the silica merely found its way along lines of easy passage—the bedding-planes and joints. Any alteration or deviation in these divisional planes is sure to produce corresponding changes in the lines of quartz deposition. Thus it is impossible to depend upon the makes of quartz maintaining their original directions or any uniformity of thickness. There is nothing to be surprised at in this. It does sometimes happen when a

5 cm

GEOLOGICAL SKETCH MAP OF HOGANS TRACK

300 200 100 50 0

Scale of Chains

W. H. Twelvetrees
Government Geologist.

payable reef emerges from granite into sandstone that it degenerates into unremunerative stringers. The further question presents itself—at what depth will the granite be struck here? The answer can only be given after detailed survey. Approximately, however, we may reason thus: the Golden Ridge Hill is about 250 ft. above the bottom of the Brilliant shaft, and descends 1000 ft on the N. side, the granite mounts about half way up the hill on that side; consequently, if the underground surface of the granite intrusion is a horizontal plane, it would come through the hill southwards at about 250 ft. below the present bottom of the shaft. But we have no proof that the upper boundary of the underlying granite is horizontal: possibly it might sink into the form of a deep valley, receding to a great depth. Further, we cannot be sure of locating the points where the supposed reefs issue from their granite parent. In the absence of any surface exposure of granite on the south side of the Ridge Hill, I am not very favourably impressed with the chances of the Brilliant veins. If an undeniable reef could be found, the prospect would be altogether different. As it is, perhaps a small party might be able to knock out a living by working some of the richer veins. The outlook at the bottom of the main shaft is not promising at present, especially as samples of lode stuff which I broke from right across the formation, when assayed by the Government Analyst only yielded 6 dwts. 12 grs. gold per ton, and 8 dwts. 4 grs. silver. The present battery will not treat this kind of reef-matter effectively. But the vein must be further explored by driving south upon it with occasional short crosscuts, and the southern portions of sections 115 and 109 must be prospected more thoroughly than they have been hitherto. The discovery of a few rich veins, even if small, would soon pay for a lot of dead work.

Golden Ridge Mine.

No work is being carried on here now. Operations seemed to have ceased a couple of years ago for want of funds. The lease covers three 10-acre sections—90-93G, 110-93G, 111-93G on Hogan's Track, N.E. of the Brilliant. The Golden Ridge Syndicate Company, Limited, of London were the adventurers, and appear to have expended about £1000 on the mine without any results beyond establishing the existence of veins on the property assaying from 1 dwt. to 13 dwts. gold per ton. Want of success has probably been due in some measure to misdirected efforts. Of course, it was very natural to try and follow the veins where found to be auriferous, but a mistake was made in confining work to the southern side of the hill. The granite country comes in on the northern slope, and as there is reason for believing that the auriferous veins proceed from that rock, search should be made at the contact, and work set out accordingly.

There are two principal points at which work has been carried on—the Iron Blow and the main reef. The Blow is exposed on the top of the Ridge Hill, about 1200 feet above the valley to the N. A shaft has been sunk upon it 50 feet in depth. Being abandoned, I could not go down it, but the Hon. N. J. Brown has kindly placed at my disposal some of the mine reports and the assays of quartz. I could not establish the bearing of this outcrop with any exactitude, nor even assure myself that it is a reef at all, but it appears to run E. of north, and W. of south. The shaft is in sandstone with veins of good-looking quartz. The main vein is, perhaps, 10 inches to a foot wide, stained with iron oxide and green arsenate of iron. At 50 feet a 20-ft. crosscut was put in to the N.W. through sandstone. but no quartz was met with, and, in fact, no quartz is reported to have been seen in the shaft below a depth of 25 feet. In March, 1897, Mr. W. F. Ward, the Government Analyst, assayed sample from heap at top of shaft and found gold, 9 dwts 19 grs.; silver, 1 oz. 12 dwts. 16 grs.; but as the stone has disappeared in the shaft, and there are no proper walls to the formation, such as it is, which seems to be running with the country, I can only regard it as another instance of the unreliability of the quartz makes in this sandstone.

The main reef on the property has been sunk on in an underlay shaft to a depth of about 50 feet. The reef or vein is enclosed in sandstone, which here has a westerly dip. A smaller prospecting shaft has been sunk on this reef, known as Knight's shaft, from which four tons of stone were raised and sent for treatment. Two tons were crushed at the old City of Melbourne battery and returned 21 dwts. per ton. The other two were treated at the Ballarat School of Mines, and the Hon. N. J. Brown has permitted me to extract the results from the Laboratory Superintendent's report of treatment, as follows:—

One ton net yielded	17 dwts. 23 grs. bullion (fineness, 16 carats 1⅛ grs.)
Assay of barrel tailings	7 dwts. 20 grs. per ton tailings.
Weight of barrel tailings	2 cwts. 3 qrs. 22 lbs.
Assay of battery tailings (running)	15 grs. per ton.

Contents per ton of stone.	*Fine gold per ton.*
Bullion extracted at battery, 17 dwts. 23 grs., containing fine gold	12 dwts. 4 grs.
Left in battery tailings	15 grs.
Left in barrel tailings (chiefly in the pyrites)	1 dwt. 3 grs.
Total contents	13 dwts. 22 grs.
One ton net yielded	1 oz. 6 dwts. 21 grs. gold bullion.

Crushed in battery through 2500 holes to the square inch over Wynne and Tregurtha tables, then over Halley and blanket tables. The Wynne and Tregurtha concentrates were amalgamated in the barrel.

Yield from 1st ton	17 dwts. 23 grs.
Yield from 2nd ton	1 oz. 6 dwts. 21 grs.
	2 oz. 4 dwts. 20 grs.

bullion from the two-ton parcel=1 oz. 2 dwts. 10 grs. bullion per ton.

A deep tunnel has been driven N.W. into the hill on its southern fall to strike the main reef. The tunnel is in sandstone country all the way. At 340 feet in, a small quartz vein, heavily charged with arsenical pyrites, was cut, and the adit continued past it another 200 feet without any further discovery. The present end is in unmineralised sandstone with irregular massive heads unfavourable for driving, and with no indication of proximity to any mineral veins. The small vein cut at 340 feet was sampled where intersected, and assayed by the Government Analyst, who gives the result as 2 dwts. gold with a trace of silver. This vein is rather persistent in the drive, but varies a good deal in thickness. I did not see any stone more than two or three inches wide, and some of it only an inch. It is highly pyritic. The quartz, what there is of it, is kindly-looking. From all appearances this is the lode seen at surface, and yet I feel some doubt, as it is not running exactly with the country strata. The sandstones have been subjected to some moving force in this section, for the beds, which are dipping at high angles at surface, are seen lying rather flat in the tunnel. The property requires a thorough survey by a mining and geological expert in order to locate the veins and advise as to mine works. All the work done hitherto may be looked upon as preliminary, and serving to give some idea of the chances of the sections. It has exposed veins of auriferous quartz, but has shown that so far the stone is irregular in occurrence, and variable in quality. I do not know the latest results in Knight's shaft, but if the stone holds down it will have to be followed. The principal search work, however, must be taken in hand from the northern side of the hill. The surface conditions are favourable for cheap working. Adit levels are practicable; mine timber of excellent quality is plentiful; water power in the valley is available; the locality is healthy; and Hogan's Track passes through two of the sections; but if work is to be resumed, it must be laid out judiciously, and after taking competent advice.

NEW CARTHAGE MINE.

This is reached by a deviation called the New Carthage Track, which branches off from Hogan's Track to the N.E., a mile past the Golden Ridge mine. The path then descends the Four-mile Hill a thousand feet into a valley watered by one of the feeders of the Upper Scamander and carved out in granite rock. The principal mine work done is on the 10 acres, 1496-93G, known as Marshall & Miller's section, where an adit, just above the track near the base of the hill, has been driven 60 ft. S. 20° E. into granite. The approach is in 15 ft. of decomposed granite *in situ*. At 60 ft. it intersects a small quartz reef, which runs about W. 20° S—E. 20° N., dipping or underlaying south. The course of the reef has been driven on about 50 ft. each way. Being very near surface, the country granite is usually rather soft, though near the reef it is sometimes very hard, and is then a quartzose variety, with little or no felspar and abundant black mica. The adit did not intersect the reef at more than 30 ft. below grass, and an old stope worked from surface comes down to within 13 ft. or 14 ft. of the back of level. A rise has been put up over where the best stone was noticed, and for three feet up the lode was 12 inches wide, but above that small and broken. In the sole of the level at this point the stone is stated in the mine reports, lent to me by Mr. T. Furlong-Marsden, to have been 15 inches wide. None that I saw exceeded a foot, but the estimate may have included marginal mineralised material. In the W. drive the stone keeps to a fair hanging-wall, and is of very variable width. It is of a bulgy nature, thinning out and swelling every now and then. Three feet behind the end it is 6 inches wide, but in the end itself has pinched. This end is in rather decomposed and soft granite. The quartz is kindly-looking, and has a family likeness to a good deal of the East Coast auriferous stone. It does not show free gold; nevertheless, it has good gold contents. Its main visible characteristic is the arsenopyrite with which it is charged. It is often stained with arsenate of iron, and occasionally carries a little galena. Samples which I took from different parts of the reef in this drive have been assayed by the Government Analyst, with the following results :— Gold, 1 oz. 12 dwts. 16 grs.; silver, 1 oz. 12 dwts. 16 grs. I did not notice any galena in these specimens, from which the silver yield might have been derived. If, as is most probable, the whole of the metal came from the arsenopyrite, it is electrum, a natural alloy of gold and silver. In the E. drive the greatest width of stone which I observed was 9 inches. Sandstone country comes in in the end, and the reef is pinched out. A short crosscut has been put in on the hanging-wall of drive a few feet behind this end with a view to pick up the lode, but only granite rock was found. I am afraid it will not be of much use to drive this end any great distance further. It might, however, be continued a little way to settle whether the reef lives at all in the sandstone. The present drives are near surface, and the future development of the mine will have to be by sinking. A good stream just below the mine had water enough to drive 10 head of stamps, and the power can be increased by bringing in an auxiliary supply from a creek higher up : but the product from this reef will require treatment by smelting and parting methods, as the gold does not seem to be in the quartz but in the other minerals. I was told that 45 tons of stone were sent to Victoria for treatment, and yielded 4 oz. gold and 4 oz. silver per ton ; and I have learned since my return that another lode on the property has given a still higher assay. The assay returns show unmistakeably that the mineral is highly auriferous, and the next thing is to ascertain the quantity of mineralised stone which can be obtained. At present both ends are far from encouraging. The best plan will be to sink where the stone was best in the drive, but some trouble with water may be expected. Gold-bearing reefs in granite are not viewed favourably in this Colony, and this one seems very variable and bunchy. But we really know next to nothing of it, and, considering its contents, it is singular that it has not secured more attention. It is certainly small, but is too good to be left alone. The work done hitherto has been, strictly speaking, only prospecting, and it is time something is done to prove the value of the occurrence.

DOUBLE EVENT MINE.

This is also an abandoned claim, about a mile N.W. of the New Carthage. The track from the New Carthage runs north-west along what is marked on the Upper Scamander chart as the Scamander River itself, but which I was assured was only a tributary stream. About 100 ft. up the hill, which is granite all the way up, is a cutting on section 939-87G, which exposes a vein of quartz about 9in. wide. The bearing of this lode is about N. 67° E., and the character of stone resembles that of the New Carthage. It lies under six feet of soil and granitic detritus. About 20 chains N.E. of this is another parallel lode. On the main Double Event reef towards the top of the hill a shaft has been sunk 60 feet on the underlie. The bearing of this reef is N. 57° E., and it dips to the N. at a high angle. I could only inspect the shaft by looking down. I saw that it is in soft decomposed granite, getting harder going down. The stone is on the N. side of the shaft, and is 10 or 12 inches wide at the top, widening out, I am told, as it descends to two or three feet or more : this, of course, I could not see. There is a short cuddy N. at bottom of shaft. The stone from the shaft is of a solid and encouraging appearance. I was told that quartz from the bottom had assayed 4 oz. 6 dwts., but quartz selected by myself from the pile at mouth of shaft and assayed by the Government Analyst only yielded 3 dwts. 6 grs. A tunnel to the S. will cut this reef at about 70 feet depth, or ten feet below the present bottom of the shaft. The reef is exposed further E. in a small sink ten feet deep, which shows good bluish quartz 18 inches wide, and widening to the N. going down. It has been uncovered at intervals along its course eastwards some 100 feet or more, and for some distance also westwards. At the top of the hill further E. it is covered by the sandstone strata. The way to develop this mine is by adit, cross-cut, and drives E. and W. : particularly E. At a good height and in a remote locality, the mine, though not particularly difficult to get at, is rather unfavourably situated ; and if the average yield from the stone is no more than the low assay return just quoted the outlook is unpromising. The appearance of the quartz is inviting, and there seemed to be more of it than I had seen elsewhere on this field. I am in ignorance of the results obtained from previous work, and particularly as to whether it was discontinued owing to the stone or the gold-yield falling off, but judging from the little I was able to see, I should recommend renewed trial on a moderate scale.

In terminating this Report I beg to thank Messrs. Geo. Carney and S. Terry, jun., who took me over the ground. As will have been noticed from my remarks, the field is broadly divisible into two sections : the sandstone and the granite areas. The Brilliant workings are in the former, the New Carthage and Double Event in the latter. The Golden Ridge mine is in the sandstone, but the property comprises both. In the granite portion of the field the reefs are true lodes : in the sandstones they appear as small veins, often deflected by the bedding and joints of the sedimentary strata. Even in the granite the reefs are not large, and in both granite and sandstone the nature of the gold appears to be the same—viz., alloyed with a large proportion of silver, the latter sometimes in excess of the former. I have formed a more favourable opinion of the granite area than of the sandstone country, but both require more prospecting than they have had hitherto.

I annex map and section to illustrate the present Report.

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

W. H. TWELVETREES,
Government Geologist.

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

REPORT ON SOME TIN MINES IN THE ST. PAUL'S RIVER VALLEY, NEAR AVOCA.

Government Geologist's Office,
Launceston, 28th October, 1899.

SIR,

IN accordance with your instructions I examined the deposits of tin ore in the St. Paul's River Valley on the 10th, 11th, 12th, and 13th instant, and have the honour now to hand you my Report on the same. The properties inspected were the Roy's Hill and St. Paul's Tin Mines.

ROY'S HILL MINE.

This is situated in the south-west angle of the Robert Hepburn 2560-acre block. It is on a low hill 6 miles east of Avoca, and about half a mile south of the Avoca to Swansea Road, which runs eastward along the southern bank of the St. Paul's River. This river flows through the St. Paul's Valley, which near the mine is flanked by St. Paul's Dome on the north, and the Snow Mountain Range on the south. Avoca itself is built on a basalt area: the river there flows in a basalt channel. On the way out to the mine, on the north side of the bridge over the St. Paul's River, a granite spur comes down across the road, showing large weathered boulders and enormous flat surfaces of granite rock in the grass. The hog's back form of some of these boulders reminded me of glaciated roches montounés, but I could not detect any ice-scorings. On the south side of the river, immediately on crossing the bridge, vesicular basalt is seen overlying soft tertiary sandstone with concretionary ironstone. The St. Paul's River Valley here widens into a broad grassy plain (the Benham Plains), thickly strewn with cellular tertiary basalt, which continues for a mile or two eastwards. The valley of the St. Paul's was no doubt originally scooped out of the granite. In its deeper portions, and in the upper part of these, it has been filled with detritus from the Permo-Carboniferous and Trias-Jura rocks, and this, perhaps, covers up an earlier lead or gutter containing the stanniferous waste of the granite.

Turning off to the south, and taking the bush track which leads to the base of Roy's Hill, the soil appears to consist of the tertiary waste of Permo-Carboniferous sediments. About a thousand yards along this track brings the traveller to the mine hut at the foot of the eastern slope of the low hill. Standing at the back of the hut, and facing the west, we see a hill in front of us, in the form of a ridge, running, roughly, north and south. This hill is covered with Permo-Carboniferous sandstones, grits, and conglomerates lying in horizontal beds, mostly concealed by sandstone detritus and quartz gravel. The sandstones at the top of the hill overlie some 20 feet of stanniferous wash and conglomerate. Geologically, this occurrence of tin-bearing alluvial of Permo-Carboniferous age is highly interesting. Works in the wash have shown the existence beneath it of a band of tin-bearing quartz-mica rock or greisen. This greisen is sometimes quite typical, but for the most part has too little mica to be altogether normal. It is often very dense and hard, consisting then mainly of quartz spangled with silvery-white and bronze-yellow mica, and, in this state, is a poor carrier of tin ore. In other places the mica becomes more abundant, and the rock softer and more favourable for metal. The mica mineral apparently belongs to the Lithia group, either lithionite—a lithia-iron mica, or lepidolite—a mica in which potash is partly replaced by lithia. The latter can only be safely distinguished from muscovite by the lithia reaction. I have not been able to detect any crystals of felspar in the rock, but the kaolin which occurs occasionally would point to orthoclase. Tourmaline in short, slender prisms, is a constant accompaniment, and sometimes the rock is wholly a quartz-tourmaline one of bluish hue. I searched a good deal for granite, but was unsuccessful, though I found a tourmaline quartz-rock much resembling granite, but without felspar. The Permo-Carboniferous strata southwards from the mine repose on the granite of the higher hills, and though I could not see granite *in sitû* on Roy's Hill, I have no doubt that it underlies it, and is, in fact, immediately below the sedimentary beds. It was, moreover, discovered by Mr. Montgomery at some spot which we could not find.

The remarkable horse-shoe form of the workings was sufficient to suggest to me that they are not on the line of a fissure lode. The great feature of this property, from a tin-miner's point of view, is that the tin-bearing rock is a greisen or quartz-mica mass. Wherever we have to do with greisen we are dealing with a modification of granite, altered granite, if you will. It is not necessary to look for true lodes as a *sine quâ non* for tin ore. The plane of contact of one rock with another is sufficient to constitute a direction of least resistance, or a line of easy escape for the fluoride. Thus the marginal part, and not the central part, of a granite mass (except along joints) is the part most likely to be "greisenised." Assuming tin to have been brought up in combination with fluorine, tiny crevices admitting the fluoride are all that is requsite for introducing solutions which exert a destructive action on granite. Once the enemy is admitted, it finds its way through the rock mass, altering and corroding, removing original mineral, and depositing tin oxide along the path of its ramifications wherever the conditions of deposition exist. That tin was introduced as a fluoride is probable, from its constant association with minerals containing fluorine. Thus, both lithionite and lepidolite micas contain fluorine. Tourmaline does the same; likewise topaz, which is associated with tin ore at Mount Bischoff, Bell Mount, and elsewhere. The tin, separated from its fluorine, which passed over to combine with silica, &c., encountering water in rock interstices, combined with oxygen, and would then be precipitated as oxide. For this process, as said above, no wide fissure is required, nor molten lode rock; consequently, the owners need not be discouraged by the mere fact that the Roy's Hill deposit is not a lode. It calls for a little more circumspection than true lode-mining, but that is all. The tin deposit is not quite so easy to trace as if it were contained in a channel between properly defined walls. It will follow the sinuosities of the margin of the underlying granite, and will necessarily be somewhat troublesome to work, but if the metal is there the wit of man will devise the means of winning it.

No one who knows the history of mining on this hill will be disposed to doubt the existence here of tin ore in considerable quantity. A good deal has been sent away, both from the wash and the greisen rock. I am not able to state the exact quantity raised, but, from what I was told, I should imagine it to be between 50 and 100 tons. Four or five tributors have been at work for the past fifteen months, but want of water has interfered greatly with their operations, making alluvial mining a business mainly for the winter season. They have won three or four tons of ore, but are now relinquishing work for the season, owing to deficiency of water.

Mr. Montgomery's Report of 5th October, 1893, deals fully with the work on the hill to that date, and I need only touch on what has been done since. The tributors have confined their work to the alluvial on the western side of the hill. A trench about 150 ft. long, south of No. 1 shaft, has been deepened to 14 ft. A 24-ft. shaft here has been sunk 20 feet in sandstone and wash, the remainder in dense quartz-mica rock, with a little tin. At the S. end of the trench, a 30-ft. shaft is sunk. The first 6 feet are in bedded sandstone, below which are 10 feet of decayed conglomerate, with angular tin crystals in the matrix. This gives place to the underlying solid rock, which is composed of granular quartz, specked with tourmaline, and carries veins of tin ore. Northwards, in this trench, we have another section of the same ancient conglomerate. The surface soil is studded with angular white quartz detritus. Below this come 6 feet of sandstone, lying on twenty feet of conglomerate, containing large blocks of sandstone and rounded quartz and quartzite pebbles, some 7 inches in diameter, embedded in a wash of quartz detritus and lithia mica. This stanniferous wash is also seen further N. In a cutting N. of No. 1 shaft, underneath 6 feet of solid yellow sandstone, is the same tin-bearing conglomerate. In one of these trenches I noticed beds of micaceous grit and sandstone overlying a wash of rounded quartz pebbles in a sandy matrix, resting on quartz-mica rock. On the ledges here some good nuggets of tin ore have been found. The lower part of the wash consisted of about twelve inches of tin-bearing quartz cement.

A few hundred feet lower down on the western slope are some trenches in the surface soil, yielding stones of quartzite, sandstone, etc., and Mr. Fritz Rübenach, the tributor, told me that some good tin had been obtained from this wash. This tin has evidently come down from the hill-crest: there is none *in sitû*.

On the top of the hill is an old shaft said to be 40 feet in the conglomerate and wash, and from which a drive E. is stated to have been advanced in the same formation for some distance. In this case the shaft is not deep enough to be of any use.

The tributors have cleaned up some of the old excavations on the N.W. portion of the hill. As may be supposed, they did not work systematically, and avoided blasting ground as much as possible. From ground left by them in one of the shafts I obtained some rich bulky samples of tin ore. The crosscuts E. at the top of the hill, recommended by Mr. A. Montgomery, do not seem to have been put in, and we are as much in the dark as ever with reference to the exact width of the greisen band. This greisen forms the contact between the granite and the (Silurian?) slates, etc. to the west, but even if the stone nearest to the Silurian contact is usually the most favourable for metal it is not necessarily always so, and until the stone on the granite side has been tested we do not know how it behaves.

As all the shafts were full of water, and no one at hand with reliable information respecting old work, I had to be content with what I could see, and am somewhat at a disadvantage when approaching the question of recommendations for future work. However, the abandonment of the shafts may be safely taken as an indication that the ground ceased to be remunerative, but none of these shafts exceed 50 feet in depth, and no one can seriously regard that as sufficient. If the greisen modification of granite had been the result of the action of meteoric waters percolating from above, these superficial explorations might possibly have sufficed. But greisenisation is due to deep-seated pneumatolytic action, and is undeniably and absolutely independent of proximity to the surface. We may go to any depth and find it still. Although it is a disease of the granite it is not a disease of superficial degeneration and decay; it is a transformation of the rock under the influence of vapours and solutions carrying tin. Admitting the plutonic origin of the rock, the supporters of the lateral secretion theory of lodes contend that the metal has been derived from the adjoining country-rock. They point to the fact that the rock-forming minerals entering into the composition of tin-bearing granites contain a little tin themselves, and they then conclude that the metal in the tin-stone has been brought from this source. The inference is that, when these minute quantities have been exhausted from the adjacent country, the lode will become barren. It is perfectly true that small quantities of tin ore have been found in the felspar and mica minerals of granite. Thus Scharizer found 0·064% SnO_2 in lithionite, and 0·157% in lepidomelane. Niemeyer found 0·10% in Zinnwaldite (lepidolite, lithia mica). Schroeder found 0·223% in dark mica, and Schulze even 0·32%. A. W. Stelzner had samples of felspars from stanniferous granite in the Erzgebirge very carefully isolated and analysed, giving 0·016%, 0·018%, 0·0191%, 0·03%, 0·0301%, 0·0748%, 0·083% SnO_2.*

But we need not assume that the accumulations of tin binoxide which are mined have been concentrated from original homes in the mica and felspars; the reverse is conceivable. These minerals have more likely received their quota of metal from the solutions which permeated the granite, often penetrating within felspars, attacking their very substance, and precipitating the tin in the crystals whose interiors they had ravaged. The silicon and fluorine will account for most of the destructive action evidently exerted on granite wherever we find it tin-bearing. Pseudomorphs of cassiterite after felspar often occur in such granite: the muscovite or potash mica is found altered to stanniferous lithia mica; and, while the felspar has been removed, quartz increases to the extent familiar in most tin-bearing granites.

The tin has been brought up from below, and hence there is no reason to fear that the rich tin ore found in the superficial portion of the rock on Roy's Hill will not be found also in depth. Along the horse-shoe line, for some 400 or 500 feet, good tin ore has been found near the surface; but I am told that the matrix in the shafts which were sunk became harder, and poor in metal. I do not know that the greisen band has been fully tested in these workings. The stone may be now richer on the hanging wall or contact side, and now on the granite or footwall side, though the word "wall" is perhaps a misnomer. It is true the dense quartz-rock, with a little mica in it, thrown out of the shafts, does not look encouraging, but then the stuff has been all picked over,

* J. H. L. Vogt. Ueber die relative Verbreitung der Elemente in Zeitschrift für praktische Geologie. Sept., 1898., p. 315.

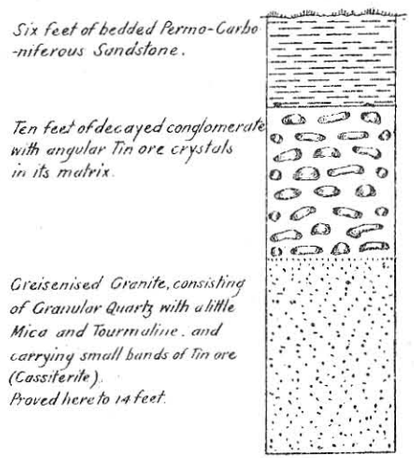
5 cm

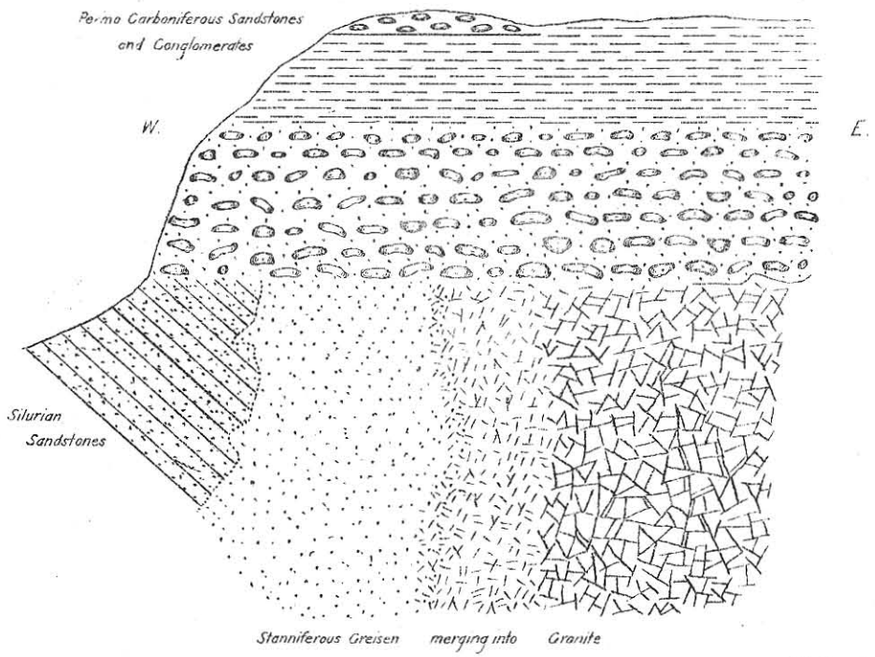
SECTION OF STRATA AT ROYS HILL MINE

0 5 10 20
Scale of Feet.

VERTICAL SECTION OF SOUTHERN SHAFT ROYS HILL

20 10 5 0
Scale of Feet.





W. H. Twelvetrees,
Government Geologist.

5 cm

SECTION ALONG line A—B

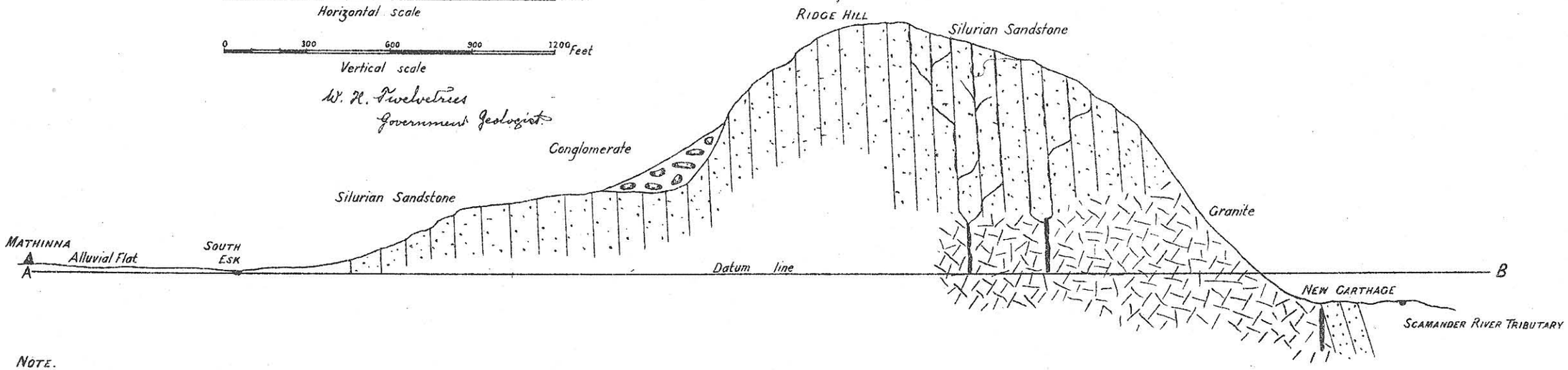
0 1 2 3 4 Miles

Horizontal scale

0 300 600 900 1200 Feet

Vertical scale

W. R. Twelvetrees
Government Geologist



NOTE.

Lodes and veins diagrammatic only.

and it is not easy to judge now the value of the stone extracted.

I think surface exploration has been conducted quite far enough along the line in a southerly direction. Deeper work is now required to develop the mine. This can only be carried out by shaft-sinking. For convenience of working, the most suitable place for a shaft would be somewhere about midway along the N. and S. line on the western edge of the hill; but, apart from considerations of convenience, the most southerly of the existing shafts, or the shaft north of it, is in a promising position for remunerative work, as the indications in both of these shafts are good. A shaft 150 feet deep would place the owners in a position to drive N. and S. along the metalliferous line at a reasonable depth, taking care to crosscut and thoroughly explore the mineralised band. As mentioned already, the direction of this band being conditioned by the contour of the granite, the underground workings will be irregular and inconvenient, for they will wind about with the boundary line of the eruptive rock. What may prove a serious factor is the underground dip of the boundary plane of the granite. There can be no regularity in this, and if it flattens very much work will become difficult and expensive. Judging, however, from the slope of the hill and the depth of the wash and apparent body of Silurian sediments on the western side, I am inclined to think that no insurmountable difficulty will be encountered.

Seeing that such good tin has been obtained here in the past, it is a pity that the property is lying idle for want of courage and capital. Of course there are no really remunerative returns in sight, and, I should add, that I have no information upon a rather important point, namely, how much of the past output has been derived from the quartz-mica rock, and how much from the tin-bearing conglomerate? It is possible that the returns have been largely increased by the contents of this conglomerate or wash. Unless the returns from these two sources are kept separate, a false estimate of the value of the mine may easily be made, for the wash, richer than the rock, is limited in extent, and a little steady work would soon exhaust it. I invite the owners' attention particularly to this point, for it may turn out that the reputation of the mine as a tin-producer rests mainly upon the conglomerate which holds the concentrated tin ore of the underlying greisen; consequently, it is a matter of first importance to prove the value of the solid stanniferous rock. This rock has apparently given some good ore in the past, and it is probable that exploratory work, carried out judiciously, and on the lines suggested above, would discover further patches or bodies of payable stone. A long line of the greisen rock having been traced at surface carrying patchy tin, there is no reason why similar rich patches should not be met with at various levels and points below. Such patches are eminently characteristic of greisenised granite, and the deposit will certainly be of this nature. Under these conditions it is useless to expect continuous payable stone.

Prospecting on the E. part of the hill ought not to be neglected, but serious attention should be confined to the western works, where payable stone has been extracted.

The water difficulty will have to be overcome for dressing purposes, but no expense for machinery should be incurred before sufficient exploratory work has been done. The adventurers will be guided by the result of this. I am told that the Snow Creek will not give sufficient water for machinery purposes throughout the summer, but I daresay a site might be selected for a dam and storage reservoir as an auxiliary. To bring in a race from the St. Paul's River would mean a length of perhaps three miles, but it would be the most efficient way of obtaining the necessary power for a crushing and dressing plant.

The conclusions drawn from the examination of this mine are as follows:—

1. The tin ore is not deposited in a fissure lode, but is disseminated in free crystals through a quartz-mica rock, which is a metamorphic or modified form of granite = greisenised granite.
2. This transformation of the granite has taken place at its contact with Silurian sandstones and slates.
3. The greisenised rock is richest in tin near its contact with the Silurian strata, and becomes poorer the further it recedes from the contact.
4. Overlying the greisenised rock are horizontally bedded sandstones and conglomerates of Permo-Carboniferous age.
5. The granite is probably Devonian, and was already greisenised and denuded in Permo-Carboniferous times, as shown by its rounded smooth outline in one of the trenches, and by the fact that mica and tin-ore crystals liberated from it are found in the matrix of the conglomerates. Tributors have found this Permo-Carboniferous alluvial tin deposit rich enough to work. A portion of the output of the mine has doubtless come from this conglomerate, and this fact has an important bearing upon the value of the mine as a whole.
6. The greisenised rock will be excessively inconvenient to work, as its direction will continually vary with the outline of the granite mass. It will wind in and out horizontally, and its dip is liable to change irregularly all through the quadrant from 0° to 90°.
7. Under these conditions the deposition of ore does not possess the regularity and constancy characteristic of lode deposits, but will be found to be irregular; good patches will be separated from one another by barren, or at least unremunerative, ground.
8. The best way of testing the ground will be by a shaft or shafts of moderate depth, and then exploring underground by drives and crosscuts.

It is evident that mining profit or loss depends upon the ratio of good patches to dead work. Future trial alone can show whether the richer parts of the rock will pay for the barren ground. A good deal of desultory surface work has been done, but all the shafts were stopped when the rock became barren. The deposit, therefore, has not been adequately tested, and should not be abandoned before deeper prospecting has been tried. There is nothing in the geological conditions to prevent the deposit, as a whole, from living down to a great depth.

St. Paul's Tin Mine.

This mine is ten miles east of Avoca, on a Mineral Lease No. 1683-93M, covering 40 acres, with an additional area of 200 acres held under a prospecting licence. Its position is a mile and a half south of St. Paul's River, opposite to the Brookstead estate and S.E. from St. Paul's Dome. The Avoca-Swansea Road passes the property a mile to the north, and a bush track, practicable for carts, connects the mine with the road. The mine was worked in

the eighties by the old St. Paul's Tin Company, by whom it was held till the end of 1893. It was then forfeited, and was subsequently taken up by the present owners.

Geology.—The St. Paul's Valley here shows corresponding rocks on the N. and S. sides, and is evidently a valley of erosion. The lofty St. Paul's Dome and the mountain range on the N. side of the river are capped with mesozoic dolerite (diabase is the altered form; greenstone in the vernacular), flanked below with sandstones and shales of our Trias-Jura coal measures, beneath which are Permo-Carboniferous mudstones and limestones reposing upon granite, the foundation rock of the district. Further west, the coal measures overlie Silurian strata, the latter disrupted by granite. The same general succession is observable on the S. side of the St. Paul's River. Leaving the road, and striking due south towards the St. Paul's Mine, the surface soil is seen to be full of detrital quartz; once on rising ground, loose blocks of country granite, and finally the granite itself, *in sitû*, are met with. This rock is the same coarse-grained granite, with biotite, mica, and large porphyritic felspars, which occurs at Brookstead, Roy's Hill, St. Paul's Bridge, and elsewhere in the tin districts of the north-eastern part of the Colony. Some of the felspars exceed an inch in length, and are sometimes equally broad. The river basin has been formed in this granite rock. A mile to the S.W. fossiliferous Permo-Carboniferous limestone occurs, surmounted by Trias-Jura sandstones, above which towers the diabase crest of the high E. and W. range to the south of this valley. To the S.W., however, the granite sometimes abuts directly on the diabase (dolerite), which is younger than the former, though in this direction, too, I found Permo-Carboniferous mudstones. In this part of the St. Paul's Valley I did not find any basalt.

Mine.—Confining my remarks at first to the 40-acre central section of St. Paul's, I may say that the general mining features of the hill which forms the block are the numerous lines of outcrop of quartz-tourmaline, granitoid tourmaline-quartz, and tourmaline-mica-quartz courses traversing the property and intersecting in different directions, the country rock being the coarse porphyritic granite abovementioned. The dense bluish bands of tourmaline rock specked with quartz are very striking. These are either poor in tin or contain none at all, but are generally associated with the occurrence of tin ore. Sometimes they run through the coarse country granite, sometimes they form bands in the more quartzose modifications of granite. This quartzose granite is in a form somewhat resembling that of a dyke traversing the ordinary granite, and contains tin ore, sometimes disseminated through its mass, at other times developed in its joint planes. Some of these hard tourmaline courses can be traced half through the property or more, but more frequently they form short "makes," parallel or inclined to each other. On examining several of these tourmaline courses minutely, I found that no wall or sharp line of separation marked their junction with the country-rock, but that the tourmalinisation of the adjacent granite was shown by an irregular extension of the tourmaline into the granite, and of the granitic quartz into the tourmaline. In some cases the granitic quartz rock is imperfectly tourmalinised, so that we have a rock partly granite, partly blue tourmaline. I very much doubt the propriety of calling these tourmaline courses "lodes." I believe them to be products appertaining strictly to the granite rock. In other words, they are probably due to a fluoride permeating the country-rock along the planes of jointing. The same action caused the silicification of the granite in the neighbourhood of the joints and the deposition of the tin ore. I believe this will account for most of the tourmaline and quartzose courses on this property. The ore is, accordingly, very free and beautifully crystallised: crystals of amber and ruby tin are not uncommon. In the tin-bearing granite a bronzy lithia mica is often developed, converting the rock into an imperfect greisen, another fact in support of the above idea. An important support of this interpretation is to be found in the way in which the apparent lodes intersect. If these were true lodes we should find heaves or lateral displacements at many of the crossings; but though they sometimes cross at right angles, or nearly so, the tourmaline bands keep on their course without a break or deviation, or, failing that, come to an abrupt end.

As underground work has not been carried on lately the shafts are not unwatered, and I could form no opinion of the ore-courses by inspection of underground. My remarks must therefore be taken as based entirely on a surface examination.

What is called No. 1. lode is an E. and W. course of tin-bearing stone which has been sunk upon in the western part of the property. Here there are two shafts, one 70 feet, the other 50 feet deep. The lode in the bottom is said to be from three to four feet in width; this I could not verify. I examined the stone at the mouth of the shafts and found it to be a tourmaline-quartz rock with a little mica of the lithia variety, and some of it containing nicely-crystallised cassiterite. Some of the rock is coarse and more granitoid; some nearly pure tourmaline. I believe the entire phenomena to be those of a modification of the granite. At the bottom of the hill on the W. side an adit level has been begun, and driven E. a distance of 150 feet, I am told, to pick up the lode and follow it into the hill. It would come about 30 feet under the bottom of the 70-feet shaft, and nearly 100 feet below the bottom of the 50-feet shaft higher up the hill to the E. To open up this course of stone I should advise the 50-feet shaft to be deepened to about 150 feet, so that the long adit could be continued, and communication effected; a crosscut N. could then be driven to intersect parallel ore-courses in that direction. The course immediately to the N. has not been tested sufficiently for me to express any opinion of it, but the course further north, No. 4, or Red Lode, as it is called, seems to be more important. It looks as if it would junction with the No 1 lode at the top of the hill. From its surface bearing it appears to run into that lode from the N.W. at an angle of about 25°. A shaft 30 feet deep has been sunk on it. It is stated to have given the best ore of any of these lodes. Naturally, the richest stuff has been disposed of, but tin-bearing samples can be selected from the heap at the mouth of the shaft. Some fine ruby and ember tin crystals are met with. The stone is tourmaline quartz, often coloured red with iron oxide. Good tin-bearing wash covered it up until it was discovered in sluicing.

The above seem, so far, to be the most important ore-courses on this block. The rest, which are numerous, are mainly lines of blue tourmaline stone, with a little tin ore on its faces now and then, as well as in the granite which immediately borders it.

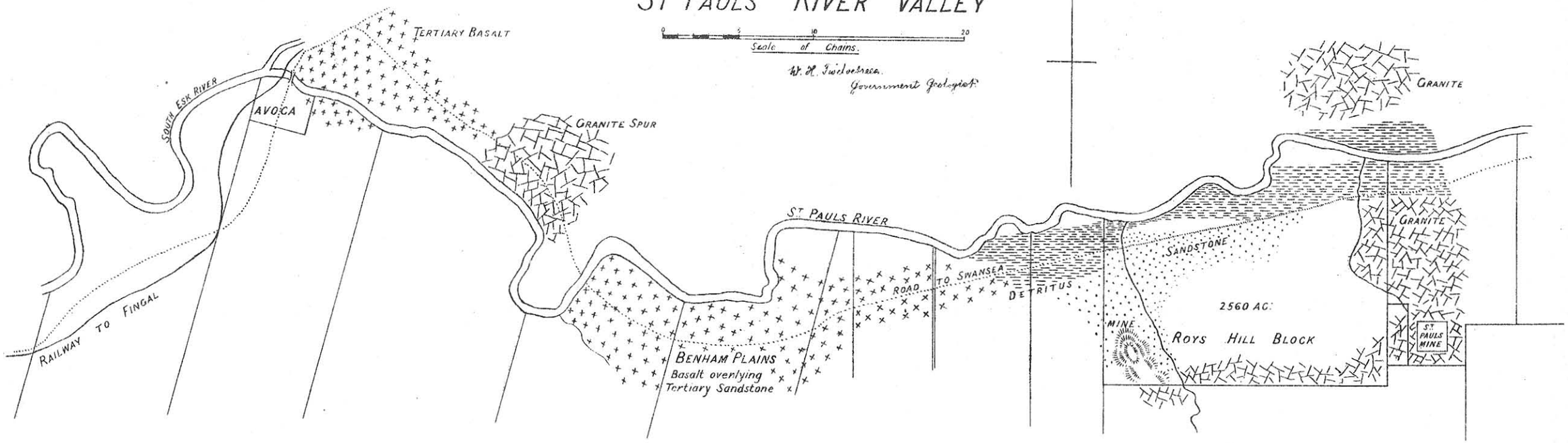
To the N. of the 40-acre block is an alluvial flat, and further N. is a rather steep hill, called the Razor-back, some 100 to 120 feet in height. At the top of this is a course of stanniferous granite, which has been sunk upon to 30 feet. This is about 3 feet wide, and resembles an elvan course. The rock is granitoid in character,

5 cm

Geological Sketch Map of ST PAULS RIVER VALLEY

Scale of Chains. 0 5 10 20

W. H. Twelvetrees.
Government Geologist.



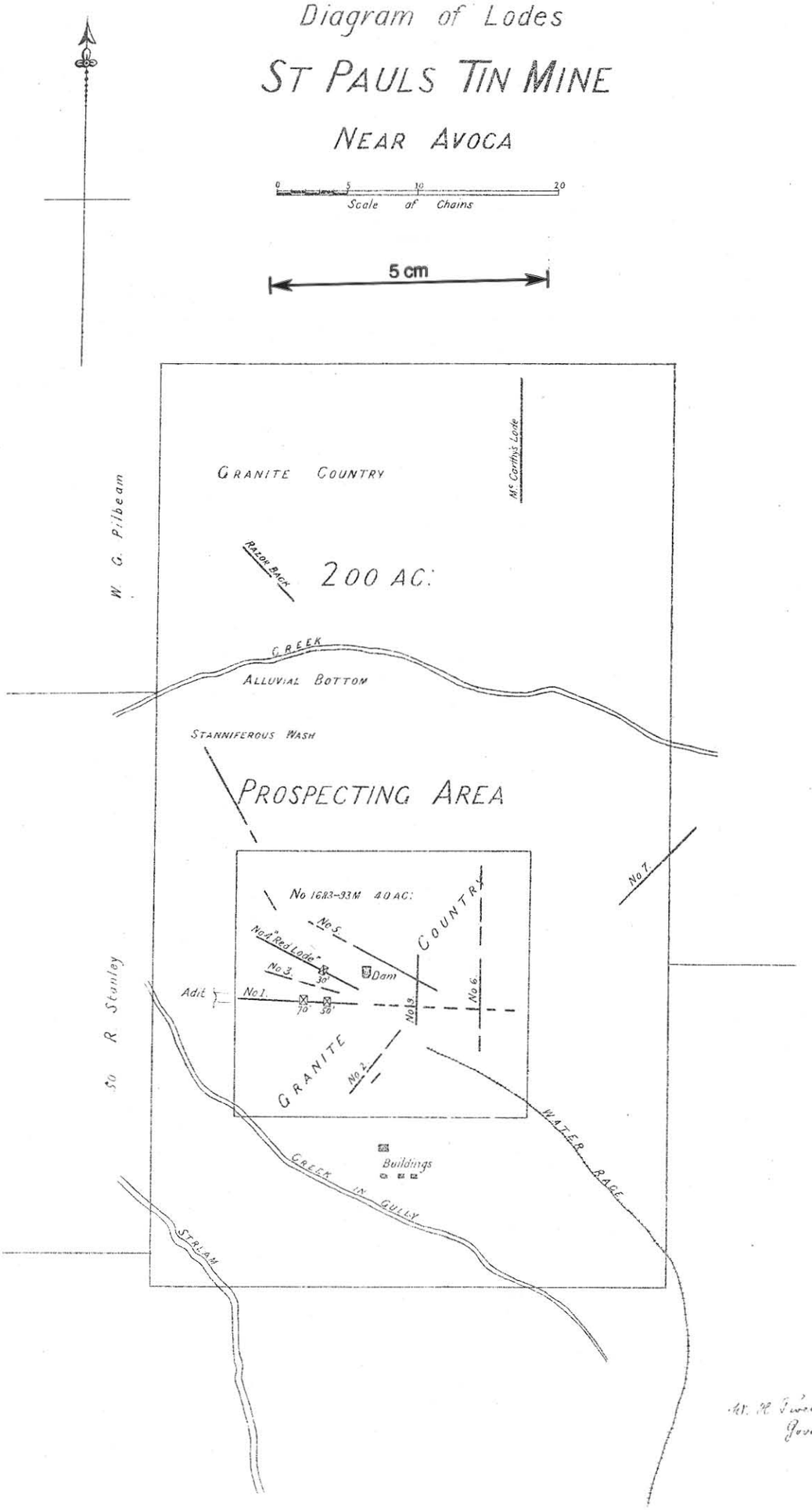
REFERENCE

- Recent and Tertiary detritus and alluvium
- Tertiary basalt, often vesicular
- Permo-Carboniferous sandstone
- Granite, the basement rock of this field.

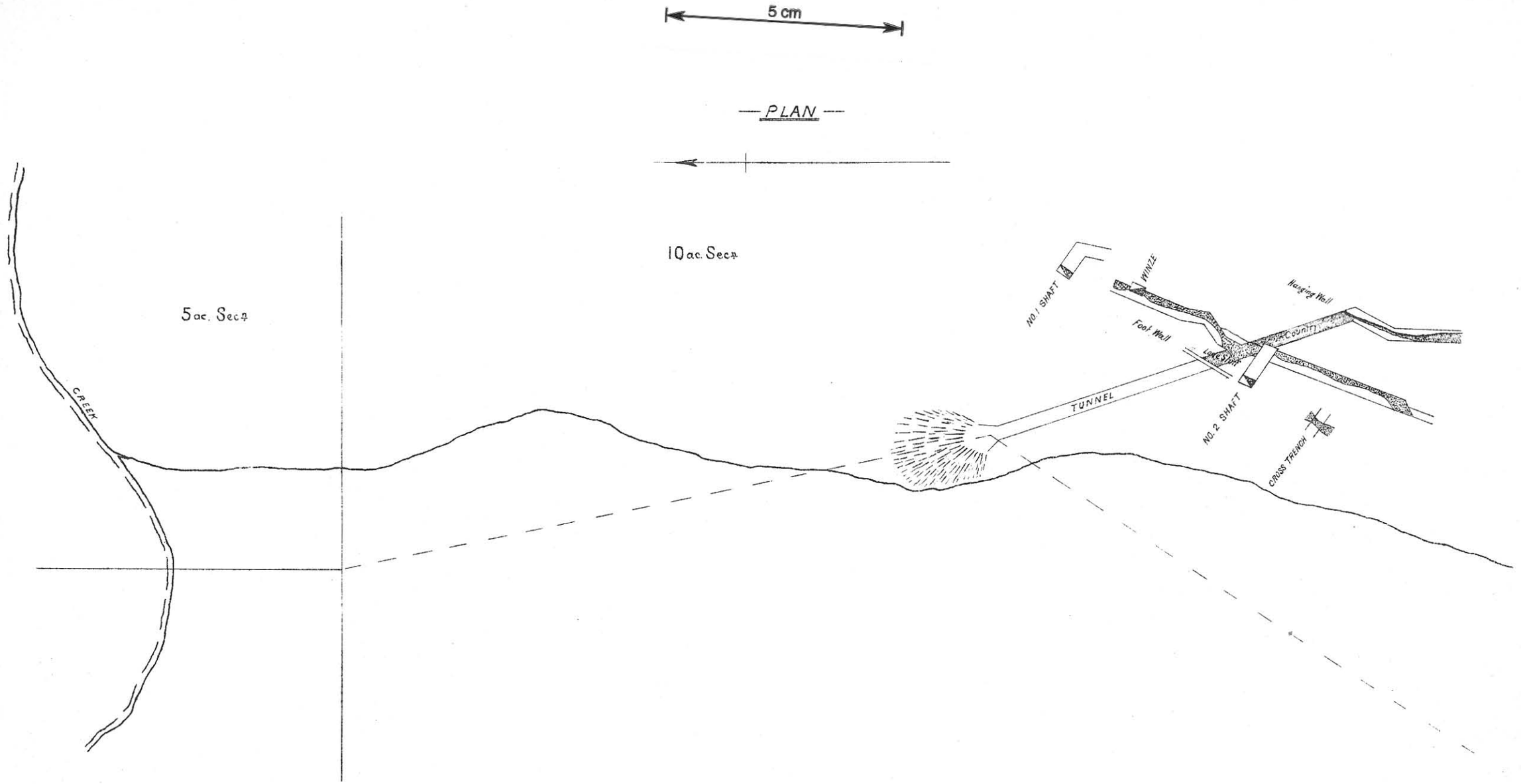
Diagram of Lodes

ST PAULS TIN MINE

NEAR AVOCA



W. H. Twelvetrees.
Government Geologist


5 cm
PLAN
10 ac. Sec.
5 ac. Sec.
CREEK
NO. 1 SHAFT
WINZE
Hanging Wall
Foot Wall
Country
TUNNEL
NO. 2 SHAFT
CROSS TRENCH

consisting of quartz and felspar, with some tourmaline, and carries a little tin ore. The bearing of this course is N.W.—S.E.

On the southern side of the Razor-back there is some promising alluvial, but towards the base of the hill, near the flat, the coarse bedrock granite shows itself. This alluvial flat may possibly yield some tin, but, from its position, is sure to hold a good deal of water. On the south side of the flat the sluicers have left good ground behind them: here a long outcropping line of tourmaline rock, 4 to 6 inches wide, has been uncovered. This line bears N. 30° W.; it has no definite walls, but is bounded by coarse stanniferous granite, into which it often merges gradually. I noticed occasional tin crystals on the granite faces. Further to the S.E. a close-grained yellow granite appears, and further on a short tourmaline outcrop, about 2 feet 6 inches wide, runs through coarse country granite. I saw many other short courses of tourmaline rock exposed on the property, some of them with a little cassiterite on their faces, but it is unnecessary to refer to them in detail.

In view of the conclusions drawn above with respect to the nature of the tin deposits in this hill, I am not very sanguine as to results obtainable from opening up these joint courses. A little tin will no doubt be won from most of them, but I would recommend that exploratory work be confined to deepening the 50-feet shaft on No. 1 lode, connecting the adit with it, and crosscutting or driving to the Red Lode. This work will be in the patch of ground which has yielded a little tin-stone, and if it do not prove remunerative, I do not think much expense need be incurred in testing any of the other outcrops. Perhaps there is a more immediate likelihood of success in the direction of hydraulic sluicing, but the wash in the different parts of the property requires careful prospecting.

My thanks are due to Messrs. Fritz Rübenach, W. Kent, and R. Stanley, for assistance rendered on my visits to both the Roy's Hill and St. Paul's Tin Mines. Annexed are map and plans to illustrate this Report.

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 STRATA IN THE SHAFT OF THE NEW SOVEREIGN MINE, MANGANA.

Government Geologist's Office,
Launceston, 6th November, 1899.

SIR,

IN accordance with your instructions, I visited Mangana on the 20th ult., and examined the strata in the main shaft of the New Sovereign mine, owned by the Mangana Gold Reefs Company, Limited, of London. The company leases three 10-acre blocks, 380, 381, 382-93G, at Mangana, five miles W.N.W. of the township of Fingal.

The entire property is in the belt of auriferous slates traversed by the quartz reefs of the Mathinna and Mangana mines. No fossils have been found in these strata, but, upon stratigraphical grounds, the whole series is referred to the lower division of the Silurian system, the same as the country rocks on the Beaconsfield and Lefroy goldfields. I am not aware that any one has taken the trouble to follow up these slates on their line of strike northwards, but it would be interesting to do so, and connect them actually with the strata further north, at Mathinna. As Mathinna is nearly due north, and the strike of the Mangana beds is W. of N., I fancy the line of continuity would come out a little to the W. of the Mathinna township. But this does not affect their geological position in the slightest: there is no doubt whatever that they are part and parcel of the Silurian slate series, in which all the great goldfields of the Colony are situate.

The reef runs into the hill in Sailor's Gully, and has the same strike as the slates which enclose it. The slates of the surrounding country are often vertical, or dip at high angles to the N.E., but where the reef runs through them at the main shaft of this mine they are much flatter, and have an average dip of only 2½ feet in the fathom. Near the reef they are traversed by numerous small veins of quartz, and often carry iron and arsenical pyrites, with occasional splashes of galena: sometimes, too, they are heavily charged with copper pyrites.

I found the reef, as laid open by the workings from the main shaft, an undeniable fissure lode, varying from 20 to 25 feet in width, between good walls. The narrower width prevails at the lower levels. Thus, at the 110-ft. level, the width is 25 ft.; at the 164-ft. level, 22 ft.; and at the 209-ft. level, 20 ft. In the upper levels, 110 ft. and 164 ft., a fine body of quartz is exposed, accompanied by lode slate and other reef material. The quartz gets more stringy going down, and at the 209-ft. level it is broken by a horse of sandstone, from which it is separated by soft slate. But, taking the whole make of stone for 200 ft. below surface, we have, unmistakably, a remarkably good body of quartz. The reef is one of the well-known Australian type of lode channels, in which the space between walls is filled with quartz and lode-slate. Slickensides are seen on the walls, and signs of movement within the channel itself. This is a feature very marked in the upper parts of the gold-bearing reefs at Mathinna. As on the previous day I had been through the New Golden Gate mine, the resemblance impressed itself upon me. The massive appearance of some of the stone likewise invited a comparison. The quartz itself is rather poor, the present company, according to returns kindly furnished to me by Mr. W. Grant Meudell, having obtained from 2866 tons stone a yield of 532 ozs. 7 dwt. 16 grs. smelted gold, or an average of 3 dwt. 17 grs. per ton. The upper parts of the reef gave the highest yield, these returns being from stopes in the higher section of the company's mine. From the upper zones in the reef crushings have been taken out, giving from ½ oz. to 1½ oz. gold per ton, but the stone in the main-shaft workings has not yielded more than from 2½ to 4 dwts. It probably bulks under 3 dwts. At the depth now attained it is likely that a settled average has been reached, and a very little improvement will, at this moderate depth, with approved treatment and economical working, suffice to make the stone payable.

The reef runs through the company's blocks, and has been traced for a still greater length. This, and its inherent nature, augur well for its persistence in depth. The country through which it passes is, in descending order, yellow and light slate in its upper portion, grey and black greasy slate at the 110-ft. level, black greasy slate at the 164-ft., giving place then to grey sandstone down to 250 ft., where it is replaced by a nice black slate. A light slate is now coming in at the bottom of the shaft, which is 280 ft. deep. The country in the bottom is veined with quartz, an indication that the stone is still living down in the reef, which cannot here be more than ten or twelve feet away.

It is said that the company intend sinking another 140 ft., making a total depth of 420 ft. This, after all, is only shallow mining, and it would be ridiculous to stake the future of the mine upon the results which may be obtained at such a small depth from the surface. There are good grounds for perseverance in continuing the present work of sinking. The facts which support a hopeful outlook are:—

1. The lode channel is a true fissure, extensive in length and important in size.
2. The auriferous quartz, in its best parts, is a singularly inviting and solid body of stone.
3. The indications in the bottom of the shaft are that the stone is still in the reef at that depth.
4. The strata through which the shaft is being sunk are the slates and sandstones which contain the auriferous reefs of the Colony, and the slates at the bottom of the shaft have an appearance which, in this district, is considered favourable for good quartz.

For these reasons I regard the prospects as encouraging. The only serious drawback is the low grade of the stone; but the work should be persevered in, with the hope of an improvement in this particular.

It is scarcely needful to add that this work, if successful, will infuse new life into the somewhat neglected goldfield of Mangana. My impression is that at Mangana there are the conditions for a permanent and flourishing field, and I recommend very strongly a resolute policy of deep-sinking.

I here beg to thank Mr. T. M. Hooper, Manager of the New Sovereign mine, for attention and information. I invite attention to accompanying sections of reef and shaft.

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

W. H. TWELVETREES,
Government Geologist.

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

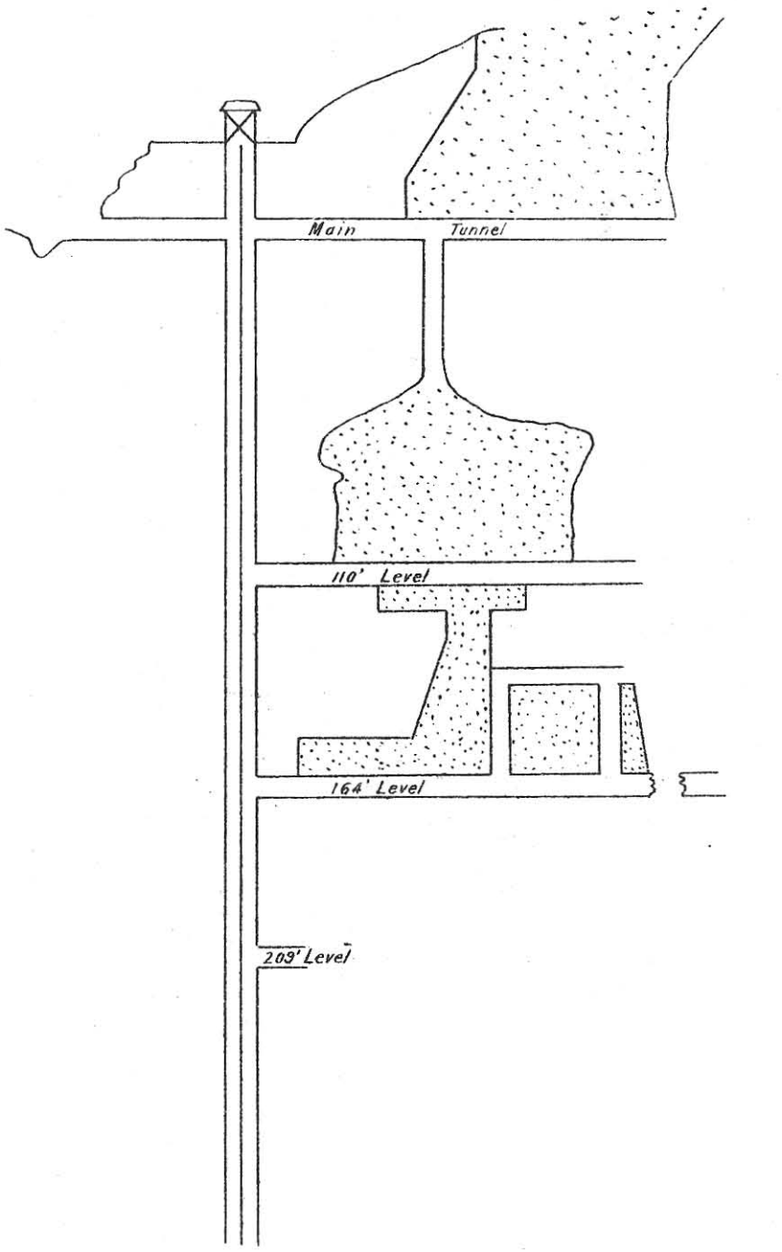
5 cm

LONGITUDINAL SECTION

90 60 30 0

Scale of Feet

W. H. Twelvetrees
Government Geologist



MANGANA GOLD REEFS LIMITED

REEF AND MAIN SHAFT AT NEW SOVEREIGN MINE

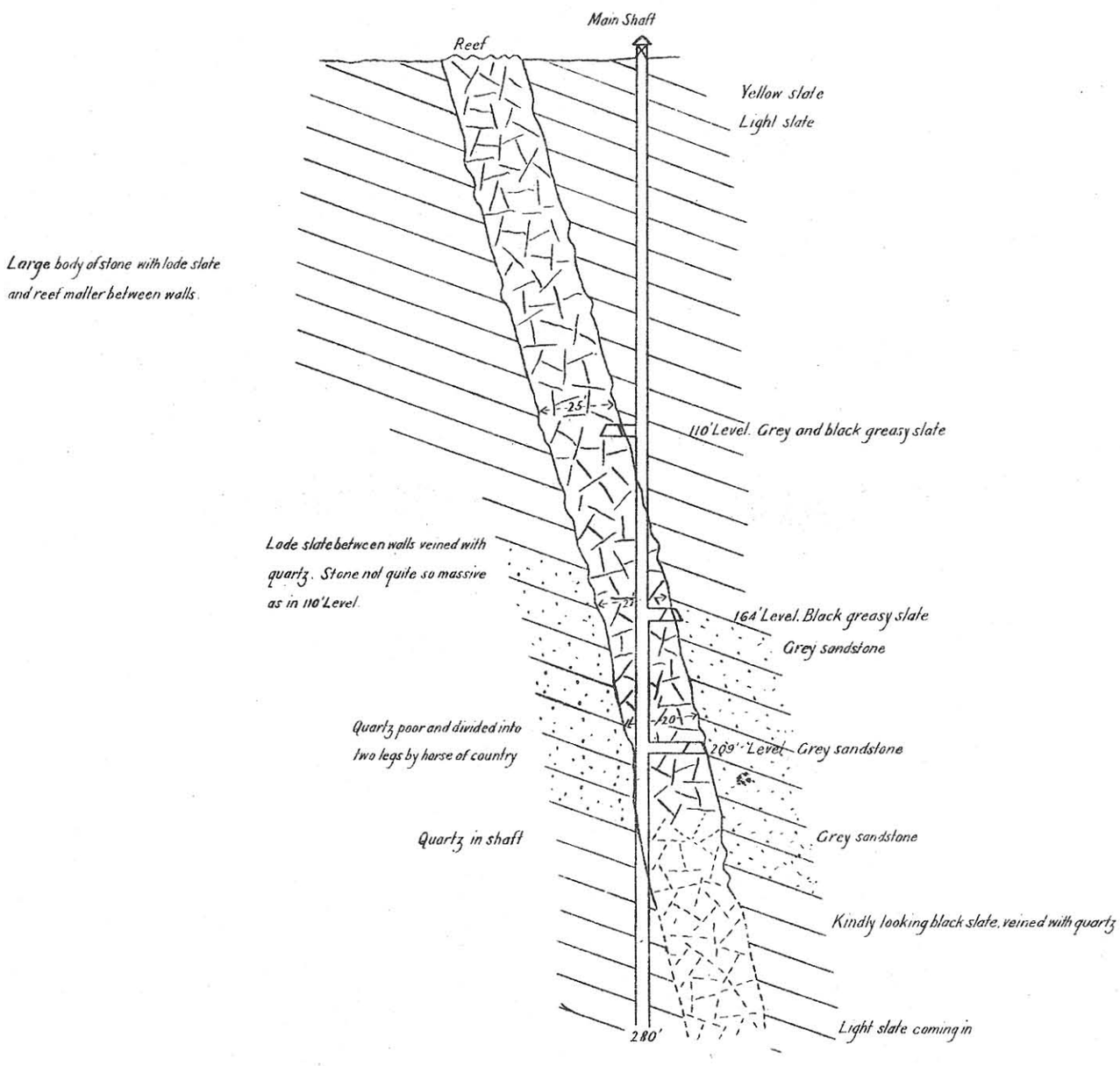
W. 0 30 60 90 E.

Scale of feet.

W. H. Twelvetrees
Government Geologist

5 cm

Cross Section



REPORT ON THE ASBESTOS DEPOSITS, ANDERSON'S CREEK, NEAR BEACONSFIELD.

Government Geologist's Office,
Launceston, 20th November, 1899.

SIR,

ON the 11th, 12th, and 13th instant I visited the serpentine country to the west of Beaconsfield, where asbestos has long been known to occur; and I now have the honour to submit my Report thereon. The only mine work which is being carried on there at present is on the ground now being leased to the Australasian Asbestos Company, who have taken up five sections,—1772, 1773, 1774, 1775, and 1935–93M, for the purpose of mining for asbestos.

These blocks are on Anderson's Creek, about 2 miles W. of the township of Beaconsfield, as the crow flies, or 3 miles by road. The road first runs N.W. from the township past the hospital, and the track is then taken across the Brandy Creek and the mineral sections of the North Tasmania Gold Mining Company, and Knight and Morgan, running thence due west to the serpentine area. Carts can be taken along without difficulty; but, in the event of the asbestos industry becoming a permanent one, the best way of getting the material away would be to lay down a tramway to Beauty Point, on the River Tamar, between 4 and 5 miles away. I may mention, to help in fixing the locality, that Anderson's Creek runs north through Sections 1772, 1773, and just takes a bend through the S.W. angle of 1774.

The sections are thus all situate in the Anderson's Creek basin, where a strip of serpentine rock is exposed, extending over an area of about 3 miles long N. to S., by 1½ mile wide E. to W. The eastern boundary of the serpentine occurs in the eastern part of Section 1774, where the cart-track from Beaconsfield crosses it: thence this track goes south for half a mile in serpentine country, as far as the bridge over the creek. Light green serpentine, weathering with a ferruginous crust, and traversed by thin veins of chrysotile, is seen *in situ* at intervals protruding through the soil on each side of the track right up to the bridge, but on the S.W. side of the creek the valley bottom is occupied by sand and quartz drift or detritus. At this spot the creek is evidently on the boundary line between the serpentine and sandstone. Proceeding further W., sandstone detritus is found, with the usual covering or admixture of quartz drift. This continues for about half a mile W. of creek, when the foot-hills of the Ironstone Range begin to rise from the valley plain. These ironstone mountains form a pile of ancient schists of apparently sedimentary origin, the exact nature of which, however, is obscured by additions of iron and chromium, and transformation into iron oxide. Reverting now to the eastern or Beaconsfield side-line of the serpentine, the actual contact is hidden under the superficial drift and soil, but can be located within a few yards by the difference of colour in the soil, and by the occurrence of quartz detritus. There is here some metamorphic sandstone or quartzite, which is probably the contact rock. Thence eastwards, for a score of yards, a succession of grey and yellow sandstones and conglomerates occurs, covered, between here and Knight and Morgan's sections, with a heavy layer of sandy and clayey soil and quartz detritus. In those sections the familiar cabbage tree conglomerate and sandstones are exposed by mining, and continue through the North Tasmania blocks across Brandy Creek, where some break in the continuity occurs. This break is, for the present, best explained by a N. and S. line of dislocation, laid down on Mr. Montgomery's map of Beaconsfield as a "probable fault." The road thence to the township continues over sandstone and alluvial gravels along the eastern base of the Cabbage Tree Range.

The indications enable us to form an opinion of the relative age of the serpentine, though in this area there are no data for fixing its absolute geological antiquity. The hardening of the sandstone on its eastern boundary suggests that it is intrusive into the lower Silurian, and therefore, posterior to it. Whether the serpentine of the Colony is, as a whole, older than our granites, is as yet unsettled, the evidence collected so far being contradictory.

Serpentine is not only a rock-forming mineral, but often forms a rock by itself. It is essentially a hydrous silicate of magnesia derived from the alteration of olivine-bearing eruptive rocks. Meteoric waters have attacked and decomposed the olivine and pyroxene minerals, which have re-arranged themselves as magnesian silicate. Excess of silica has been re-deposited as chalcedony and opal, and, combining with manganese, has sometimes formed a manganese silicate in the rock. In the open cutting being worked on section 1774, a large block of rhodonite, the pink or flesh-coloured silicate of manganese, was broken out of the asbestiform serpentine while I was there. In Petterd's Minerals of Tasmania it is stated, doubtfully, that rhodonite has been found at Zeehan.

The serpentine is a compact pale to dark green rock, which is very generally, throughout this area, traversed by small silky or steatitic veins of asbestos or chrysotile. These veins, when they are not dense, are parallel bands of pale green and silvery-looking fibres, with their long axes transverse to the direction of the bands. I have seen a sample with fibres 2½ inches long, but this length is exceptional. Veins ¼″ and ½″ wide are common; less frequent are those of 1″ and 1½″ width. They closely resemble some of the chrysolite mined in Canada, and the best of them are of sufficient width for industrial purposes, but the drawback is that they are usually separated by such wide intervals of compact rock as to make their mining an expensive operation. If they were close enough and sufficiently plentiful, the vein-stuff could be broken out, cobbed, and sorted, but so far there is not much encouragement, and I understand the Company do not intend, at present, to lay out much money on this description of rock, though, if they come across any payable belt of these veins, they will take advantage of the discovery. I have seen them best exposed on the western part of section 1774, but they intersect the serpentine in varying degrees of excellence all over the properties. Sometimes they are picrolitic, or brittle; or densely serpentinous. These veins are not injection

fissures, but may be rather regarded as cracks due to an increase of volume which takes place in the hydration of the olivine and its conversion to serpentine: the cracks become filled with serpentine, fibrous or otherwise. It is, therefore, most likely that the cracks would be developed along the lines of jointing or easy parting of the rock. At the same time it may be conceded that where any faulting has occurred a natural channel would be formed for the crystallisation of the fibrous mineral. Lines of contact would also provide such channels. An example of this is furnished by the Broughton Mine, in Canada, where there is an asbestos seam at the contact of the serpentine with the slate. The fibre there is 6″ or 7″ long, and is of exceptional quality. I should add, however, that the chrysotile veins of the Quebec serpentine belt do not average more than one or two inches in width, and, as they interlace like the veins in a stock-work, the whole rock has to be quarried out and the fibre separated. The fibre usually bears a small proportion to the rock quarried, most frequently only 1 % or 2 %.

Some of the serpentine in the Anderson's Creek field takes a handsome polish, and is easily worked. It would be suitable for small ornaments. I saw a pretty polished paper-weight made from it at the residence of Mr. Joseph Davies, General Manager of the Tasmania mine, Beaconsfield. Suitable blocks of large size do not appear to be common. I have no doubt that small *articles de luxe* of this ornamental stone would find a ready sale in the Colony.

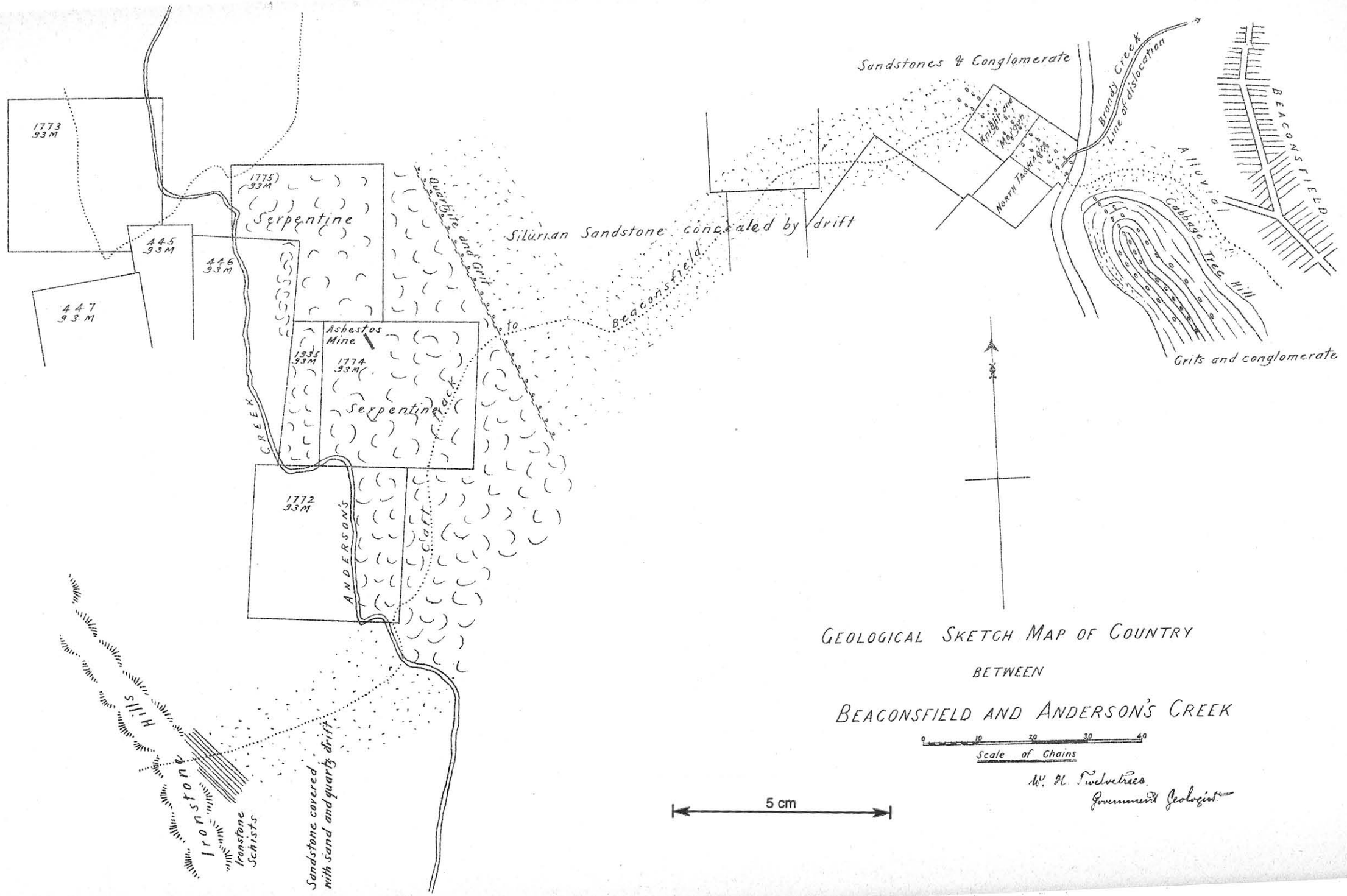
As serpentine is metamorphic, I endeavoured to trace it to its parent rock. A search resulted in the discovery of specimens of the rock from which it originated. Although this rock is much serpentinised, it is still fresh enough for identification. In an old cutting in the lower part of Section 1774, I noticed, among the blocks of stone which had been quarried, a dark heavy granular to compact igneous rock, strongly resembling a peridotite or pyroxenite. Felsparless, and showing glistening faces of bronzite, it is readily recognised as an ultra-basic rock. Its low specific gravity, 2·71, must be due to its serpentinisation. The examination of a microscopical slice shows that felspar is entirely absent, and that the rock is a peridotite, consisting of bronzite (enstatite) and olivine. This variety is known as harzburgite. The olivine is nearly all serpentinised, and the bronzite is in process of conversion into its serpentinous modification—bastite. It will be remembered that it is with such a rock as this that the nickel-iron alloy awaruite of New Zealand is associated. I feel confident that here it does not form an intrusion into the serpentine, but graduates into typical serpentine rock, and is, in fact, the original rock. Further reference to it will be made in my petrographical report at the end of the year. The preceding remarks seemed necessary to show that the serpentine in this locality has been derived from an ultra-basic rock, and not from gabbro.

Asbestos has come to be a term which no longer denotes any true mineral species. Asbestiform means simply a fibrous condition developed in rocks originally actinolitic, pyroxenic, or olivine-bearing. In the present case it is developed in serpentine after olivine. The asbestos occurs in several modifications, more or less distinct: chrysolite, cotton-stone, picrolite, mountain leather, &c.

The company lay great stress upon a variety of asbestiform rock, which is not so pure nor so delicately fibrous as the vein chrysotile, but to which they are devoting their exclusive attention. It is a somewhat massive "cotton-stone," with matted, interlacing fibres, and encloses less decomposed fragments of rather soft, and sometimes pasty, serpentinous rock. On crushing these fragments they are reduced to a talcose, often minutely fibrous, material. This variety is what the company call "asbestic," a fibrous matted asbestos, mixed with earthy, partly decomposed, magnesian rock. A few years ago such rock in asbestos quarries was neglected as so much waste, but it is now worked up and largely used for lining and plastering purposes, for which it is extremely useful, setting quickly and hard, needing no hair nor sand, and being incombustible. Asbestic proper, then, is a manufactured article, an asbestos plaster, in which the short fibre-stuff and impure varieties of asbestos are used. Laid over woodwork, it renders the structure fireproof, under ordinary conditions. It is durable, and, besides being tough, it is elastic, a very valuable quality in a plaster, for it is not liable to crack when walls settle after building. As hair need not be used with it, it is germ-proof. The manufacture of "asbestic" seems to have commenced in 1896, and a large crushing and cleaning mill has been put up at the Danville mines in Canada, the principal centre of production, by the Danville Asbestos and Slate Company. The advantages just enumerated at once created a strong demand for the article, and there is now more asbestic sold in the world than asbestos. The Danville mines, however, are said to be running out of stock, and it is anticipated that the Tasmanian industry will feel the benefit thereof.

About 20 ft. below the S. brow of the hill a face 12 ft. wide has been cut into a seam of natural asbestic for a height of 10 ft. From this bench 100 tons were broken recently, bagged, and shipped to Melbourne. The seam is running N. 22° W., and is traceable 150 ft. further up the hill, where it would gain 10 ft. additional backs. Thirty feet below the floor of this bench a second bench is being cut in asbestic rock, which will give, when advanced into the hill, a face 50 ft. high, and ultimately 50 ft. wide. When I was there nine men were at work in one shift. A tramway 232 ft. long conveys the stone to the tip, the waste forming one side of the embankment, and cobbing stuff being thrown on the other side. The material from this cut, however, is not being bagged, as it is intended to junction with the top cutting and work the face where the fibre is better. The seam or band of asbestiform rock is good jumping ground, and the mining cost, inclusive of dead-work, of the first 100 tons, did not exceed 3*s.* 6*d.* a ton. With a face such as that now in preparation, marketable stuff ought to be broken out for not more than 1*s.* a ton, provided the proper quality is maintained. At present 6*s.* per ton has to be paid for transport to Beauty Point, and thence 9*s.* 6*d.* a ton per Union Co.'s steamer *viâ* Launceston to Melbourne; but both transport and freight charges can be materially reduced once a regular output is attained.

The seam or filling is not a lode, and its continuity cannot be relied upon, even though the line of decomposition may be discernible for a considerable distance. It is highly improbable that its width will be constant, but if it continue downwards, as is likely enough, its quality may be expected to improve as it gets below the reach of surface waters, which produce an injurious effect by adding iron oxide and other deleterious ingredients. An excess of iron will diminish the elasticity of the fibre, discolour it, and take away its value by rendering it fusible. I took average samples of the stuff broken in the top cutting when work was being begun



GEOLOGICAL SKETCH MAP OF COUNTRY

BETWEEN

BEACONSFIELD AND ANDERSON'S CREEK

0 10 20 30 40

Scale of Chains

W. H. Twelvetrees.
Government Geologist

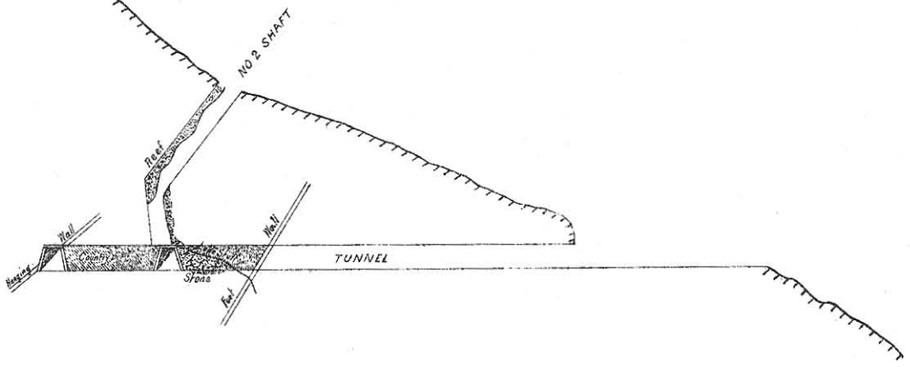
PLAN AND SECTION
OF
QUEEN OF THE EARTH GOLD MINE

25 20 15 10 5 0 10 20 30 40 50 60 70 80
Scale of Feet

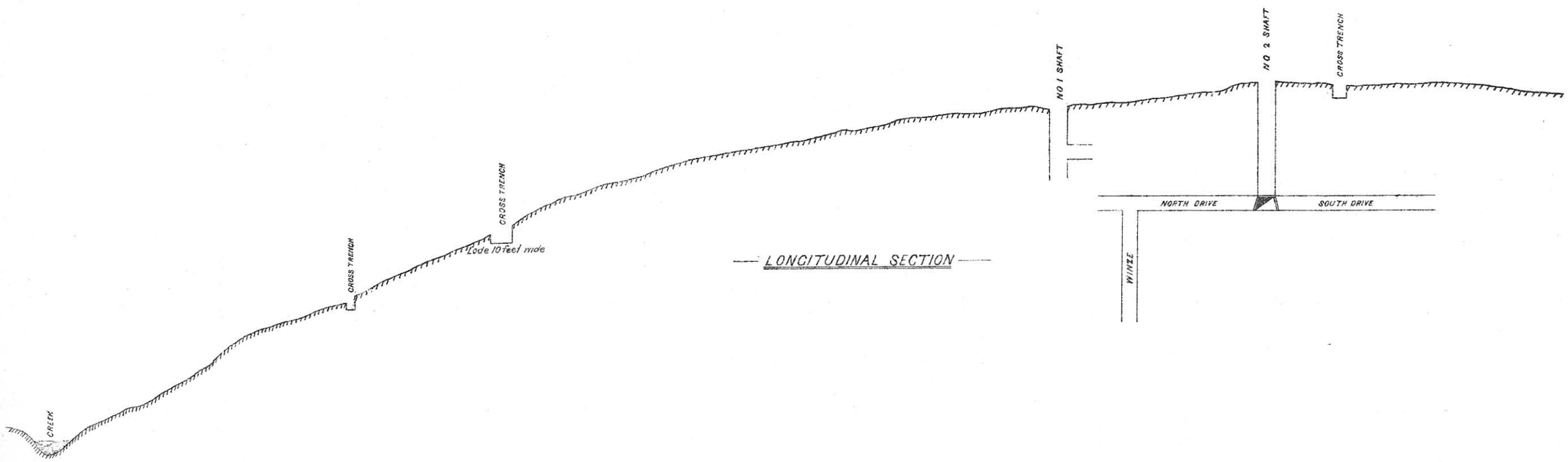
W. H. Twelvetrees
Government Geologist
15th. Feb. 1900

5 cm

— CROSS SECTION —



— LONGITUDINAL SECTION —



there. These came from about 6 feet below surface, and Mr. W. F. Ward, the Government Analyst, assayed them for iron oxide, with the following results :—

Bulk of sample (1000 grains), consisting of impure asbetos and earthy material, contained	28·35 per cent. oxide of iron
Asbestos, unmixed with impurities (180 grains), contained	7·74 „ „

This excessive proportion of iron is no doubt due to proximity to surface, and there is reason to believe that the asbestos will be purer the deeper the works go down. For comparison, I give a few assays of Canadian asbestos, culled from different sources, but it is only fair to remark that they refer to typical asbestos, and not to impure asbestic rock :—

Assay by	Boyd	5·75	per cent. iron oxide
„	Prof. Durst...	5·77	„ „
„	Prof. Donald	2·41	„ „
„	„	2·26	„ „
„	„	0·69	„ „
„	„	2·23	„ „
„	„	3·66	„ „
„	„	2·81	„ „

The quantity of water, too, which is in a state of chemical combination, varies somewhat, the most flexible fibre containing the greater quantity. The percentages arrived at in different assays are—12·2, 12·5, 12·62, 13·55, 13·8, 14·05, 14·25, 14·28, 14·31, 14·37, and 14·48.

The chemical composition of serpentine and asbestos is practically identical for both. Thus Professor J. T. Donald gives the following analysis of Canadian asbestos and serpentine :—

	Asbestos, very finest quality, from the Thetford-Black Lake District.	Serpentine, from the Ottawa Laurentian.
	%	%
Silica	40·57 ...	40·52
Magnesia	41·50 ...	42·05
Ferrous oxide	2·81 ..	1·97
Alumina	·90 ...	2·10
Water	13·55 ...	13·46
	99·33	100·10

The uses of asbestos are numerous, and are increasing yearly. It is used for steam-packing, boiler-covering, theatre curtains, knitting yarn, fire-escape ropes, filtering-cloth in chlorination works, brattice-cloth in coal mines, paint, roofing, plaster, paper, millboard, &c.

Eighty per cent. to 90 per cent. of the world's production is supplied by Canada. The first Canadian mine was started in 1878, and that country soon supplanted Italy in the yield of asbestos for common economic purposes, though, as the Canadian fibre, mostly from 1½ to 2 inches long (exceptionally, 4 inches to 6 inches), is shorter than the Italian, the latter commands its own special market. In Canada this mineral is usually quarried. The stone has to be cobbed by hand, or passed through a stone breaker and rolls if the veins are small and separation is difficult. All the Canadian mines are supplied with the necessary reduction machinery, and if the Beaconsfield Company find their enterprise progressing satisfactorily, they intend erecting a suitable plant at the mine.

The face which the company will now operate upon will give a good quantity of marketable low-grade stuff suitable for making asbestic; and it can be quarried very cheaply. The 100 tons already shipped is evidently of the right quality, for I was shown instructions to ship another 50 tons, so that the company are getting fair returns from the start. I believe the price realised for the mineral, after final treatment in Melbourne, is £5 or £6, but the Melbourne manager of the company writes, that as they are only yet in the initial stage of grinding and getting the produce ready for market, a price cannot be quoted just yet. The directors have, however, instructed their mine manager to ship another 100 tons. The mine ought to contribute a fair share to the world's output, for though the Canadian production has greatly increased, the annual supply does not run into very large figures, as may be seen from the following particulars taken from Rothwell's Mineral Industry :—1879, 300 tons; 1880, 380 tons; 1881, 540 tons; 1882, 818 tons; 1883, 955 tons; 1884, 1141 tons; 1885, 2440 tons; 1886, 2458 tons; 1887, 4619 tons; 1888, 4404 tons; 1889, 6113 tons; 1890, 9860 tons; 1891, 9279 tons; 1892, 7431 tons; 1893, 5539 tons; 1894, 7649 tons; 1895, 8275 tons; 1896, 10,380 tons.

A great deal of the permanent success of this mine, however, will depend upon the regularity with which new faces of stone are brought into work, for it must be borne in mind that the seam cannot be trusted beyond the point of the pick. I should recommend that the seam be carefully traced and opened upon in advance of the present works, and exploratory work started in some of the other places where fibrous rock is seen. However encouraging a single face may be, and that which is now being worked is undoubtedly promising, it is insufficient as a basis of constant supply. With so little work done as yet, it is impossible to forecast what the enterprise may not grow into. I have been continually told that several trials of this asbestos have been made from time to time, and to no purpose: but it seems to be forgotten that these attempts were made in the days when only pure and long-fibre asbestos could find a sale, and that the manufacture of "asbestic" does not date back more than four years. The mere fact that 10 or 20 years ago no market could be found for the Tasmanian article does not affect the value of the deposit to-day. It is now available for many uses not dreamed of a quarter of a century ago. While I do not estimate any enormous quantity of fibre as in sight, there is probably enough to make the enterprise fairly remunerative. Provided the work is carried on in a legitimate and miner-like way, all reasonable encouragement should be given to the adventurers, for the success of this novel industry must be productive of benefit to the district, as well as to the Colony at large.

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

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

Note.—Some boulder-like masses of a grey to greenish quartz-like silicate have been found in the asbestos seam. When first met with they were supposed to be waterworn boulders of quartz, but they are not quartz, nor are they waterworn. The mineral has been determined by Mr. W. F. Petterd as scapolite, a silicate of alumina and lime, and it appears also to be intimately mixed with the rhodonite mentioned in this Report.

REPORT ON THE ARBA EXTENDED TIN SECTIONS AT BRANXHOLM.

Government Geologist's Office,
Launceston, 25th November, 1899.

SIR,

I HAVE the honour to report that, on the 24th instant, in accordance with instructions, I visited the two 20-acre sections at Branxholm held by the Arba Extended Tin Mining Syndicate, situate to the E. of the Arba Company's property, and distant 12 chains E. from Pearce's Cascade or Branxholm Creek. They are about a quarter of a mile S. of the road which runs from Branxholm to Derby, and are reached by a short bush-track from the creek.

The bed-rock is the coarse porphyritic two-mica granite common throughout the district, and this is covered all through the two sections with soil and wash varying in depth from 6 to 26 feet. The wash is stanniferous, at least in places, and has an average thickness of 3 feet.

The sections form rising ground at the eastern edge of the creek flat, and are flanked by granite hills on each side. On the S.E. side is Bullman's Bluff, which forms a feature in the landscape, and up which the granite bed-rock extends for some distance. The waste from this rock has no doubt contributed to the formation of the terraces of wash on the Arba Extended sections.

This wash is of a different description from that in the Arba Company's workings, and from its position I imagine it is of subsequent date. The difference between the two is readily seen by examining the Arba Company's old Red Face workings in the fork of the creek, to the W., or east of Pearce's Creek. The ground there is 30 or 40 feet deep to the gutter, and was worked by the Arba Company fourteen years ago, and by Chinamen, on tribute, up to six years back. It consists of a gravel of quartz and sandstone pebbles, cemented and coloured with iron oxide. The pebbles are often a good deal flattened in shape, and the whole deposit appears to be of fluviatile origin. A remarkable feature is the occurrence of large granite boulders in the wash. There is one left there, which must be 15 or 20 feet cube. I do not think it is necessary to invoke glacial action or powerful streams for the transport of these immense rocks. I am disposed to believe that gravitation is quite sufficient to account for their position. Both here and in the Arba Company's main workings, where several of them were met with, there is a sudden drop from the granite rim into deep ground, and if such blocks became detached by any means from the parent precipice, they would naturally fall into these basins. Northwards, too, the granite rises to surface, so that this patch of alluvial fills a huge depression in the rock, some 30 feet deep. The fall in the granite further north forms the deep ground now being worked by the Arba Company, where the bottom of the gutter lies 120 feet below the surface soil. The whole of this area was doubtless formerly covered with basalt, perhaps flowing from Bullman's Bluff, but on this latter point I am not clear, as I could not make the ascent this time. The lava sheet has since been removed by denudation, and the oxide of iron, so abundant in the gravels, was very likely derived by percolation from the wasting superincumbent sheet. After the removal of the covering of lava, the denudation of the re-exposed granite was resumed, and the Arba Extended terraces were formed.

The wash of these ledges consists of rounded, sub-angular and angular white vein-quartz, with tourmaline and water-worn black blende, tourmaline-quartz pebbles, &c., and gives prospects of tin oxide. Colours of gold are also found now and then. I examined the Chinamen's diggings a little further to the south, where six men are working on shift in the same run of ground. I found the basement rock there also porphyritic granite, carrying splashes of tourmaline-quartz, which form segregated patches in the granite a few inches in diameter. Quartz-veins one to two inches or more in thickness are here seen intersecting the granite, and such veins unquestionably furnished the quartz of the terraces.

There was not much to see on the Arba Extended ground at the time of my visit, as the excavations were filled with water, and the tunnel had caved in from the fall of a tree. The first sink was 10 feet by 7 feet, and about 8 feet deep. There is said to be about 3 feet of wash in the bottom, giving 6 ounces of tin ore to the dish. A little tin is visible in some of the wash thrown out.

A couple of hundred yards further E. is another sink, 6 feet deep, but this only reached the top of the wash, when incoming water stopped further work. A few yards to the E. of this a short tunnel was driven, which has fallen in and cannot now be inspected. Prospects of the wash have been sent to town, showing $\frac{3}{4}$ lb. per small dish.

A water-right of 2 heads has been taken up, and further 5 heads have been applied for. A tail-race 12 chains long will be required, and piping and nozzle for hydraulicking, which is the most effective and economical way of working the ground. It is said that the water may be expected to suffice for nine months in the year.

From what has been said, it will be seen that this is essentially a small prospecting claim. The most convenient ledges will have to be sought and attacked. Not very much is known yet as to the actual quantity of tin-bearing wash available, and as the works were covered up I could not take any prospects, but, judging from dirt lying about, I have no doubt that it is stanniferous in places, and there appear to be small terraces of such wash here and there on the property. The two men working before the tunnel fell in are said to have been making wages. The overburden is easy stripping. The proposition is only a small one, and the only means which I see of finding out whether it can be made a payable one is by risking a little outlay and testing it.

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

W. H. TWELVETREES,
Government Geologist.

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

ON THE OCCURRENCE OF A NEW SPECIES OF GARNET AT PORT CYGNET.

By W. A. Macleod and O. E. White.

The Igneous rock containing this Garnet as a constant accessory constituent, occurs as an outcrop about 6 feet wide on the beach between Port Cygnet and Lymington.

It is intruded between other volcanic rocks, and, as far as could be ascertained from a hasty examination, seems to be the only exposure in this locality. From fossils found it is probably contemporaneous with the Permo-Carboniferous sediments.

The microscopical and chemical examinations of the rock point out its relationship to the Trachyte family, examples of which are so plentiful in this district, and which have been fully described by Messrs. Twelvetrees and Petterd.* Many of the varities of Trachyte mentioned by them have melanite garnet as an accessory constituent.

The percentage of SiO_2 in this rock does not run very high for a Trachyte, being as low as 55·87%. Trachytes proper often include as much as 62%—64% of Silica.

The Garnets of a brownish-yellow tint are scattered abundantly through the rock, and crystals with well developed trapezoidal faces, measuring sometimes over a quarter of an inch diameter, are plentiful.

Dana (System of Mineralogy, p, 272) says "Garnets containing protoxide of iron often become rusty and disintegrated through the oxidation of the iron, and sometimes are altered more or less completely to limonite, magnetite, or hematite."

These remarks apply to the mineral in question, which, where accessible to the weather, has lost its lustre, and, in many cases, dissolved away. Pseudomorphs (after garnet) of a yellowish-white metallic mineral (undetermined) occur. These are probably iron pyrites.

Comparing the analysis of the mineral with the published analysis of the different species of garnet, it will be seen that this is a new variety. In no other recorded types do the oxides of Mn., Mg., and Ca. bear the same proportion to each other, with the exception of some Iron Alumnia Garnets, and there the percentage is much lower, being only between 3% and 4% of each base.

* On Hauyne Trachyte, &c., in districts of Port Cygnet. Proc. Royal Society, Tas., 1899.

The Specific gravity =
Hardness = 7·5. Fusibility = 3·5 about.

I. Analysis of massive Garnet from Brazil.
II. ,, ,, Garnet, Port Cygnet.
III. ,, ,, Trachyte ,,

	I.	II.	III.
SiO_2	37·23	36·87	55·87
Al_2O_3	15·22	7·28	18·21
FeO	26·76	17·12	8·01
MgO	3·14	12·49	·46
CaO	4·31	11·98	4·54
MnO	3·40	13·68	2·61
Na_2O	...	...	3·36
K_2O	...	...	5·75
Ignition loss	...	00·29	2·28
		99·71	101·09

Macroscopical characteristics of Garnet Trachyte. Bluish-grey in colour on a fresh fractured surface, studded with crystals of garnet.

Microscopical characters.—The holocrystalline ground-mass is made up of lath-shaped sanidine felspars, the interspaces being filled with brown mica. No Plagioclase seems to be present, or if so, is difficult to distinguish from the sanidine. Carlsbad twins, as well as single individuals, are plentiful. Fluxional arrangement of the felspars is evident.

Sanidine also is present as phenocrysts, having both tabular and columnar habit, and in some cases shows a zonal tendency. Decomposition of some of the crystals has set in with alteration to muscovite.(?)

The ferro magnesian mineral is a brown Biotite without idiomorphic character. It is strongly pleochroic. Magnetite is sparingly scattered through the ground-mass, and appears to have resulted from the decomposition of the mica, generally accompanying the latter.

The Garnet is in well formed crystals, distributed somewhat unevenly through the rock, colourless in transmitted light. Zonary banding is present, and in many cases augite is enclosed. On the edges of the section brush-like aggregates of a brightly polarising mineral occur. These, We think, may be referred to the soda pyroxene Œgerine.

To this new species of garnet we propose to give the name of "Johnstonotite" as a slight token of our appreciation of the valuable, and in many cases, arduous work done by Mr. R. M. Johnston, in the Geology of this Island.

NOTES ON A "FAYALITE BASALT" FROM ONE TREE POINT.

By O. E. White and W. A. Macleod.

The rock on which these notes have been written occurs as a basaltic flow in a small promontory, on the far side from Hobart, of Sandy Bay.

The geological age of basaltic flows and tuffs is given by Mr. R. M. Johnston (Systematic Account of the Geology of Tasmania, p. 249 *et seq.*) as being younger than the tertiary leaf-beds, and from the occurrence of this rock and its associates, sections of which can clearly be seen on the Brown's River Road, there seems to be no reason for doubting that the age ascribed is approximately correct. The average thickness of the flow is on the exposed section about nine feet, and the extent of the sheet, as far as it can be traced, is not great. (*Ibid.*, p. 281.)

This paper has been written rather to give an account of the peculiar Petrographical character of this rock than to attempt a description of its geological occurrence, and further, such an attempt would only be a trespass on ground already well worked.

In the title the name "Fayalite Basalt" has been used as descriptive of this rock. This term may be open to some criticism when we consider the definitions given by the leading authorities of the term "Basalt." For example, Rosenbusch defines basalt as a rock consisting essentially of olivine, augite, and plagioclase, and regards such rocks as the tertiary and recent equivalents of olivine, diabase, and melaphyre. This rock will answer the requirements as to geological age, but not those relating to mineralogical constituents, for in some seven sections examined not a trace of augite was discovered. Olivine exists as the red variety Fayalite (FeO, SiO_2), and plagioclase felspar, probably as labradorite. This peculiar mineralogical composition involves almost a total absence of magnesia, and this absence is confirmed by chemical analysis, the result of which is given below. From a structural point of view the term "Fayalite Basalt," seems to be justifiable. The terms "Dolerite," "Anamesite," and "Basalt" are here applied respectively to the coarsely textured, finely textured, but still visible to the naked eye, and the very finely textured or microscopic varieties. This rock, then, would preferably be classed as a basalt as regards texture, though the fayalites are just visible to the naked eye. Briefly, therefore, this rock is a basalt in which fayalite has replaced augite and olivine. Macroscopically, the rock is of a dark, compact appearance; fracture, conchoidal. The fayalite crystals are just visible as small dark red spots, which stand out clearly under an ordinary hand lens. The specific gravity obtained by weighing in air and water of two specimens is 2·81. According to Von Lasaulx the specific gravity of basalt varies from 2·80 to 3·00.

The following is a chemical analysis of an average specimen of fragments taken from the upper, middle, and lower zones of the flow, care being taken to avoid weathered fragments :—

SiO_2	47·21
Al_2O_3	16·06
Fe_2O_3	11·87
FeO	4·43
CaO	7·34
MgO	·12
K_2O	2·40
Na_2O	7·51
Ignition Loss	2·55
Total...	99·49

From the nature of the case, that is on account of the gradual merging of different varieties of rocks, it is difficult to state definitely a typical average analysis of Basalt, but most analyses show MgO in considerable quantity, say, from two or three to seven or eight per cent., and in several analyses of this rock only traces of MgO were obtained. This would point to the olivine mineral being true Fayalite, that is, FeO, SiO_2. Not having material for Specific Gravity solutions, we were unable to separate any of the fayalite crystals and confirm this point, but trust, at some future time, to investigate this matter, and bring the results of our investigations before the Society.

The following is a brief account of the microscopic characters displayed in thin section by this rock :—The most striking mineral under the microscope is Fayalite, which appears in crystals and grains of a beautiful orange-yellow colour in ordinary transmitted light. In thicker sections the tint deepens to a fine red. In the majority of cases the Fayalites exhibit crystaline outlines, the prismatic form predominating, and giving excellent longitudinal and cross sections. Here and there occur patches of Fayalite exhibiting no discernable crystalline outline. In length the crystals vary from 0·5 m.m. downwards. The inclusions visible under a high power (one-sixth inch) appear to be apatite and needles of felspar, and perhaps glass, though, on account of their minute dimensions, it is difficult to obtain good extinctions under crossed nicols.

Under crossed nicols the Fayalites exhibit the ordinary interference colours and the normal extinction of rhombic crystals. Pleochroism is not noticeable.

We have noticed neither augite nor olivine in any of the sections examined, and most probably these are entirely absent in this rock. Apatite was mentioned above as occurring in the Fayalites. It is also found here and there in the base as long needles of a faint violet-brown tint, and exhibiting pleochroism from a very faint brown tint to a deeper violet-brown ($E > O$). On treating a section with hydrochloric acid the apatites slowly dissolved out, leaving the glass slip visible underneath. The Fayalites were also attacked, though less rapidly.

The base consists of a ground-work of glass, penetrated with needles and fine laths of felspar running in all directions, the whole being thickly dusted with grains of magnetite. The felspars exhibit extinction angles, varying from 40° to 48°, which, according to Michel Levy's table for microlites, indicates a basic felspar, probably labradorite or anorthite. The percentage of lime (7·34% CaO) in the analysis, and also that of the alkalies, some 9%, point to the felspar being labradorite (in which the proportion of alkalies to lime is approximately one to three) mixed with a little andesine or some more acid felspar. This supposition is based on the assumption that the base is of the same composition as the microlites of felspar,—a somewhat doubtful assumption to make.

This rock appears to have followed the normal order of consolidation,—the apatite and magnetite consolidating first, then the Fayalite and felspars. It is difficult to determine exactly the relation of the Fayalite to the felspar microlite, for, included in the Fayalite crystals, appear thin rods, which in some cases are glass, but in others are doubtful, on account of the difficulty of obtaining good extinctions under crossed nicols. All the microscopic characteristics point to the conclusion that it consolidated quickly, and under little pressure. Sections were taken from both the top and bottom of the flow to determine if there was any difference in these two regions, but the results were disappointing, and it would clearly require a flow of much greater thickness to give any distinct points of difference in crystallisation due to pressure. This rock appears to stand the influence of the weather and sea, and little sign of decomposition was noticed in any of the sections, though here and there, in some of the more weathered sections, traces of some chloritic mineral were seen. If occurring in larger flows it would no doubt make a good stone for such purposes as the foundations of buildings, road-metal, &c.

Appended are two water-colour drawings of Sections—

No. 1. Low power (× 50) showing (*a*) fayalite crystals; (*b*) apatite crystal. The relative proportions of Fayalite and base are here shown.

No. 2. Shows a fayalite crystal under a higher power (× 300). The small rod-like inclusions are here shown; also the character of the felspar microlite and magnetite grains in the base. Both drawings are taken under ordinary light.

REPORT ON THE NORTH MOUNT VICTORIA GOLD FIELD.

Government Geologist's Office,
19th January, 1900.

SIR,

I HAVE the honour to report that, in accordance with your instructions, I visited Alberton on the 26th November, and remained there until the 8th December, examining the North Mount Victoria Goldfield.

The mines are on the northern and western flanks of Mt. Victoria, which rises 3000 feet above the township of Alberton, on the Dorset River, or 4000 feet above sea-level. The numerous auriferous quartz-reefs have been worked intermittently for a long time, at least since 1883. Mr. G. Thureau, a former Government Geologist, reported on the field as far back as 1883 and 1884. Since that time a good deal of work has been done, not always remunerative, however. Still, I believe some £50,000 worth of gold has been won from it, if not more. The short and rather tricky makes of gold-bearing quartz have often proved too much for the limited resources of prospectors; money, too, has not always been wisely expended, and this, in a field where more than ordinary managerial skill is requisite, has contributed to frequent failures, and the consequent disappointment of investors. Owing to this, the field has not been taken in hand by the public to the extent it really deserves; and the only companies which are now working there on a decent scale are the Ringarooma and the Central Ringarooma, both under one mining management. There are other gold properties, to which I shall refer later on, but their position at present is an expectant one. If the premier company go ahead, the outlying claims, most of which have been worked at one time, but are now idle, will have a chance of attracting capital. In this Report I have called attention to these claims, that they may receive their fair share of public notice.

The thickly-timbered country and heavy surface-soil on the mountain sides form impediments to geological explorations, but during my stay I learned enough to enable me to offer the following brief sketch of the geology of the field.

Seven formations are represented, which, in ascending order, are as follows:—

1. Silurian sandstones and slates.
2. A Silurian basaltic lava-sheet interbedded with the slates.
3. Quartz-reefs and elvans proceeding from a granitic source and traversing the slates, &c.
4. Sandstones, grits, and conglomerates of Permo-Carboniferous age (or Devonian ?).
5. Intrusive dolerite or diabase of Mesozoic or lower Tertiary age.
6. Tertiary basalt, and auriferous alluvium.
7. Recent gravels of existing rivers and creeks.

Their relations are described in the following explanatory remarks:—

(1.)—*Silurian sandstones and slates.*

These are the strata which, from Waterhouse in the north to Mangana in the south, everywhere enclose auriferous reefs, and form the golden belt of eastern Tasmania. They are accompanied here by the same succession of beds as is noticeable near Mathinna, further south. Recently, when on Hogan's Track, N.E. of Mathinna, I observed the identical conglomerates and quartz-grits lying on the edges of the sandstones which I have seen here on the W. flank of Mt. Victoria, on the old track to Black Boy, now Mathinna. The Silurian sandstones and slates for the most part maintain the same general strike as is seen in so many places along the belt, viz.,—N. to N. 20° W. This uniformity denotes their physical connection all along the zone. The dip is mostly S.W., but varies a little according to local anticlines. The angle of dip is high, and the slates are often almost vertical. This position is characteristic of the old slates throughout northern Tasmania, and points to them being segments of large earth-curves, denuded now to nearly straight combings, rather than beds tilted locally by neighbouring disturbing influences. In the zone of oxidation the strata are soft, and of yellowish colour, and are then considered a favourable matrix for makes of highly auriferous quartz. At the New Mercury, both slate and sandstone are indurated sufficiently to be called metamorphic; the sandstone there is dark-coloured, and forms a tough, dense rock detested by miners. On the whole, however, I found quartz-reefs living in the harder descriptions of rock quite as freely as in the softer stone.

(2.)—*Silurian basalt.*

In Silurian times the igneous magma below this area was basic, as evidenced by an old basaltic flow visible in the tunnel of the old Crown Prince Mine, just over the N.E. brow of the Ringarooma Mount. The mine is high up the hill, 800 feet above the level of the Dorset. The volcanic rock is referred to by Mr. Thureau in his 1884 Report. I found it crossing the tunnel at 300 feet from mouth, N.E.-S.W., as a 2-ft. bed, conformable to the slates. The black slate upon which this contemporaneous sheet rests is indurated by the contact. The strata here have a different strike from those on the W. side of the hill, bearing E. of N. instead of W. The presence of this bed of basic lava suggests that in lower Silurian times in this part of the Island, whenever we meet with eruptive rock of the age of the slates, we may expect it to be of a basaltic or gabbroid nature. The later granites do not appear until in the course of time the underlying magma had grown acidic.

(3.)—*Quartz-reefs and elvans.*

In the long tunnel of the Ringarooma Mine we have an elvan course or dyke 22 feet wide, traversing the slates. It appears to run parallel with the bedding of the slate, but a small flucan on each side indicates its intrusive nature. It has a light grey to greenish compact felsitic groundmass, sprinkled with blebs of quartz and crystals of arsenopyrite, with occasional glistening crystals of felspar. It closely resembles in appearance many Cornish elvans. It has proceeded from the new

granitoid magma which had then supervened. Below this entire auriferous belt from N. to S. there doubtless lies, at an unknown depth, a substratum of granite. When the magma consolidated as granite in upper Silurian or more probably Devonian times, invading elvan courses were protruded, as apophyses, and the sedimentary rocks, already strained by earth movements, must have been further fissured, and the excess of silica deposited as quartz reef. At the same time I imagine the gold to have been precipitated from solution. Whatever its origin may have been, its existence in the reefs of quartz dates from the age of the reefs. This does not, however, exclude a possible enrichment of the upper parts of reefs by a dissolution and re-precipitation of some of the gold. The assumption of some such action seems almost necessary, in order to account for the very general patchy richness of the gold-bearing quartz near the present surface, and its falling off with increasing depth. On the other hand, the depths attained on this field are so trivial that it would be wrong to draw conclusions adverse to deeper work. As any elvans are presumably geologically contemporaneous with the reefs, they are not likely to fault the latter; and, as a matter of fact, no extensive faults have been observed on the field. The reefs themselves do not occupy fault fissures, and rarely show two defined walls; usually one of the walls is ragged. A few are supposed to be persistent for considerable distances, as makes of quartz are traced on their line at intervals; but without careful survey it is impossible to say whether such makes belong to one and the same continuous fissure. My impression is that a continuity will often be found to exist. The peculiarity of this field is that the quartz usually makes for a certain distance, when it thins out, and a fresh make is afterwards found ahead, often not exactly in the line of the first, but parallel to it, the miner being led over the intervening space by a mere thread or possibly strings of quartz running through the country. In this way a series of comparatively short lenticular splices of quartz occurs, to follow which requires the exercise of sound judgment on the part of the mining manager. Breastheads or faces of sandstone often appear to cut off the run of quartz abruptly, and the miners are apt to think that a disturbance has occurred and shifted the reef. I witnessed this phenomenon so often that I could not neglect its consideration, and in the majority of cases (without denying occasional minor faulting) I was led to the conclusion that the heads and faces were there prior to the deposition of the quartz which abuts against them. The reef channels have been formed by repeated short and irregular fractures, which have often failed to penetrate these heads. This is shown strikingly when a quartz-vein is suddenly arrested by a head and then splits up, taking a line of easy passage right and left along the face. The heads are interesting to students of mining geology, and would repay careful study. I am inclined to believe that for the most part they do not represent earth movements at all, but original changes in deposition and bedding, say, from regular laminations to amorphous, massive deposits, and *vice versâ*.

The irregularity of the reef channels, and the frequent absence of any defined channel whatever, must necessarily invest mining here with some difficulty, and add to its expense. Fortunately, the country as a rule is easy working, and shoots of quartz are met with which are rich in gold, and pay for a good deal of dead-work. The Ringarooma Company afford a prominent instance. One cake of gold paid for driving their long tunnel (1100 ft.), another is paying for the purchase and installation of their electric pumping and winding plant. One ounce per ton is a common bulk yield of auriferous shoots at shallow depths, and 2-oz. and 3-oz. stone is on record. Some phenomenally rich quartz was shown to me from No. 3 reef in the Ringarooma Mine, and very rich stone from the same Company's mine at the New River, as well as from the Central Ringarooma. From the nuggets found in Krushka's alluvial workings on the New River, Mr. Wm. Brown, the Ringarooma Company's General Manager, believes there is a rich reef on that part of the field, which is still to be discovered.

One of the conclusions which may be hazarded from a study of the whole field is, that these somewhat irregular quartz-channels may be expected to make into more constant solid reefs when a greater depth is attained.

(4.)—*Conglomerates and grits.*

These are seen in a horizontal position on the old Black Boy track, as mentioned above, about 1500 feet above Alberton. They lie unconformably on the Silurian slates and sandstones, and imply an unrecorded interval of geological time. The grits pass into coarse sandstones, and the conglomerates have a gritty, sandy matrix, enclosing quartz-pebbles, often of considerable size. These rocks require further study before definitely assigning them to the Devonian or Permo-Carboniferous systems; but, from their physical characters, I class them provisionally in the latter. They evidently mark a long line of beach north and south.

(5.)—*Dolerite (diabase).*

This is the igneous rock known in different parts of the Island under the names of trap, greenstone, bluestone, ironstone, &c. It forms the summit of Mt. Victoria, but the boundary line between it and the conglomerates lower down the flanks is concealed by surface-soil and by its own detritus, derived from the higher slope of the mountain; I therefore could not see whether there is any tilting at this junction, or what is the immediate effect of contact. The dolerite descends to the level of the Black Boy Track, 1500 feet below the summit of the mountain. About 500 or 600 feet above the track are what are called "the plains," a horizontal boulder-strewn plateau, from which rise the serrated and columnar crests of Mts. Victoria and Albert, 800 to 900 feet high. On the plain lie fallen columns of the same rock, and it is evident that the plateau is the base of a former extension of the columnar pile which now crowns the mountain. It is a much-debated question whether this dolerite, or diabase, as it is more often, though less correctly, called, which crowns so many of our mountains in Tasmania (Wellington, Arthur, Barrow, Saddleback, Nicholas, Ben Lomond, Dundas), and is so prevalent on the Tiers, forms the remains of a lava flow, merely capping these heights, or whether it is intrusive. In the latter case it either occupies the central parts of these mountains, or was an intrusive sheet (sill) between strata, the upper members of which have since been denuded. The nature of its structure precludes the lava theory, for it is undeniably that of an intrusive rock; but whether it formed a sill, or whether it intruded into the overlying sedimentary rocks *en masse*, can only be decided by investigation in the field. I refer at foot to recent papers on this rock *; the points raised are still

* Igneous Rocks of Tasmania: Twelvetrees and Petterd, 1898. (Tr. A.I.M.E., pp. 12-15.) Report of Secretary for Mines, 1898-9. Mesozoic Dolerite and Diabase in Tasmania: Twelvetrees and Petterd. Igneous Caps of the Tasmanian Tiers: R. M. Johnston (Tr. Roy. Soc. Tas., 1899). Microscop. Studies of Igneous Rocks (Proc. Roy. Soc. Tas., 1896).

unsettled, and any contribution of facts by independent investigators bearing on the subject will be received and duly acknowledged by this office. The great thickness of the diabase here (fully 1500 feet) is strongly adverse to the sill theory, especially when we consider that it may originally have been much thicker than at present. The section afforded by Mt. Victoria is of special interest in this connection. It is significant that the same igneous rock crops out in the Dorset valley, 3000 feet below the summit, and 1500 feet below its lowest exposure on the upper slopes of the mountain. Crossing the Dorset from Ringarooma, and turning S. along the road to Alberton, the diabase is seen descending towards the river, and forming the low spur which runs N.W. down from Mt. Victoria. Here, too, the contact with the sandstones is obscured, and going up the hill S.E, the rock soon sinks below the slates and sandstones which form the divide between the Dorset and the New River property of the Ringarooma Company. This is the only patch known in the district, and its occurrence here, so far below the upper exposure, favours the supposition that it is a protrusion from the main mass.

The acidic reservoir below this area had by that time plainly grown basic again; the magma recovered its basaltic or gabbroid nature; and, as is shown by the latest igneous flow on the road to the New River, where nodules of basalt are seen in the fields, it retained its basicity to later Tertiary times.

The intrusion of this doleritic rock into the Silurian sedimentary beds must have shaken the whole series considerably. I attribute to this cause the repeated small faults met with in the New River mines, especially in the Central Ringarooma. No violent displacements of the reefs appear to have taken place, but numerous minor heaves have given a little trouble in mining. Although the diabase in the spur mentioned above trends in the direction of those mines, it nowhere appears in their vicinity, and the small faultings are very likely to be the result of concussion from intrusions at some little distance.

On the theory which I have here suggested, the diabase of the lower spur is connected in depth with the central eruptive rock of Mount Victoria. It has welled up through the underlying granite, and would be followed down to any conceivable depth. I should think, however, it is not at all likely to interfere with mining, for it seems to dip under the sedimentary rocks on the Black Boy track at a very high angle. Still, its presence anywhere in the field would not be surprising.

(6.) (7.).—*Tertiary and recent Deposits.*

I have referred to the Tertiary basalt on the New River road. This was most likely formerly continuous with the sheet on the west side of the River Dorset. I did not trace its boundaries, as the rock has no bearing upon the quartz mines of Mount Victoria. In the New River basin is auriferous alluvium, which may have been at one time protected by a basaltic covering, as well as other gravels and washdirt belonging to a more recent period. This ground is sometimes fairly deep. That worked by Mr. Krushka is from 15 to 20 ft. and upwards; and there is ground which may be deeper. The Mount Victoria reefs must have shed a good deal of gold in past times. Why more alluvial gold is not found is probably due to the large amount of scouring during the long period of elevation in later Tertiary and recent times.

Ringarooma Mine.

This is owned and being worked by the Ringarooma Gold Mining Company, Limited, on 53 acres, above the Dorset River. The sections are 151, 152, 814, 890, 904-93G, each 10 acres, and 112-93G, 3 acres, the site of battery. The company has been in active work since December, 1894. The present manager, Mr. William Brown, took charge in March, 1896, since when, without taxing the shareholders, the mine has paid for its own development, the erection of its battery and buildings, the purchase and installation of electric pumping and winding plant, the purchase and development of the New River freehold, 317 acres; the purchase of working plant, manager's house, the old Victoria plant, tailings and leases, and the Bright Star pumping plant (now being used.)

The battery consists of 10 heads, with foundations and framing-up for 15 heads. It is driven by a 38-ft. water-wheel, 25 h.p., supplemented by a 25 h.p. engine to supply deficiency of power when the water falls off in summer. At present the engine is being used for the electric plant. The steam is generated in a 100 h.p. boiler. Framework is now ready to receive a second engine of 50 h.p. The stamps weigh 7 cwt. each, mortars, the ordinary style of boxes, tables 10 feet long, covered with electro silver-plated copper. For this plant one of the new Wilfley's ore concentrators is now on the way out. The present concentrators are Alve's patent wire cloth ones; these will be taken up, the Wilfley put in their place, and the Alve's then placed at the end of the Wilfley. The Wilfley is in principle a riffled table with a differential movement, the motion being quick at the outer end of its stroke, and slower at the inner end. This motion helps to separate the minerals, and the more distinct the separation, the easier it is to adjust the table. The tables have a good reputation for catching float-gold and for making clean concentrates.

A fine electric plant for pumping and winding, and for lighting battery and mine, has been started, and is just approaching completion. A telephone wire connects the battery with the mine, half a mile distant. The dynamo is 500 volts, and works up to 70 h.p., running 500 revolutions per minute. The motor for the winding gear is 25 h.p., and the pump motor is 20 h.p. The pump has 6″ working valves and 7″ pipes. Pithead pulleys, 3 feet. Forty lamps in mine light tunnel and drive to the main shaft and chamber. At the time of my visit 37 hands were employed at the Ringarooma Mine. This mine is only two miles distant from the New River Mine, on the other side of the hill in a direct line, and an aerial tramway is being thought of to bring over the quartz from that mine to the Ringarooma battery, instead of crushing it, as now, at the New River mill. The company have raised from this mine 2435 tons quartz, which on crushing yielded 3174 ozs. retorted gold, realising £3 18*s.* 0*d.* per oz. This return averages 1 oz. 6 dwts. gold per ton of quartz. The first four crushings yielded at the rate of 2 ozs. 11 dwts. 14 grs., 2 ozs. 0 dwts. 20 grs., 2 ozs. 4 dwts. 13 grs., and 2 ozs. 8 dwts. 11 grs. per ton respectively.

The mine-works consist of adit-levels, with their connecting rises and stopes, in addition to which a main winze, or underlay shaft, is being sunk to operate upon the reef below the present deepest workings. Three tunnels, the Premier, Rosalind, and the Long Tunnel, have been driven E. into the mountain to intersect reefs exposed on the hillside, and running roughly parallel with the slope of the hill. The main reefs are the Gumsucker

and Rosalind (these two are really one), and the Premier. The former is the most westerly, and the out-crop of the latter is visible 240 ft. further up the hill to the E., in which distance a vertical height of 80 ft. is gained. The horizontal surface-distance between the two is 225 ft. The Gumsucker dips 75° to the E., while the Premier dips from 78° to 80° to the W.* The Gumsucker reef has been exposed in the mine to a depth of 275 feet on the underlie, and, with the Premier, has been cut in all three levels; in the upper, or Premier level, at 80 ft. from surface on the underlie; in the Rosalind level, at 150 ft.; and, in the main tunnel, at 300 ft. From the angles of dip at their lowest observed exposures I judge that the main shaft now being sunk will bottom on their junctions in another 150 or 160 ft. It is apparent that this shaft has been admirably planned, for it will give access to the most promising physical feature of the mine, the junction of the two master reefs, where experience teaches that an enrichment of stone is very likely to occur.

Long Tunnel.

A main tunnel has been driven E. 1134 ft., and has intersected both reefs in depth, as mentioned above, as well as a third one (No. 3.) The true dip of the latter reef is not yet ascertained. At 1010 ft. in, N. and S. drives were opened on the reef. The tunnel at that point intersected the Gumsucker channel, carrying a few inches of quartz, but so unlike the N. Rosalind and Gumsucker stone that it was continued 40 ft. E. before returning and driving N. and S. The tunnel was afterwards advanced further 80 ft. to the other reefs. The country rock crosses this tunnel, bearing N. 20° W.—S. 20° E. The first 380 ft. are in sandstone, then a change to slate occurs. About a couple of chains in a 3-ft. channel is cut through, containing quartz charged with iron sulphide, but poor in gold. This might very well be driven upon when funds are available. At 10 chains in, a dyke of light grey and greenish flinty quartz-porphyry (elvan) crosses the level. It runs apparently, most likely only apparently, with the bedding, is 22 ft. wide where cut across, and has a dig on each side. The base is very compact, and is sprinkled with blebs of quartz, crystals of arsenopyrite, and an occasional crystal of felspar. Detailed description of same will be furnished in my annual petrographical report.

North drive from this tunnel has been driven 80 feet. In the first part of this drive I noticed that the hanging-wall carried stone a couple of inches to a foot wide. Here, as elsewhere through the mine, the foot-wall is ragged, ill-defined, and can hardly be described as a wall at all. A few yards N. the vein leaves the reef-channel and runs away E. into the slate, thinning out to a mere streak. The channel was followed a few feet further N., and a little gold-bearing stone was found, not more than 2 inches wide; but in the stopes above it attained as much as 2 ft. width. Behind the end is the Winsome winze, which, worked from above, gave a yield of 3 ozs. per ton from its first crushing. The channel in the end of this drive is filled with slate, or sandstone and slate, and has fair walls, 3 ft. 6 in. apart. The dip is steep, and has here changed to the W. This end, usually called the N. Rosalind end, is the extreme N. end of the Gumsucker channel. Payable stone came down the Winsome winze to within 30 ft. of this level, when it pinched and dwindled to a length of only 2 ft., and gradually died away to what is seen in the back of level. Just behind the end is a crooked drive going off to the W., and brought up by a fault which displaced a parallel channel further W. In this end a vein of quartz leaves the foot-wall and passes over to the hanging-wall. The stone is barren, carrying a little pyrites. Possibly it is the same as that just visible in the end of N. drive. Massive sandstone on each side; channel, slate or sandstone.

South drive has been driven S. and S.E. for a distance of 245 ft. The first 40 ft. were on stone 3 in. lying against the hanging-wall. This was worked down 12 ft. below sole of level, and gave a return of 3 ozs. gold per ton. Here there is a fault which has displaced the reef to the E.; and, from this fault northwards, the reef is called North Rosalind. There is a small vein to the E., outside the channel, carrying gold. The eastward heave is 4½ ft. In the Rosalind adit, 130 ft. above this, the heave is 12 ft.; but in the bottom of the stope, 12 ft. below this drive, the fault was hardly noticeable. The stope, which extends southwards for 100 ft. in length, to a depth of 12 ft. below level, has proved this ground. It carried a foot of stone of fair quality. According to Mr. Brown's Report, the north end of this shoot* was very good; the south end also good; the middle payable, though bunchy. In the middle of the shoot, the main winze or underlay shaft, 12′ × 4′ in the clear, is being sunk, and has now reached a depth of 65 ft. It is intended to open out at 58 ft., leaving 10 ft. or 12 ft. for sump. At the mouth of shaft a large chamber has been excavated, 40 ft. long × 18 ft. wide, and 12 ft. high. It is electrically lighted with six 16-candle power lamps; and, when I was there, an electric winding-motor was being used temporarily for pumping, pending the fixing of a new pumping-motor, just arrived. The water is giving no particular trouble; about 500 galls. per hour are being raised; and there is power enough for 750 gals. I noticed that Mr. Brown had introduced a device of lining the pulleys with blackwood, to save the rope. The reef in the bottom of shaft was 4 ft. wide in S. end, 2 ft. in N. end, and 5 ft. in centre. It showed 2 ft. 6-in. stone at the S. end, 4-in. stone at N. end on hanging-wall.

Returning to the S. drive, a few feet S. of shaft, the gold-shoot terminates. The dip of the reef then changes to the W. A buck-reef goes off on the E. side in slate country, 40 ft. to the South Rosalind. A prospecting crosscut has been driven here 27 ft. to cut the No. 3 channel, but without any result. The drive was then continued S.E. another 80 ft., on what is called the South Rosalind reef. The stone is irregular, but highly payable. There is stoped ground above here right through to surface. Thirty feet above there was a shoot of very coarse gold, 12 ft. in length, shortening as it went up, and lengthening going down. The drive to be opened out from the main shaft will come right under this, and, in all probability, will lay open a very valuable block of ground. In this drive the walls continually form elbows, which give the drive a crooked course. The manager says he has noticed that on the apex or elbow of the wall, when he is on the run of gold, he always finds the stone poor and thin. but, after turning the angle, the stone grows richer. He further remarks

* In Australasia the terms "dip" and "underlie" are often used as if they were completely synonymous, which they are not. The one is the complement of the other, the angle of dip being the inclination measured from the horizontal, the underlie, that from the vertical.

* The word is often spelt "chute" by mining engineers, but the English form of spelling is followed by the officers of the N.S. Wales and Victorian Geological Surveys, the American (U.S.) Geological Survey, Professor Louis in Phillips' Ore Deposits, and others. Mr. R. L. Jack doubts its correctness, and prefers "chute."

RINGAROOMA MINE

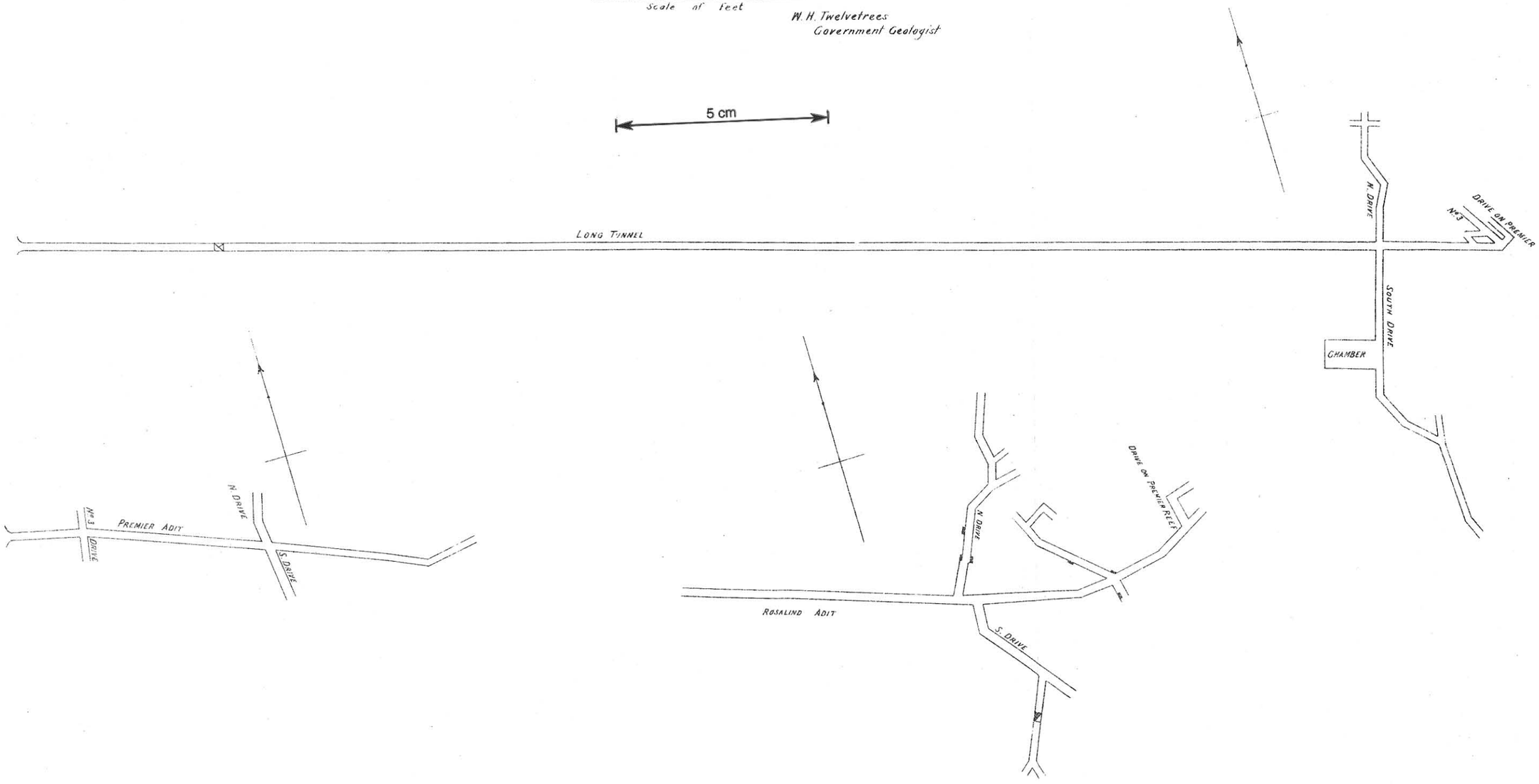
SHOWING TUNNEL AND DRIVES

0 20 40 80 120 160

Scale of feet

W. H. Twelvetrees
Government Geologist

5 cm



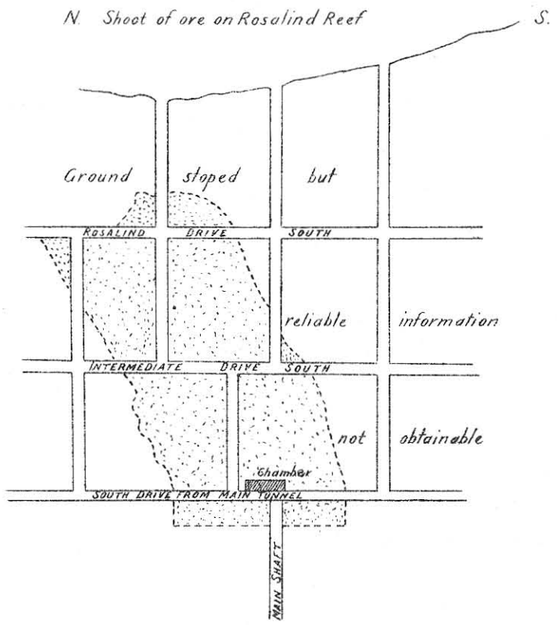
RINGAROOMA MINE

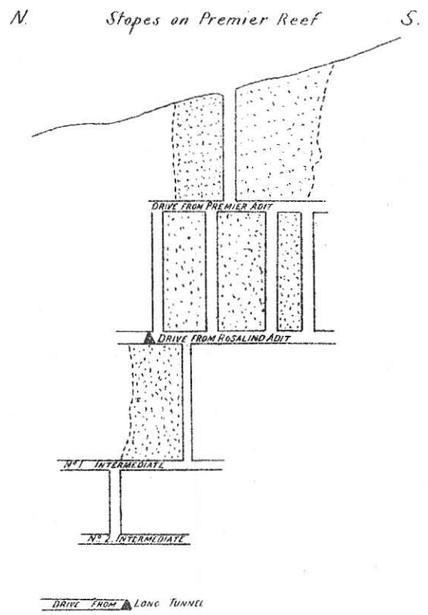
0 40 80 120 160 200

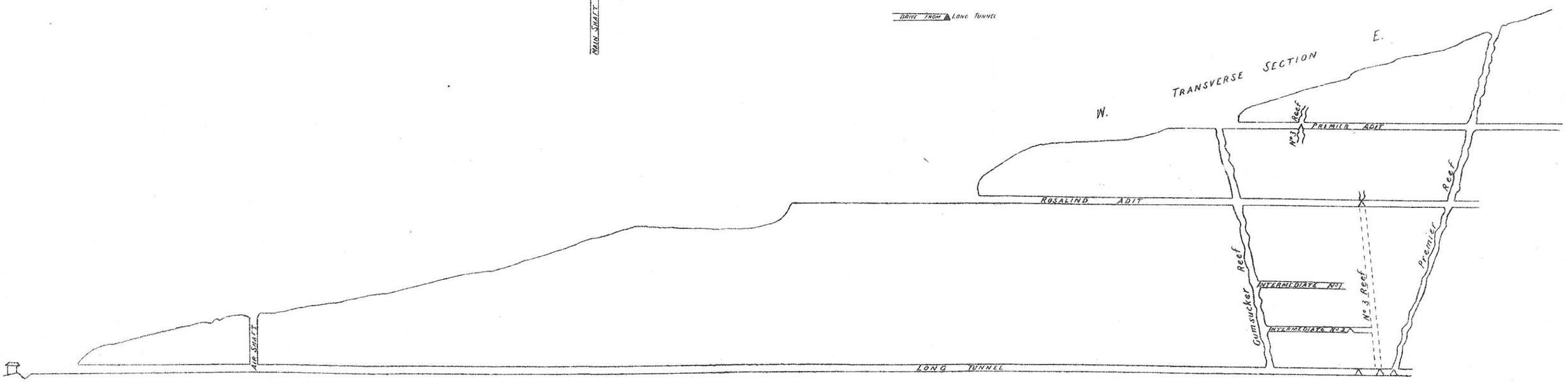
Scale of Feet.

W. H. Twelvetrees
Government Geologist

5 cm







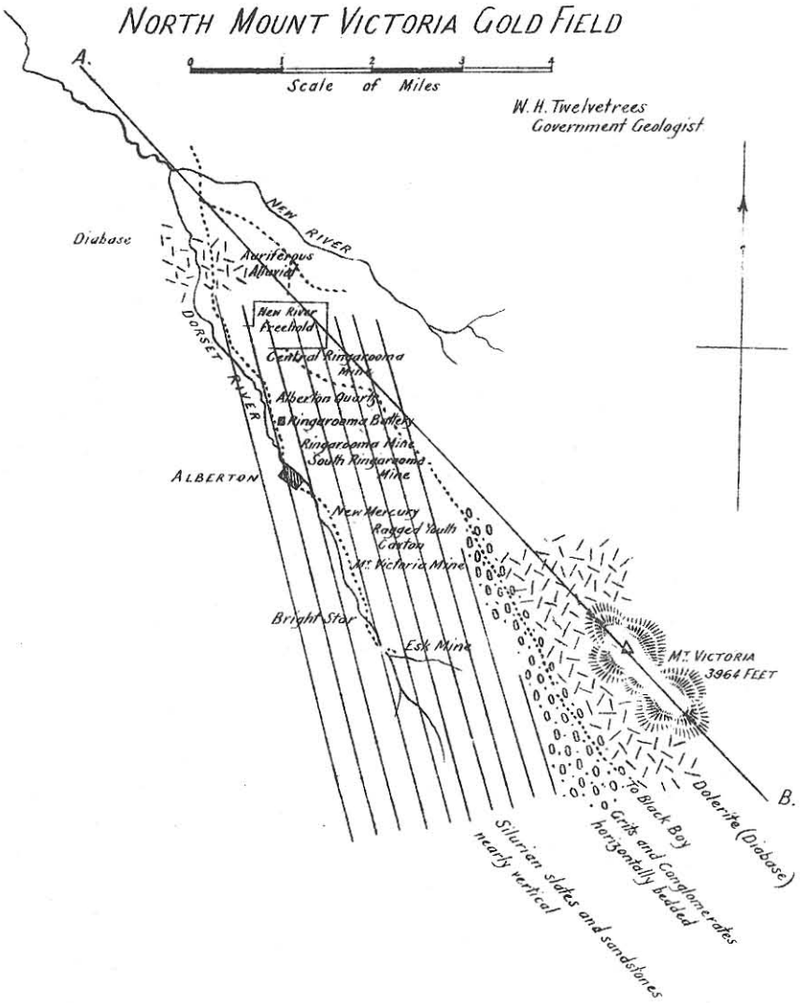
6

5 cm

GEOLOGICAL SKETCH MAP

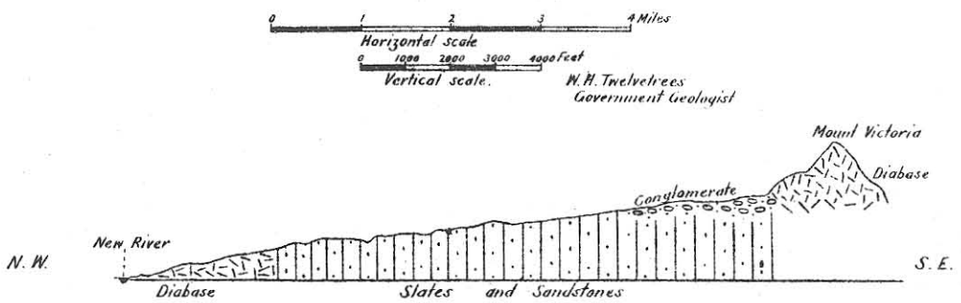
OF THE

NORTH MOUNT VICTORIA GOLD FIELD



NORTH MT. VICTORIA GOLD FIELD

Section on line A—B.



that all through the mine, whenever the dip of the reef becomes steeper, she gets poorer, and if it changes to the W., the reef grows absolutely poor. The last 16 ft. of this drive was in barren stone, and then the level was stopped. This was nearly a year ago. The underlay in the end has gone back again to E. I could not recognise any true channel, still, in the 3-ft. face there is about 7 in. of barren bunchy stone. One of the first things in a proper programme for developing the mine would be the resumption of this drive. It is a pity that financial considerations made it necessary to stop it. As a pioneer drive it will have to be continued, for both it and the level below from shaft must be carried on together. The future programme must also include the driving of crosscuts E. and W., just south of the main winze, where a barren vein has crossed the level. The ground there evidently needs exploring. Whether the southern end of the reef has been violently displaced from the northern part, and the ground between is barren or not, can only be satisfactorily explained by work from the new shaft. The stone upon which the shaft is being sunk may possibly be found to extend beneath this ground; if it does not, then crosscutting will prove it, and I should not be surprised if such work disclosed a main reef-channel, for the South Rosalind drive certainly does not show the appearance of being on a proper reef, although, as the manager says, the absence of walls ought not to be allowed to weigh much, for the same feature recurs all through the mine. At any rate, crosscutting ought to settle the point, and would intersect the Premier and No. 3 reefs as well. This is the most important part of the mine. The shoot above the southern portion of the drive indicates a disposition to increase in length as it goes down, and if it can be connected with the 100-ft. shoot near the main winze, the outlook here will be rosy.

Coming back now to the main tunnel, it is continued another 100 ft. into the hill, when it intersects the Premier reef at a depth on the underlie of 300 ft. from surface. This reef underlies W. towards the Gumsucker. At its intersection the reef-channel is about 3 ft. wide, and is somewhat split up, showing a foot of stone, intermixed with slate, and a nice dig on the E. side. The quartz here is on the footwall, shown in a short drive N.W. The end is in curly sandstone, with quartz veins; the dig is still here, and 3 in. of stone lies on the footwall. Just south of the drive, on the Premier reef, there is a drive N.W. on what is believed to be the No. 3 reef, which has an E. underlie. Above this was good ground, payable all the way down to within about 30 ft., when it started to run poor and bunchy. No. 3 seems to run against the Premier wall, and then go N. and S. The stone extends 3 ft., wall to wall, but is poor, only just gold-bearing. This end is 27 ft. N. of the end of the Premier drive, and that reef ought to come in here. The stopes above are said to have measured from 10 to 30 ft. of 3-ft. stone, cutting out every now and then, but, taking good, bad, and indifferent, averaging 1 oz. gold per ton. The manager tells me that where the stone was widest it was the richest. The No. 3 has every appearance of junctioning at this spot with the Premier reef, and a comprehensive plan of future development would include the exploration of the united reefs in depth. A short crosscut from the bottom of the main shaft will intersect them. The main tunnel should also go ahead into the hill, with a view of cutting any parallel reefs. Its continuation for about 400 ft., more or less, would bring it under a reef higher up the hill, known as No. 5 reef, which it would intersect at a depth of about 450 ft. This reef is an old discovery, which is said to have yielded good stone at one time. A couple of shafts have been sunk on it 60 or 70 feet. As things are at present, it is quite impossible to say which way the reef runs, or whether there is any reef-channel at all: but it looks as if it were parallel to the Premier, with a spur running W.

Intermediate Levels 1 *and* 2.—Two intermediate levels have been driven on the Gumsucker and Rosalind reef, between the Long Tunnel drives and Rosalind drives. No. 1 is 70 feet below the Rosalind adit on the underlie, and No. 2, 110 feet. The latter is more or less a repetition of No. 1, and I did not examine it, confining my inspection to No. 1. About five yards S. of the winze from the N. drive from Rosalind adit, the N. Rosalind reef has been driven upon S., and stoped out up to Rosalind level. There was very good stone in these stopes, 18 inches wide. A few feet further south, with hardly a break, in fact, merely an elbow, the Rosalind reef runs into the Gumsucker. Going south, both the channel and the stone appear to die out; further south again, black slate and quartz are seen; what may be called the wall (though true walls are absent), then gets a W. underlie A little barren quartz in the country is all there is to guide one. The South Rosalind reef here runs N., and there is very probably stone lying between it and the Gumsucker 40 to 45 ft. apart. In the S., or rather S.E. end of the drive, the slate country is running with the level, and nothing is seen in the face beyond a slaty seam, a few inches wide, on the W. side. Work seems to have been stopped in this end about a year ago, as there was nothing to lead them on in the driving. Above this level everything has been stoped out right through to surface, and underfoot to the lower level. I could not help noticing here, as elsewhere in this mine, that a good deal of judgment is required in driving, and it seems to have been fully exercised. The quartz has a habit of running away spur-like outside the channel. For two or three feet these spurs are often very good in gold, but do not persist vertically for any distance, up or down.

Returning now to the N. drive on the Rosalind-Gumsucker reef, the vein, 2 inches wide, crosses from the E. to the W. wall. Going northwards, dabs of quartz occur here and there, but nothing payable. Still further N. is a patch of stone in the middle of the drive, and then the wall breaks, and slate comes in. Near the N. end of the drive is the Winsome winze. There was a horseshoe body of rich stone at this end, and the same shape was observed in the stope above. I got to within 30 feet of the end of the drive, which was blocked with mullock. The stone behind the block was reported to have returned 1 oz. to the ton. A barren reef is said to cross the level. Whenever such reefs are met with underground, they are worth attention. Going back to the winze, a crosscut, No. 3, has been driven E. A few feet in a small vein was cut, showing gold. It was followed for some feet with no results. The same vein was also cut in a lower crosscut, between this and the bottom level. On the footwall of No. 3 reef, good stone came down from the level above to within a few feet of this drive. The reef has been driven upon here south for 30 feet, but it runs with the country, and has not proved to be of any value. It was not seen in the crosscut, but flat leaders are common. Further east is a blow of stone, and in driving N., 30 tons of quartz were taken out in the drive; 25 tons of this were crushed, and yielded 25 ozs. gold, thus paying for the crosscut and everything connected with it. This is the

hanging-wall of No. 3 ; the other is called the foot-wall reef. The reef here abuts on a cross-wall, and spreads out right and left. The blow, when risen on and stoped out to 30 feet, ran out to the apex of a cone, but no trial was made to see whether the stone would make again. Another big blow, 4 ft. wide, comes into the W. with good gold ; there is only a foot of slate between them ; west of the blow is the footwall. Above this the hanging-wall took the gold, and the foot-wall ran barren. Further on, a quartz-stringer, barren, runs with the country. Here are crosscuts : W., 12 feet, found nothing ; E., 22 feet, only siliceous seams cut.

Rosalind Adit.

This has been driven into the hill 400 feet, and is 142 feet above the bottom tunnel. It intersects all three reefs in its course, Gumsucker, No. 3, and Premier.

At 205 feet in a drive goes north, cutting the Winsome, from which winze 24 tons of stone were got, yielding 72 ozs. gold. The winze is now used as a pass for the Premier stone. A few feet further on in the adit there is a short drive N. on the Gumsucker reef, which is brought up by a break. It is, however, picked up again in the Rosalind N. drive 14 feet to the W. At 220 feet the Rosalind drive S. leaves the adit on the course of the Gumsucker reef. Here it is above the centre of a good shoot of stone, going down a few feet N. of the main shaft. This is the S. end of the shoot, which is 50 feet long, and extending in length downwards towards the S. The N. end of it drops vertically. At the S. end of the stone there is no reef-channel or veinstone to be seen ; only sandstone in the roof and pure slate in the face. From this point the drive goes through barren country, leaving the Gumsucker, and continuing till the South Rosalind is cut.

In the adit a reef between the Gumsucker and No. 3 was intersected, driven on a few feet N., and risen on a little in the back of level. At 321 feet in, No. 3 reef is cut and driven upon N. and S. The S. drive is only 23 ft. in length, and is unimportant. The end is in slate, and no stone is visible ; but there is an old winze sunk in the level to a depth of 30 feet, which is said to have given stone worth 8 or 9 dwts. The drive on the N. side of the tunnel goes 76 feet in a N.W. direction. It carried a small reef with 4″ to 18″ good average stone lying on footwall. The ground above is all stoped out to above the Premier level, as well as underfoot. Thin, flat, and other leaders of quartz are seen running with the country, and the end breaks into the Winsome drive.

Proceeding to the end of adit, we come against the Premier reef, which has come down 150 feet from surface. The reef is 4 feet wide, intermixed with slate. A drive N. goes 25 ft. alongside the reef, which is then tapped. It has only been broken into 2 ft. 6 in., but not cut right through. I imagine that the quantity of slate found in it discouraged further work. Quartz veins, 1″, run through the slate-matter. Nothing has been done on the reef at this spot during the present company's time, and it does not look at all promising. But there was gold above, and it is possible for it to make again below. It certainly is a little better in the long tunnel below, where it has a better channel, containing more stone. This promises better for its intersection by a crosscut from a lower drive from the main shaft. Again, though in the Rosalind adit it has no wall of any kind, it has one in the long tunnel.

Premier Adit.

This is the upper tunnel, and has been driven into the hill 352 feet to intersect the Premier reef at a depth of 80 feet from grass. At 50 feet in, the level cut the No. 3 reef, which had never been seen at surface, although the latter is not more than 25 feet above the back of the adit. This is an object lesson in underground exploration, and shows how easy it is to miss valuable reefs. The No. 3 reef was never suspected to exist, has been worked all the way down to its junction in the bottom level, 200 feet, and has proved highly payable throughout, excepting the last 30 feet, which was poorer. The stone up here was not more than 12″ to 15″, but widened going down. Short N. and S. drives, 15 feet and 10 feet respectively, show 6 inches of stone in N. end, and there is estimated to be about 15 tons in the S. end.

One hundred and forty feet further in the Premier reef is cut, and the adit continued 160 feet beyond. The reef has been driven upon N. and S. The north drive, 39 feet, shows a 10-ft. channel with about a foot of confused lode showing in the face. The stone has been poor and patchy. The stope over the back, where the channel was 8 feet, had 5 feet of stone of low grade, but in this part of the mine six or seven dwts. will leave a profit. The south drive, 46 feet, is in a 6-ft. channel of dark sandstone, with a wild cat running across it. The lode is about 2 feet wide, and consists of makes of quartz cutting out and making again in splices. The stone is on the footwall. The stope over the back of level was in 4 feet of low-grade stone.

The bearing of the Premier reef varies at different horizons. In the Premier adit it varies from N. 1° 30′ W. to N. 2° W. ; in the Rosalind adit it is N. 10° 37′ W. ; in the long tunnel, N. 31° 20′ W. ; and a surface observation which I took was N. 6° W. It has been fossicked a good deal at surface without much return. The stone on its outcrop is laminated, and of good appearance. It is said to have been traced a good distance both ways, but more survey work at surface is required before the outcrops can be identified with confidence.

The prospects of the mine undoubtedly centre in the work at the main shaft, which will prove the ground below that already stoped. No great depth has been attained yet, for the bottom of the shaft is still about 70 feet above the bed of the Dorset River. From what has been said of the positions and dips of the reef, it is plain that the sinking of the shaft will furnish splendid facilities for the necessary exploratory work, and if the run of stone continues from above, and improves a bit, it will soon pay for the sinking. The sinking should be continued steadily to the anticipated junction of the two reefs. That junction is, without question, the great feature of the mine. The south drive from long tunnel is one to be resumed at the earliest opportunity ; and the long tunnel itself ought to be continued. With these exploratory works in steady progress, the mine ought to be in a position to give a good account of itself. Its past record proves it to have a backbone. It occupies a good place among the gold-producing mines of the Island, but requires increased outlay on dead work to thoroughly establish its position, and make it a permanent mine.

I now proceed to describe the mines further up the Dorset River, owned by the Ringarooma Gold Mining Company. The first of these is the—

New Mercury Mine.

This is situate 40 chains S.E. from Alberton, and the leased property comprises the following sections :—

631-93G, 10 acres; 633, 2 acres; 634, 2 acres; 1363, 10 acres; 797, 10 acres; 798, 10 acres; 799, 10 acres; and 303, 1-acre battery site. It is approached by a good road along the river Dorset to the battery, 25 chains from the township, and then a track 15 chains long leads up to the mine.

The mine is an old one, and was worked as far back as 16 or 17 years ago on two parallel reefs, 230 feet apart, which, from time to time, yielded good gold returns.

The upper works are entered by a cross-cut tunnel, now 8 or 10 years old, intersecting the reef (No. 2), which has been driven on N. and S. In the N. end the face is ferruginous sandstone, carrying iron-stained quartz, a few inches up to a foot thick. Further back the stone had been wider, from a foot to 30 inches, dipping W., and on the hanging-wall of drive. When it widened it got very mullocky. The reef-channel is about 2½ ft., filled with sandstone seamed with small quartz veins. In the S. drive the dip has turned over to the E., and there is good-looking quartz on the foot-wall. This stone appears to have split up in going south. It is all stoped away up to surface. When Mr. Brown began work, the depth of stone stoped was 12 ft., and about 15 in. wide, but in sinking on it it was found to enlarge, going down clean, but poor, with only a little gold on the footwall. This winze, sunk by the present company, was connected with the No. 2 level below. Under-hand stopes were worked below the level, about 50 feet long, yielding 6 dwts. gold per ton. There are two cross-courses in this drive, one of which has been driven on in the lower level. At the S. end of the old stopes there was nice-looking stone, but the crushing which was taken out did not yield remunerative results. In the S. end the apparent channel is 4 ft. wide, filled with horizontal layers of dark sandstone, and with a quartz vein on each side. The appearance is that of country rock fissured by separate veins, but in my examination of the mines in this district, I have grown accustomed to these vague, ill-defined reef-channels. The reef might make better below.

No. 2 *Level.*—The No. 1 lode cut in this level has been worked all the way down from surface, 60 to 70 ft., and was payable even with under-hand stoping. The shaft took all the reef when they came to open out. A vertical 2-in. vein runs on the E. side; the other was followed down some 20 to 30 ft. How deep, exactly, I cannot say, as the winze could not be plumbed, and the water was running over into the level. In the N. drive, on reef where the No. 2 tunnel intersects the lode, it was from 4 in. to 12 in. thick, and comparatively barren, but down in the winze, a little better. The lode a little south of the main chamber split up into two branches, the one being, as just stated, comparatively barren, the other going N.E., carrying the gold, but very irregular, and has not been further prospected. How far the S. drive goes in could not be seen, owing to a block.

Proceeding further in this No. 2 level, the No. 2 lode is cut, showing solid 8-inch low-grade quartz; but in extending the crosscut E. a mullocky formation was met with, showing gold freely in places, but the whole width only yielded 4 dwts. North and south drives have been put in. In the north drive a rich vein comes in from the west; the drive connects with No. 1 level above by a rise. The stone is very irregular, now widening, now thinning; the maximum width said to be 15 inches. Above, it is partly stoped out, but gave a yield of only 2 dwts. to the ton; in the sole of level, however, where the winze comes down from No. 1 level, it went as much as 1 oz. to the load. Sinking was continued 6 feet below the level on stone over 1 oz. in value. The stone crushed from this winze was 92 tons, yielding 32 oz. gold, the principal part being derived from the last 16 feet of the winze. The best gold in the mine is at this end of the shoot, which is pitching N. It is said to have been very fine: in the battery nothing was in the boxes—all on the tables. We are, here, about 120 feet ahead of the low-level tunnel. Above, the stone ranged from 15 inches to 5 feet, but the only gold was on the footwall, and the quartz was very poor. Under-foot, it is estimated at 25 dwts. per ton. The last crushing was in 1897, when 98 tons returned 76 ozs. gold; but this parcel included a lot of mullock. A crosscut north requires putting in here. In the end is metamorphic slate with vertical bedding, or slight inclination to the E., with 2 inches of quartz on footwall side, though there is really no proper wall. Above the end, the quartz is said to be clean and poor, but better below, though broken up a good deal.

In the S. drive on this lode the rock is extremely hard. Four inches of quartz goes on in the back, and makes on the western side of drive; it then breaks off, and I could see nothing in the end but metamorphic sandstone, with no signs of any walls.

No. 3 *Tunnel.*—A low tunnel has been driven to some 92 feet under the above workings. It has advanced about 140 feet, but the metamorphic sandstone and slate-rock which it traverses has been so hard that the contractors have repeatedly relinquished work. The driving has cost from 30*s.* to 35*s.* a foot. The country rock crosses it with a bearing of N. 17° W. Although the rock is unusually hard, harder than at the N. end of the Mt. Victoria field, the formation of the quartz-reefs does not seem to have been detrimentally affected thereby. The quartz itself is charged with iron and arsenical pyrites, and has a favourable appearance for gold. Gold, moreover, is visible in the stone, and, as said above, it is often very finely divided.

Looking at this mine as a whole, the aim should be to get below the No. 2 level, where the underfoot stope on No. 2 lode indicates fair stone going down. The water difficulties prevent any further work on it from above. The No. 3 tunnel will give access to the ground below this good shoot, and at the same time prospect No. 1 lode, about which the reports are conflicting. Despite difficulty in letting the work, it ought to be pushed ahead.

I notice last year's published accounts of crushings from the mine to June 1st state 107 tons quartz as returning 34 ozs. 8 dwts. retorted gold. This stone was from the old backs. It is, consequently, quite evident that the future of the mine depends upon the result of future exploratory work, which ought to be taken in hand seriously as soon as funds permit.

There is an efficient crushing-mill on the Dorset River, fixed in 1898, comprising ten head of 9 cwt. stamps, with electro-silvered copper plates and blanket concentrators. The motor is a 40-ft. water-wheel, sufficient for 20 head of stamps. The company have half a mile of fluming. The water here fails earlier than at the Ringarooma battery, lower down the stream, but there is sufficient supply during nine months in the year.

Ragged Youth.

This mine has recently been taken over by the Ringarooma Gold Mining Co. It is situate on a ten-acre section (1288-93G) to the E. of the Dorset River, and

about 20 chains S. of the New Mercury. The upper workings are high up on the hill, above a small creek flowing into the Dorset.

Going through the mine from above, downwards, a tunnel has been driven N.E. into the hill, where a shaft has been sunk 25 ft. to the level below, and continued on the underlay from that level to the creek, another 80 ft. The stone was stoped as the shaft was sunk, and I was told it was payable all the way down, but the quartz was getting less in quantity, though still good quality. The first crushing of 32 tons yielded 54½ ozs. gold. There are good backs over the upper level, but the stone is poor, so far as explored.

The shaft between the upper level and the one below shows that irregular stone lives down. It makes and dies out intermittently. In sinking, there would sometimes be 3 ft. of stone, frequently not extending beyond the ends of the shaft, then a blank, with no indications whatever. In the N. end of the level the face is sandstone, with irregular veinlets of quartz. All through it is impossible not to see that cross-cutting is the first duty here. There are certainly walls in the drive, but behind these are probably others, for there is not the slightest proof that the present walls are the true ones. This level is short, and only 25 ft. below shaft-collar in the upper one. The country strata are sandstones, and run N.W.–S.E. Eighty feet below, measured on the underlay, is the low-level tunnel. After intersecting the reef, the latter was driven on N. on stone 6 ft. in length, (altogether there is a shoot 20 ft. long), which then gave out, after giving 14 or 15 tons of quartz for crushing. There is nothing now in the end but slate. Cross-cuts require to be put in behind this end.

The stone is very bunchy in this mine, and the reef-channel difficult to follow. Some exploratory work is still necessary to locate and further prove the reef. It lives down, but is irregular, and when work ceased was not sufficiently payable to have to contend with water. Thirty-two tons of stone were crushed from prospecting the upper part of this section, but did not pay, though free gold showed frequently, and good mortar prospects were obtained. The sum of £1007 3*s.* 6*d.* was furnished to me as the proceeds of crushing since June, 1897. The crushings in 1899, 62 tons, were scarcely payable, yielding only 54 ozs. 11 dwts. of gold.

The mine will have to be worked by low-level tunnel, which will do away with the expense of hoisting by windlass, and supply ventilation. The former expensive way of working may have contributed to the unsatisfactory results, but some dead-work is now essential to explore the ground ahead of the bottom workings.

Mount Victoria Mine.

Seventy chains S.E. of Alberton, on the right bank of the Dorset River, is the dismantled battery of the old Mount Victoria Company. The 42-ft. water-wheel is still left. Twelve of the stamps have been transferred to the Ringarooma Company's freehold property at the New River. The latter Company have acquired the two ten-acre sections (1433 and 1567) formerly held by the Mount Victoria Gold Mining Company.

The mine has been worked by adit levels. The highest is about 270 ft. above the main road, and is known by the name of the Montana tunnel. It has been driven about 220 ft. on the course of the reef, which bears N. 35° E. The reef had 10 in. to 3 ft. of clean stone. The first 250 tons are said to have returned 2 ozs. 3 dwts. per ton, but the quality fell off later, and came down to 15 or 16 dwts. per ton. A large boulder of gold-bearing quartz was shed from this reef, and carried a few fathoms down the hill; and, upon its discovery, the Mount Victoria (then the Montana) Company was floated. From this reef, I was informed, £20,000 worth of gold has been taken, and from the extent of the workings I can well believe it. The full length of reef worked and traced on surface is about 6 or 7 chains. The slate and sandstone strata of the country cross the reef, bearing N. 10° W. At the entrance of tunnel a spur goes off from the lode in a N.W. direction. It carried good gold while it lasted, but gradually died away. The reef is 5 to 7 ft. between walls, and has been stoped at surface for a length of about 100 ft., and these stopes go right down to within 25 ft. of the back of the low level, about 250 ft. on the underlay.

No. 2 level is 90 ft. below the above, and has been driven upwards of 300 ft. At first it is a crosscut, but intersects the reef, which is much the same as above. The stone gave out, and no attempt was made to prove the ground on either side by cross-cutting. A small parallel reef was tapped by a short cuddy, but cross-cuts should have been boldly extended right and left. A winze goes down to the level below. There was a good block of stone 5 or 6 ft. wide along here in the N. drive. The S. drive is short.

No. 3 *Tunnel*, 90 *feet below No.* 2.—This is a long tunnel, driven about 600 feet to intersect the reef. This done, 150 ft. were driven each way. The stone went underfoot here down to within 25 ft. of the No. 4 tunnel, when it was cut off abruptly by a floor. The N. drive in the No. 3 tunnel has a good footwall, but the hanging-wall is broken. At the northern end of the stopes over the drive the reef pinched, and though it was driven upon about 70 ft. further, the pinch continued, and only a little bit of stone was found, which gradually grew poorer until a quartz cross-course cut off the reef. Here the former owners made a mistake. By all mining rules the reef should be found somewhere on the other side of the cross-course, but absolutely no attempt has been made to pick it up by means of cross-cutting.

No. 4 *Bottom Tunnel.*—This has been driven 1300 ft., but it never cut the reef. Where the shaft from above breaks through, there is a little vein which gave a prospect just sufficient to show that gold lives down. Cross-cutting exploratory work is badly needed in this tunnel. I do not look upon the flat floor which interrupts the stone above as a serious displacement. The quartz-channel will probably be found again on a parallel side-line, which would be picked up by a little prospecting. The Mount Victoria reef has not been traced south. What is known as Marr's reef comes across the bottom tunnel as a wide, mullocky formation. A shaft has been sunk on it some distance north, and 12 or 14 tons quartz taken out, which I was told returned 1 oz. gold per ton. This reef keeps on parallel with the main road. A good many trenches have been cut, and a little stone has been found here and there. The larger stones found at surface probably do not belong to Marr's reef, but have come down from the Wilson, Caxton, and Victoria reefs, which are all parallel, or nearly parallel, runs of stone.

Above No. 1 level 70 feet of backs have been taken out, which would make about 340 ft. on the underlay of stone worked on the Victoria reef. The last work done was by tributors, four years ago. The mine had been idle before that for seven or eight months; in fact, the Mount Victoria Company worked it intermittently

off and on for a long time. That company had a good run of stone, and their work has conclusively shown that payable shoots of considerable extent do exist in this field. Though the reef has been interfered with by a floor, too much importance must not be attached to this. Such floors and heads occur continually in the mines of this district, but, so far as I could see, they are, as a rule, older than the quartz veins, which had not sufficient force to break through them, but followed neighbouring lines of fracture, providing ready-made channels for the passage or segregation of the silica.

In the Mount Victoria mine perseverance in searching will, I think, result in the re-discovery of the line of stone. There is, moreover, no reason why it should be confined to ground above the present bed of the river. That bed was once very much higher, and as its level had nothing to do with the quartz or the gold then, we need not assume that it has any detrimental effect now. Though the mine has high backs there is no necessity for confining work to adit levels. The reef doubtless lives in depth, and if adequate capital be forthcoming a portion of it should be devoted to the exploration of the lode at deeper levels.

New River Mine.

On the eastern side of the spur from Mount Victoria, called the Ringarooma Mount, the Ringarooma Company have purchased J. H. Conder's block of 317 acres 3 roods 20 perches, upon which are several auriferous quartz-reefs. This is known as the New River property, from the river of that name which flows into the Dorset. The southern boundary is one mile N.E. of the Ringarooma battery, in the Dorset valley. It is reached by a 1½-mile track over the mountain, or by the carriage road which goes round a few miles, skirting the base of the hill. On this road we have the patch of dolerite protruding through the slates to which I have already alluded, and further on, past the cemetery, red basaltic soil in the fields and nodules of basalt proclaim a former covering of lava. Turning off south into the company's freehold, low ground is traversed, which has been leased to Mr. F. W. Krushka for alluvial work. There is a nice quantity of wash here; the ground is 15 to 20 ft. deep; some good gold is found, but patchy. The nuggets which turn up from time to time seem to suggest that a richer reef awaits discovery on the New River property than any yet discovered. These workings passed, the New River battery is reached. Here twelve head of stamps are working. The battery was put together by Mr. Wm. Brown out of an indifferent second-hand plant, part of the old Mount Victoria crushing-mill. When I was there everything was working very smoothly. The battery is crushing 12 tons of stone per 24 hours, sometimes 15 tons; 100 tons per week could be put through easily. The mine is 29 chains up the valley from the battery southwards, and the stone at present has to be carted to the stamps, but it is proposed subsequently to carry a tramway through from the mine to the mill. 28 hands were employed at this mine when I was there.

A few yards south of the battery there has been some costeaning. It is intended to work this formation, which has been opened upon for 40 ft., and is gold-bearing throughout, every prospect being payable. It consists of gossanous matter at surface and quartz veins below.

The main mine-works are on the tunnel-lode known as No. 1. There is a good outcrop at surface, stones picked up at random carrying payable gold. The bearing of the reef is N. 60° to 66° E., and its dip 75° to 80°. It runs into the hill, and a tunnel has been driven on it for 200 ft. The shoot of payable stone is 150 ft. long in the tunnel, and 60 ft. at outcrop. For this length it has been stoped up to surface, 75 ft. on the underlay. At the outcrop it is from 18 in. to 4 ft. wide, and in the tunnel, from 9 in. to 3 ft. Taking the whole length of the stope, it may be reckoned as 2 ft. of payable quartz. An oblique fault marks the eastern boundary of the body of stone, and 3 ft. of stone has here gone under-foot, which will be cut by the level below. A good deal of water drips through the fault. The shaft from surface will serve to draw the mullock up, and, continued downwards to bottom level, will let the quartz down. With this width of payable stone, and a vertical distance of 40 ft. down to the bottom level, good results should be obtained. The fault is clean and steep at the W. end of the stone, which is bounded by a thin vein of manganese. In the end of the level a flat floor in the roof cuts off the stone, which goes off to the N., but the latter spur does not look as if it were the real reef, which must be ahead of the present end.

Forty feet below the above is the low-level tunnel, which will be the main outlet for this mine. A hopper will be fixed at the mouth, and a tramway constructed for delivery of stone to the mill. In about 30 feet more the stone ought to be reached coming down from the level above.

Higher up the hill on this freehold, to the N.W., is a reef running N. and S., about the same strike as the Central Ringarooma reef on the section to the south. The full width of outcrop is 4 feet, of which about 2 ft. 6 in. is clean stone. A shaft has been sunk 15 ft. in good stone, which, however, has contracted to 6 inches at the bottom. This stone looks kindly, and is of fair quality, but there has been no crushing. The same lode has been cut again to the N. A long adit is proposed as the best way of working this reef.

Over on the opposite or eastern side of the creek some reefs have been exposed on the slope of the hill. Trial shafts have been sunk on these, known as Nos. 2, 5, and 6. No. 5 is an old shaft which has been sunk 60 ft. on a narrow quartz-vein running all the way down without widening to anything like a good body of stone. Good prospects are obtainable from the stones thrown out, but there seems to be hardly enough quartz at this particular spot to encourage much outlay.

No. 6 is a shaft a little to the E. of the above, and the two reefs may possibly be the same, though not enough is known of either to determine the bearing. No. 6 looks roughly parallel with the New River reef. The shaft has been sunk 72 feet on fair stone, 8 in. to 1 ft., which, however, contracts in length. There is visible gold in the stone, of which 24 tons have been crushed, returning 18 dwts. gold per ton. Mr. Brown estimates that a hundred tons could be stoped out, returning fully that yield. A low tunnel, not more than 250 feet in length, would give 160 feet of backs, and thoroughly drain and ventilate all upper workings.

No. 2 is a shaft sunk 60 ft. on a reef which is thought may be the No. 1 tunnel lode now yielding highly payable stone. The last stone gave good prospects, but the length of the shoot is not known. There seems to be plenty of quartz, but all of it is not considered payable. Mr. Brown intends testing this.

The Tiger reef is a lode situate just outside the E. side-line of the Company's freehold on Mrs. Singline's block, but included in the leased property of the Company. Two shafts have been sunk on it: the western

one 40 ft., and the eastern one 70 ft., on 2 feet of heavy stone. These were worked about four years ago. No reliable information is available; report says the first crushing went 1 oz. gold per ton, and subsequent returns only 9 dwts. The gold in the stone is said to be coarse, but I could not see any in the stuff at mouth of shaft. I could see that the slope of the hill has been costeaned all the way up, and plenty of stones are said to have been found, with heavy gold. Should any arrangement be made for resuming these abandoned shafts, the manager would first connect both, take out the stone, and see what it is worth.

The New River property is very good-looking country for gold. The returns now being obtained from the tunnel-lode are paying the owners very well for their outlay; the country can be worked easily and economically; and there are several spots on the property where outlay on prospecting work would be judicious. Such work could well absorb £1000 per annum. I am of opinion, too, that such work is highly necessary, for if work is exclusively restricted to any single reef in this field, results are likely to be disappointing, and may prove disastrous. At the time of my visit a 350-oz. cake of gold was turned out from 345 tons quartz crushed at the New River battery. The previous crushing had yielded 18 dwts.; and the mine had 150 tons of 1-oz. stuff to begin the new year with. These results are palpable, and should encourage the owners to provide adequate capital for the development of the property.

Central Ringarooma Mine.

This property comprises 33 acres—1351-93G, 10 acres; 1406-93G, 10 acres; 1352-93G, 10 acres; 1407-93G, 3 acres—situate south of and adjoining the Ringarooma Company's freehold at the New River. Fifteen hands were employed at the time of my visit.

About 140 feet above the smithy a tunnel has been driven upwards of 200 feet in slate country N 74° E. The slate rocks cross it, running S. 36° E. Sixty or seventy feet in, a 3 or 4 inch vein carrying gold, crosses the level. At the end of tunnel, the vein, where intersected, was not very rich, but a fault here throws it back east. It is, however, brought back again in the north drive at nearly the same angle. A few yards further north in the drive a fault crosses it at nearly a right angle. The best stone in this direction made up to and before reaching the fault. The vein was then supposed to be cut off, but was picked up again N. of fault, showing rather glassy quartz, but good gold. Here, a pass comes from surface, with fair gold in stone, averaging 15″ to 18″ from top to bottom. This is the north end of a stope which extends over the back of level for 40 feet south, returning good gold. The reef-channel can hardly be said to be identified yet. In the back of level the stone is 8 inches; in the end, 4 inches; but wider in the sole. Before the fault came in there was 2 feet of clean, good stone. The reef dips steeply to the W., and its bearing is approximately N. 20° E. It is driven on at 70 feet below surface, measured on the underlay. A few yards in the S. drive from tunnel is another fault, which has heaved the stone to the E. side of drive. About 4 inches of stone continues, and will be driven on, but in consequence of these heaves the direction of the drive will be very sinuous. In this end there are two diverging bands of stone. The one on the wall will have to be left for the time being, and the one in the direction of the drive followed.

At 72 ft. above these workings a level has been driven 60 ft. on the course of the reef. At the mouth the stone is poor. Not far in is a shaft from surface 20 ft. The crushings went 11 dwts., but it is estimated that half was mullock, and that the real value of the stone was 15 or 16 dwts. There is fair stone going along here, but it is cut out by a fault. This fault is to the south of the one below. The frequency of these faults is a feature on this side of the hill. There are six of them altogether in this mine—one here, one ahead, and four below. Beyond the fault a few yards have been driven here in country, but since I was in the level I hear the reef has been found again, 8 ft. to the E., where there is 2 ft. of stone. The outcrop is seen a few yards up the hill, with stone some 2 ft. wide, and another foot of stone carrying arsenical pyrites, to the E. of the foot-wall. It is intended to sink on it. This reef has been traced at surface for about a chain, horizontal distance.

On the top of the hill, on Section 1351, is a reef known as Pennefather's lode, in the usual yellow sandstone. It has been opened upon down to 15 or 16 feet. The vein at surface is 6 or 7 inches, at bottom, 5 in., carrying disseminated gold. Fourteen tons of stone returned 21 dwts. per ton. To the south is a 40-ft. shaft, from which a cross-cut was driven, intersecting the reef, but operations were stopped in consequence of the sections below being formed into a no liability company. The reef dips S.W., and has been traced at surface for a chain S. 60° E. It is proposed to continue to sink on the underlay.

Outside the smithy I saw about 50 tons of quartz in the hopper, ready for crushing at the New River mill. The gold in the Central stone is of medium grain, though often very fine—paint gold. Still, very coarse gold also occurs. The road to the mill has been made at the joint expense of the two companies, and they are both under one mine management. The positions of the properties of these companies favour the construction of a proposed joint tunnel along the E. and W. side-line which separates them, the cost of this prospecting work to be shared by both companies. The Ringarooma Company would work northwards from the tunnel, and the Central, southwards.

The most troublesome feature in this mine is the occurrence of numerous small faults. These give rise to a series of small displacements of the lode, but I do not see any signs of them being serious, though they cause expense and interrupt regular work somewhat vexatiously. These movements have naturally occurred since the time when the reefs were formed, and, in looking round for their cause, I see no source so probable as the shocks produced by the upheaval and intrusion of the dolerite (diabase) which forms the core of Mount Victoria. This eruptive rock is not confined to the summit of the mountain, as has been very generally supposed, but is exposed by denudation 3000 ft. below the crest, on the Alberton road, near the cemetery. This intrusive band or boss forms the low spur on the E. side of the Dorset, and strikes S.E. in the direction of the New River and Central properties. I could not trace it across into those properties, but I infer that it may be closer than is apparent. In any case, this disturbing element is comparatively close at hand, and though it is not seen at the mine, and does not actually cut off the lodes, the shock of its intrusion has shaken the ground, and given rise to the numerous little faults met with underground. Despite the interference caused by these, the mine is being economically worked, and has fair

prospects. With the necessary capital for exploratory work, it should, under the present judicious management, do well.

As the preceding mines are owned or managed by the Ringarooma Company, I have dealt with them successively, notwithstanding their scattered positions. I now proceed to mention the other mines upon the Dorset side of Mount Victoria. Of these the most important is the

South Ringarooma Mine.

This is held by the South Ringarooma Gold Mining Company, and comprises 35 acres—1196, 1195, 1194-93G each 10 acres, and 453-93G, five acres—to the south of the Ringarooma Company's sections, on the western slope of Mount Victoria.

The main works are on Section 453. Just inside the S.W. angle of the section are some shafts sunk on a reef bearing a little to the W. of north, and which no doubt passes into the Ringarooma Company's ground. These shafts are now abandoned and inaccessible. Maynard's shaft has been sunk 30 feet, and the reef stoped at bottom for 14 feet. There is another shaft further south, and connection has been made between the two, 30 feet in all being stoped. The country is soft yellow slate, favourable for auriferous quartz, and £300 worth of quartz is said to have been taken out and crushed at the Premier battery. The figures supplied to me were, 77 ozs. 16 dwts. gold from 53 tons quartz. The stone in the reef is very irregular and intermittent for 200 or 300 feet. A shaft was sunk by the old Strahan Company 70 feet on the reef, which there runs N. 3° W.; this is about 100 feet N. of Maynard's shaft. Proceeding north, two more shallow shafts have been sunk; some of the stone went 2 ozs., but was not more than 3 inches in width; a little quartz can be traced all along.

To work this reef in depth a tunnel was driven at 100 feet below shaft-collar, and the reef cut after driving 170 feet. Thirty feet were then driven N.W., and 80ft. S.E. on the course of the reef. At 80 feet S.E. the quartz gave out, and the drive was continued 60 feet further, without recovering stone. There is said to be still stoping-ground overhead, but I do not attach much importance to it unless its value approaches 1 oz. per ton. The north drive is a short one, having come to the end of the good stone met with when the reef was cut; 19 tons of quartz, giving 44 ozs. gold, were got from this drive. In the end of level there is now 6 inches of poor stone; the face is soft slate; the reef has good apparent walls, but runs with the country. In this level 9 tons stone were got over back to bottom of old Strahan shaft, which gave 17½ ozs. gold. The underhand stope, about 18 feet long, and in one place 18 feet deep, gave 12 tons of quartz, returning 13 ozs. 12 dwts. The South Ringarooma Company started to extend level from bottom of Strahan shaft in a S.E. direction, but the stone grew poorer. The company followed the reef some distance, and took out a crushing, 46 tons, which returned 20 ozs. gold, or 9 dwts. per ton. In the S.E. end of stope there is still a little stone; overhead it is somewhat veiny, but stronger underfoot. No stone was got past this in driving the level. There is a good hanging-wall to reef; the foot-wall has been taken down in driving. The wall dips N.E. The end is slaty and confused, and the reef has been supposed to be faulted, but I do not think there is much disturbance, for the hanging-wall is continuous. The fact that the surface line of reef above this end is further south is no proof of faulting, and I have frequently found the surface and underground bearings of reefs in this mountain far from identical. Crosscuts have been put in right and left without disclosing anything but country on either side; if the cross-cuts are not considered long enough, the one on the south side should be extended. An inch or two of stone is showing in the end, deflected across the foot-wall side. In this level a leader was followed a few fathoms west, with nice gold, while it lasted. A lower level, 80 feet down, has been driven about 60 feet, but nothing payable was found.

What is called No. 2 reef is stone just south of the present end of No. 1 level, as shown in a trench, but nothing more is known of it yet. No. 3 reef, or Duke's show, is on section 1195-93G, about 500 feet above the Dorset River. At surface on the track a 3-inch quartz-lode is seen bearing N. 60° W., and has been traced a few fathoms each way. The stone attains a maximum width of six inches, and shows a little free gold. A few yards further east a drive has been put in on the course of the lode for about 15 or 16 feet, with stone about six inches thick, but not very regular, often a hardened band of slate seamed with quartz. The end of the drive is all slate, barring a bluish quartz vein, said to have yielded a little gold, by crushing; none was visible in the stone.

No. 4 reef is a N. and S. one, in the northern part of section 453, but the shaft which has been sunk on it has broken in. This was sunk a long time ago, and good gold is said to have been obtained from it, but I could obtain no certain information about the returns. From the bearing of the reef, it ought to have been met with in the No. 1 workings.

The last crushing from the South Ringarooma Company's ground was in August, 46 tons returning 20 ozs. 2 dwts. gold.

It is evident that this Company has dormant chances, which may develop after more prospecting. Previous work has been confined to getting to gold-bearing stone, and taking it out. When the shoot gave out funds were insufficient for the necessary prospecting, which should have gone on *pari passû* with the productive work. It was abundantly plain to me during my visit to Mt. Victoria, that the policy of risking everything upon a shoot of gold, as has been done over and over again in this field, is simply suicidal. The shoots in this district are too short and capricious to rely upon any single one as the exclusive support of a mine. The dead-work must be kept a good way ahead, and in different parts of the property, so that when one run of stone fails another may take its place for a time. This means that the South Ringarooma Company must prepare themselves for some considerable outlay on exploratory work before much can be said about their prospects. They have, however, as fair a chance as others on the field; some good gold has been found on their property, and there is no reason to think that it has given out permanently.

Recommendations.—No. 1 level, S.E., should be continued further, and the cross-cut S. extended some distance. No. 2 level must be driven steadily, to prove the reef. A long cross-cut N.E., between 300 and 400 feet, would intersect reefs 1, 2, and 3, at a depth of over 200 feet, and prove the Company's ground in a satisfactory way, perhaps cutting reefs underground of which there is no sign at surface.

Alberton Quartz Mine.

The Alberton Quartz Mining Company holds 64 acres, besides water-rights in the Dorset Valley, on the

hill-slope just north of the Ringarooma Company's mine. The mine is situate about 300 ft. above the road to Alberton. The country-rock consists of the same slates and sandstones as prevail in the adjoining mines, and with the same bearing, viz., 10° to 20° west of north. There is, apparently, no break in the lines of stratification; and, no doubt, the same strata are continuous on their strike all along this spur; for, as far as I could see, the glens and ravines descending to the valley of the Dorset result from denudations, and do not mark lines of fault.

Just inside the S.E. angle of sections 995-93G (formerly 697) to the north of the boundary line of the Ringarooma Company's section 890-87G, a shaft 121 ft. has been sunk on the W. slope of the hill, about 320 ft. above the Dorset Valley. At surface there was quartz underlying W., but some 10 or 12 ft. down the dip changed to E.; and in the bottom, which I could not reach, it is stated to be to the W. again. A cross-cut has been started at bottom of shaft to cut the reef eastwards, which it ought to do in between 40 and 50 ft. As the hill slopes to W., there would not be much use cross-cutting W. The south boundary seems scarcely a chain off, and I do not see why the cross-cut was not continued to the E. side-line. I was told it was stopped twelve months ago. Assays have been made of the stone, which is reported at 15 dwts. The stone which I saw lying about contained a little pyrites, and might yield a few colours. It is thought that the Premier reef of the Ringarooma Company runs into this section from the south. It looked to me as if the line were a little east of the shaft, and, if continuous, that reef might pass outside the side-line, but really nothing positive can be said without exact survey; as the Premier reef underlies W., it may possibly dip into this property. The other line of reef, the Gumsucker, ought to come into the section. In this hill the reefs cannot be easily traced at surface, and there is also considerable variability in their directions, so that the identification of lines of quartz is in a great measure conjectural. The make of quartz in this shaft, assuming the longer diameter of the shaft to represent its direction, bears N. 7° W., which corresponds fairly well with that of the Premier, but it is doubtful whether the two are the same line of reef.

On the creek, about 100 feet lower than the shaft, is an adit level, No. 3, called New Discovery, driven about 60 ft. N. 37° E. on the course of an auriferous reef. The hanging-wall is defined, and carries, in places, 4 to 6 inches of stone; the footwall has been taken away in the drive. The reef dips S.E.; it is pinched in the end, where there is nothing but a small vein. A breasthead comes across the face. The yellow slate and sandstone country seems a little mixed and disturbed. A little quartz has been taken out over the back of the level. I was told that 46 tons stone from this drive was crushed for 8 dwts. per ton. A few tons still remain in the paddock.

In the central part of the property are two reefs, No. 1, running N.E., and No. 2, bearing N. 4° E., and these two should junction towards the N. I could not enter the levels driven on these reefs. No. 1 was unsafe, and No. 2 was banked up with water. I was told that 175 feet had been driven on No. 1, and a small crushing taken from the back. At entrance there was a good body of quartz, but poor; a little also underfoot in the approach. The shoot of gold appears to have been short. The stone is said to have been as low as 4 dwts., and a small crushing up to 18 dwts. On the other hand, Mr. James Clark, in his published report of 12th December, 1895, states that 170 tons of stone gave an average yield of one ounce of gold per ton. The winze in tunnel is reported as having given a small crushing of 2 ozs. 16 dwts., but the stone was irregular, sometimes a mere thread. Before the level was started, a small quantity of stone was obtained from the old Endeavour shaft, giving as much as 18 dwts., and some even 26 dwts.

A level has also been driven 80 feet on No. 2 reef, and stone stoped from the backs is reported to have returned 12 and 15 dwts. per ton. These levels being now inaccessible, I could not form any opinion on their prospects. Supposing the reefs in the ends to be traceable still, it will take a few hundred feet more driving to bring them to the junction, where they would have good backs. As they have been discontinued, I have no doubt the quartz has given out, and the ends probably have an unfavourable appearance.

There is a 10-head battery with copper plates and tables driven by a 16-h.p. Robey engine, with hoppers, and a tramway from the mine. The battery is in good condition, not more than four years old. Evidently its erection was premature.

The mine exhibits, as far as I saw, some of the least promising features of the reefs of this district. Its quartz-makes and gold-shoots are short and irregular, and while some of the stone has yielded fair returns, the bulk of it has been too poor to be remunerative, and there has been too little of it to be satisfactory. However, the ground worked is rather high up the slope of the hill, and it is just possible that as the workings get deeper, the mine may improve. Wherever on this field any good returns have been obtained in shallow workings, I believe the quartz, if followed in depth, will lead eventually to more important and permanent reefs. The mine must, however, stand on its own merits, and not be judged by the adjoining Ringarooma mine. My observations led me to conclude that the reefs in the shallow zone in this mountain cannot be depended upon in their linear extensions. They are not uniform in character for any distance, and hence you cannot deduce their behaviour in any given section from their appearance and character in the adjoining ground. I believe this uncertainty will disappear at a greater depth, but that depth is hardly likely to be within the reach of a merely moderate expenditure, and I do not think it is attainable by simple adit-driving.

Caxton Mine.

This is situate on Section 1525-93G, 10 acres, 40 chains S.E. of the New Mercury battery, and about 20 chains E. of the Dorset River, a few hundred feet up the N.W. slope of Mount Victoria. The ground is held under a prospecting licence, for the purpose of exploring a quartz-reef, bearing S. 40° E., and dipping N.E. No work was being done at the time of my visit. At surface there is an old shaft on the reef which is 2 feet 6 inches between walls. The reef walls here are good, and stone said to have been from wall to wall. The lode has been traced further S.E., and stoped at surface down to about 15 feet. The channel then becomes filled with country, which gives place to poor stone. Following the reef-channel at surface, it is of irregular width, bulging in places, but finally contracting as it approaches the section boundary.

An upper level was driven on the reef 200 or 300 feet, right to the boundary, but I could not get into these workings, as there is a block, caused by the fall of old

timber in the shaft from surface. The level was reported to me as having been started on stone, when blank ground was met with, which lasted to the shaft, 40 ft. in. In one place a stope has been carried up to surface. I was told that several crushings had been taken out, some returning 15 to 17 dwts. gold, and 30 tons going as high as 1 oz. Mr. Thureau, a former Government Geologist, however, reported the average of the stone obtained in his time as 10 dwts. 9 grs. per ton.

Sixty or seventy feet below this level another one, No. 1, has been driven on the reef for about 300 ft. A shaft comes down from surface through the upper level, and the stone used to be passed down from that level to this one, and then trucked out to the shoot. At the entrance to the level is an underhand stope for 30 or 40 feet, which has the reputation of having given 100 tons of quartz, worth 80 ounces, or 16 dwts. per ton, when the work in this field was started, some 16 years ago. Then came poor ground for 20 ft., succeeded by another make of fair stone, worth 10 to 15 dwts. The front block of stone and the next block have been stoped up to surface.

Still lower is a tunnel, 90 ft. vertical distance, driven S.E. for 120 ft., to intersect the reef, but requires continuing 40 or 50 feet further. Want of funds prevents this from being driven at present. This is a pity, as it can be driven for 20*s*. a foot, and the whole future of the mine is dependent upon it. Nothing further can be said respecting this mine for the present, except that the most important and essential work is to continue the bottom tunnel and see what the reef is like as it goes down.

Telegraph Mine.

This is also known as Duke's, on a 5-acre section (1338-93G), about 100 yards E. of the Ragged Youth. A short tunnel, about 40 ft., has been driven from the track on a reef-fissure in a N.E. direction. The channel is about 4 ft. wide, and is bounded by good walls underlying S.E. There was some nice bunchy quartz on the heap at entrance to the drive, but I could see none in the end. The face is soft, and has clay flucans. Six tons of quartz are said to have been crushed, and I heard the yield variously stated from 3 to 5 dwts. Evidently it was not payable. Though the stone has given out it may make again, considering the defined nature of the walls, and some costeaning work ought to be done further up the hill.

Bright Star Mine.

This reef is on sections 448, 1176-93G, on the W. side of the Dorset River, about 30 chains N.W. of the Esk claim. The mine is now abandoned, and the shafts are filled with water. The pump shaft is said to be 50 feet deep, the upper shaft about 45 feet. The reef has been driven upon, and some crushings have been taken out. As in most of these abandoned mines, the first stone crushed was the richest, and is said to have returned over one ounce of gold per ton. Later yields were 14 dwts., and two crushings, a year or so back, are also reported, at 14 dwts. This tale of early rich stone was related to me at the various deserted claims with monotonous uniformity, and, as in some instances I have not been able to refer to published returns, I cannot vouch for the accuracy of the figures, though I have always tried to trace them to the best sources available. I am, however, the more disposed to credit such yields, in that some of them are substantiated by authentic accounts, and also because I see from the actual experience of the Ringarooma Co. in their different properties, that patchy rich stone, not far from the surface, is a very common occurrence.

Esk Mine.

This is situate on section 534-93G, 10 acres, about two miles S.E. of the township of Alberton. It is on the N.E. side of a small creek flowing into the Dorset. This part of the Dorset valley is picturesque, with sassafras and fern-tree glades, and would attract tourists if they were assured of finding suitable accommodation. If the Government would open a track from the Dorset Valley up Mt. Victoria, and put up a shelter-hut on the plains from which the serrated summit rises, and where there is plenty of pure water for cooking and drinking, the ascent of the Mount, which offers no difficulty, and commands an extensive view, would become a favourite item in tourists' programmes; two hundred pounds would cover the whole of the outlay. The township, too, would provide additional accommodation. A prospector's track, too, from the head of this valley, is required, to connect with the Mathinna track, which has been made to serve the farmers rather than the miners. A bridle-track is all that is wanted, and would pass through the mineral belt. From this part of the valley is only five miles to Hickson's mine, if a track is taken through.

On the aforesaid section the Esk syndicate drove a tunnel nearly 300 ft. E. to intersect a quartz-reef upon which a shaft had been sunk from surface. The tunnel approach is for 40 ft. in soft ground before entering the slate. At between 260 and 300 ft. the reef was cut, bearing N. of E., underlaying south, and showing a couple of inches of stone on the foot-wall. In the end of the drive, about 90 ft. below grass, the reef-channel is 3 ft. wide, between nearly vertical walls. The hanging-wall is the better defined. Water is dropping inside foot-wall, and a stray piece of quartz is on the wall. The end is slate and mullocky. The appearance is not promising. The slates cross with a strike of N. 50° W.; over the back, behind the end, there is a stope for 25 ft. with bunchy stone. Eight inches is the maximum thickness, but it is poor where wide, and has now contracted to 4 inches. There would be about 60 ft. more to stope up to surface.

About 100 yards up the hill to the E. is an old shaft known as Krushka's, which has been sunk 25 ft. on the underlay of the reef, trenched all the way up the slope. The reef here is rather solid looking, 3 to 4 ft. thick in the shaft. It carries two varieties of quartz,—one a grey description, in some of which free gold can be got, and the other of a bluish tinge, only yielding gold on burning. Both sorts are charged with arsenical pyrites, which, decomposing, sometimes impart a greenish hue. Higher up the hill another reef is seen, which ought to junction with this one further E. I remarked that the country up here was sandstone, while slate prevailed in the tunnel below. Still higher, some 50 ft., are both sandstone and slate, and there is some auriferous vein quartz; but the small veins run with the slates, and I should not advise outlay on them.

The Esk Mine is for the time known as the Duke-Ransome, and these two prospectors were putting up a stamper to see if it will pay to take stone out of the stope, as the ground is easy working. They told me 4 tons had been crushed, giving 10 dwts. per ton, and 3 or 4 tons more are now ready for treating. About 130 ft. more driving would bring the level under the Krushka shaft, where about 100 ft. of backs would be obtained, increasing with the hill. The continuation of the drive is necessary to prove the mine; later work would depend upon the result of driving.

Crown Prince Mine.

This is an old abandoned mine, above the Alberton Quartz Sections, just over the eastern brow of the hill, about 770 feet above the main road. The reef can be traced at surface about a foot wide, with only a few colours. A shaft has been sunk on the reef about 80 or 90 feet. The first 100 tons of quartz returned between 17 and 18 dwts. gold per ton; afterwards a party took out 10 tons for 1 oz. per ton; but a final 50 tons did not pay for carting and crushing. A deep adit tunnel had been driven 400 feet, when it intersected the reef, which has widened out to 6 ft. at that depth. Where cut, it had good walls, and drives were opened out on its course each way. The quality of the quartz is poor. At about 300 feet from tunnel entrance, a 2-ft. bed of porous felsparless black basalt occurs between the bedding of the Silurian slates. I take this to be a contemporaneous lava-sheet. The absence of felspar in this basalt, and the abundance of skeletal forms of magnetite give a peculiar stamp to this rock, which will be microscopically examined in due course. It is the only occurrence of such a rock that I have observed on the field. This mine is not far from the old track to Black Boy. Situate as it is, at such a height, the reef would have to be rich to yield payable results.

General remarks.

In the Mount Victoria District the country rocks do not appear to influence the lodes sensibly. The yellow slates are looked upon as favourable country, but these are in the zone of surface decomposition, and the gold in that zone has probably been dissolved and re-precipitated, with an increase in purity, and more concentrated. Where the country near a reef is pyritiferous it is a sign that the reef too is charged with pyrites, and where the quartz contains iron sulphides it is considered promising for gold. This is only what has been observed elsewhere. Dr. Don, of New Zealand, arguing against the lateral secretion theory, emphasises the result of his examinations, viz., that the country-rock only carries gold when it carries sulphide. Pyrite is a known precipitant of gold, and its association with gold must be considered to indicate an action of that kind, especially as there is reason to believe that the gold in auriferous pyrite is confined to the outer zone or precipitating surface. See Rose's Metallurgy of Gold, 1894, p. 143:—"Some authorities have contended that the metallic gold is disseminated mechanically through the mass of pyrites, but the action of potassic cyanide in dissolving the whole of the gold out of comparatively coarsely-crushed pyrites, seems to point to the correctness of the view that the interior of the crystal is not auriferous, the deposition of the gold being superficial, so that the enrichment of the pyrites is confined to its crystalline faces, and possibly, but not probably, to its cleavage planes."

We can therefore understand how it is that the presence of pyrites in quartz-reefs is welcomed as a favourable sign. When we, however, proceed to the further question of the origin of our quartz-reefs and their contained gold, we find ourselves in the domain of pure theory. As far as the quartz is concerned, we know, from microscopical analysis, that it was the last element to crystallise in granite; that it was the residuum, so to speak, which filled up the interspaces of the other crystals in the rock. If silica were present in excess, we may surmise that it would be ejected from the solidifying granite, together with any gold in solution which it might contain. On this theory the gold is not necessarily referred to the barysphere or zone of heavy metals; at least we cannot trace it proximately to a deeper origin than the granite zone. Any theory professing to account for its introduction into that zone is purely hypothetical.

The water, or water-vapour, which was emitted from consolidating granite, ascended with its auriferous contents (or, rather, reascended, for it must first have descended, the ascent being a later phase of its circulation), and, during its ascent, the decrease of temperature and pressure must have contributed to the precipitation and deposition of the contained gold. The influence of different country-rocks upon the gold contents of quartz-reefs has been urged in favour of the derivation of gold from the strata traversed by the reefs. That some influence has been exerted by the adjacent strata may be conceded, but it is not so strikingly and uniformly apparent as is often imagined; and these strata may very possibly affect the precipitation of the gold through their different conductivities or other properties, instead of shedding original gold into the vein-quartz.

The splices of quartz, the frequent absence of walls, or any line of demarcation between the lode and country-rock in the Mount Victoria mines, furnish an argument for use by those who believe both quartz and gold to have segregated from the neighbouring sedimentary strata. It may be used by those who favour the derivation of the gold from sea-water, and its subsequent collection into quartz-veins from marine sediments,—an ingenious theory, which fails, however, to cover the absence of gold mines from Tertiary marine sediments, and their presence in volcanic lavas. Nevertheless, I believe the quartz (and consequently the gold) to have had a deep-seated origin, though the lines of its passage may not be so regular as we could wish. It is this irregularity which leads me to suppose that larger and better-defined channels will be found at a greater depth. The only element which could disturb this prospect is the diabase, which possibly underlies the field in places. As long, however, as we encounter no intrusion of that rock, we need not trouble ourselves about the effect of its proximity.

I terminate the record of my examination of the field with a word upon its prospects. With the fair yield of gold in the past, it deserves a bright future. At the present time it ranks as the third productive goldfield in the Colony, and if the Ringarooma Company can secure the introduction of capital to work their important properties on an adequate scale, the whole district will most likely enjoy a considerable revival, and some of the other claims will be re-started, and fresh discoveries made. The frequency of good gold contents in the courses of quartz is highly suggestive of further gold-shoots still undiscovered; and the trifling depths attained by the shafts makes a despairing policy quite ridiculous. I feel sanguine that a goldfield will, sooner or later, be found below the present workings, but success, I think, will largely depend upon the discretion with which the work is taken in hand. Small claims must be amalgamated, and properties worked on rather a large scale, with more than one string to their bow.

I have to thank Mr. Wm. Brown and Mr. Martin for assistance and information given during my visit, and Mr. Geo. Maynard, who acted as my guide to many of the mines.

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 QUEEN OF THE EARTH GOLD MINE AND NEIGHBOURHOOD.

Government Geologist's Office,
Launceston, 15th February, 1900.

SIR,

I HAVE the honour to report that, in pursuance of your instructions, I visited and examined the Queen of the Earth Gold Mine, near Hogan's Track, on the 6th and 7th inst.

The mine is usually approached from Mathinna eastwards, *viâ* Hogan's Track, 16 miles. Opposite the turn-off to the New Carthage Mine, a footpath turns down to the Queen of the Earth, half a mile to the south. I visited it by traversing the country from the Scamander Bridge, on the coast, by a route estimated at 16 miles, but the charted distance east and west, as the crow flies, is not more than 9 miles. At the mouth of the Scamander River, where a tourists' and anglers' hotel has been started by Mr. J. G. Walker, the strata are the slates and sandstones of the Lower Silurian. On the road south of the bridge the dark sandstones weather light grey, and are of a metamorphic nature, converted into quartzite. Accompanying these are softer, unaltered sandstones. These are surmounted by recent marine wash and pebble-beds, 20 or 30 feet above present tide-mark, and form the hill spur on the south side of the river. The strike of the beds is N. 5° to 10° W., and their dip S.E. On the north side of the river, close to the bridge, is bedded yellow sandstone, with the same strike and dip. These are underlaid conformably by soft clay-slates, alternating with sandstone beds, often seamed with small veins of quartz. The road W. along the south bank of the Scamander exhibits alternations of similar slates and sandstones, sometimes distinctly schistose, and overlaid by a pebble wash, which marks the former bed of the river, when it flowed at a higher level than at present. There are signs of anticlinal flexures in the strata, for the dip at one place is reversed, and the beds are inclined to the N.W. The road passes through the farms of settlers for about 6 miles, when Mr. J. Ryan's farm, the last on the line, is reached, and thence the track leads to Robinson and Delaney's camp on the Scamander, 2 miles further N.W. Here, these plucky prospectors are working alluvial tin ground of a somewhat peculiar character. It is a wash containing pebbles of sandstone associated with a little quartz, and carrying handsome ruby and black tin ore and several good-sized nuggets of that metal. I could not see any granite detritus in the alluvial, but pieces of granite can be picked up in the river-bed near by, and the granite bed-rock itself is exposed about a mile further west. There are only two ways of accounting for this deposit, which occupies a kind of recess or former embayment of the river, viz., either it has been derived from stanniferous veins in the sandstones, which is an idea supported by the almost exclusive sandstone character of the wash, or the tin ore has been washed out of the granite. I think the latter will be found to be the correct explanation. Proceeding westwards for a mile, over the usual succession of sandstones, often schistose and much oxidised, granite country is reached, which continues, off and on, for three miles. The Scamander is often crossed running in this rock, but shortly before reaching the foot of Gentle Annie, on the Hogan's Track, hard, brown sandstone reappears, and, alternating with quartzite, continues all the way up the four-mile rise on the Ridge Hill. The Queen of the Earth Mine is situated in the same great series of strata, in which beds of hard quartzite take a rather prominent part. The rocks at this mine are somewhat harder and more schistose than those which prevail on the Golden Ridge and Brilliant sections, but I believe that their geological age is the same. Chronologically, they may occupy a lower position in the series. The creek below the mine flows over dense, bedded quartzite, and is between 700 and 800 feet above sea-level, and the same vertical distance below the Brilliant. I consider it rather probable that the granite exposed on the northern flank of the Ridge Hill underlies the Queen of the Earth sections at no very great depth below creek level. The creek, which flows eastwards through the 5-acre section, has carved its valley in such a way that the whole 25 acres belonging to this mine form a basin, surrounded by lofty timbered hills, with steep declivities; and when one stands in the creek bottom, and gazes at the encircling girdle of mountains, one wonders how ingress and egress are attained. I was assured, however, that transport of stone to Mathinna could be effected at 35*s.* per ton. This would have to be packed for 2 miles, and then transferred to drays on leaving the stony ground of the Ridge Hill, which runs E. and W. to the north of these sections. This part of the Ridge Hill is about half way between Mathinna and George's Bay.

The mine comprises works on an auriferous quartz reef on the 10-acre section, bearing N. 35° E., and dipping from 45° to 60° S.E. The country strata, laminated and bedded sandstones, and semi-slates, strike N.E., and are inclined at high angles to the N.W. The reef, consequently, is transgressive, and forms a true fissure-lode, carrying grey, dense, and honeycombed quartz, from 1 foot to 4 feet or 5 feet wide, as far as exposed, but the full width of actual stone is not yet known. The gold is sometimes visible, and sometimes free gold is obtained by crushing, though perhaps most of it is associated with the pyrites. The quartz is often heavily charged with arsenical pyrite, accompanied by a little iron pyrite, galena, and zinc blende, all of which minerals are characteristically associated with gold in the quartz veins of this field. Some bulk trials were made a few years ago of the stone from this mine, namely, 5 tons crushed at Rowley's mill, at Salisbury's foundry, Launceston, returning 25 dwts. gold per ton, and 49 tons crushed at Mathinna battery, yielding 21 dwts. 15 grs. per ton.

The following are the results of treatment of blanket-sand and assay of tailings from these parcels :—

RESULTS obtained at the Clyde Smelting and Chlorination Works, near Granville, N.S.W., December, 1895, from blanket sand from 49 tons of stone crushed at Mathinna battery, which yielded 53 ozs. free gold :—

Lot No		No. of bags.	Gross weight.	Tare.	% Moisture.	Moisture.	Net weight of ore.	Assay value per ton gold.	Gross gold contents.	Allowance 10 %.	Net gold contents.
			cwts. qrs.	qrs.		qrs.	cwts. qrs.	ozs. dwts.	ozs. dwts. grs.	dwts. grs.	ozs. dwts.
1325	Tailings.	24	15 2	2	5	3	14 1	3 1	2 3 11	4 11	1 19
1325	Pyrites.	2	0 2	—	2½	—	0 2	20 0	0 10 0	1 0	0 9
											2 8

Mr. W. F. Ward's (Government Analyst) assay of tailings, 23rd February, 1893, taken during crushing of 5 tons at Salisbury's Foundry :—

No 1.

	ozs.	dwts.	grs.	
Gold at the rate of	267	15	16	per ton.
Silver „	61	19	16	„

No. 2.

	ozs.	dwts.	grs.	
Gold at the rate of	20	8	8	per ton.
Silver „	7	20	10	„

No. 1 weight of sample = 313 grains.
No. 2 „ = 1230 „

No. 1 sample was taken after passing over the tables, being caught in a prospecting dish.

No. 2 sample was taken from the tables.

The amount of free gold shown by these crushings is satisfactory, but a good deal, taking the mine through, will, I think, be found to exist in the pyrites, and like all the gold I have seen in this field, alloyed with silver to an appreciable extent. This admixture reduces the value of the gold, which, I am informed, realises £3 17*s.* per ounce. In the erection of reduction works the best advice obtainable had better be sought, as it is well known that if an ore contain much silver there is a tendency for the gold to acquire a coating of chloride of silver in the chlorination process, which protects it from the action of the chlorine. In this mine the quartz, on the whole, is of a kindly appearance, though there is a milk-white variety with no pyrites, less promising in aspect. There is also another variety of stone, about which I feel uncertain, namely, the quartzose rock within the reef legs. This is not pure quartz, but rather indurated and silicified country-rock, converted into what, strictly speaking, is a quartzite. This rock, or its selvages and bands in it, are often mineralised, and possibly the pyritic mineral may prove payable.

About 100 feet above the creek level a tunnel has been driven S. 18° E. into the hill, intersecting the reef at 90 feet in, 44 feet vertical from surface. A selvage of clay and quartz marks the foot-wall of the reef, inside of which is a "formation" of quartz and quartzite, with country 12 feet wide. The tunnel has been driven through this and through country rock beyond, until, at about 160 feet from entrance, it struck a wall which has been assumed to be the hanging wall of the formation. I take it to be the wall of the other leg of the reef. The tunnel was then turned south, and the wall or band of quartzite followed south about 40 feet.

An inclined elbow shaft from surface comes down into the bunch of stone intersected by the tunnel inside the footwall. This is No. 2 shaft. The stone has been stoped from surface all down the shaft. Drives have been extended on this N. and S. In the N. drive—or more strictly N.E.—the quartz first lies on the footwall, but soon passes over to the other side, and keeps to the hanging wall. The drive has been continued 70 feet, and the present end is between reef walls 5 feet apart, with a filling of quartzose matter, not pure reef quartz, striped with thin veins of arsenical pyrites. About 10 feet behind the end is a prospecting winze, which goes down vertically for 27 feet, and then 23 feet deeper on the underlay. The undoubted quartz seems to have given out just below the point where the vertical was exchanged for the inclined direction. Lower down I did not see any pure quartz, and in the bottom the reef channel is filled with 2 feet of quartzose matter between walls. At bottom of winze a drive has been extended E. 18 feet, only intersecting a small quartzose leader, and the end is in country rock, a light grey laminated sandstone or arenaceous slate. The bottom of this winze is the deepest part of the workings, and I was told that no gold had been got out in sinking. The outlook here, just at present, is not promising, and the only encouragement derivable is that the reef walls continue in depth. Some uncertainty exists as to the relation of this winze to the ore-body. It is neither on the footwall of the formation, nor is the bottom drive far enough east for the hanging wall. The reef above is irregular in dip, as shown by the elbow in No. 2 shaft, and has split into two legs, enclosing a horse of mineralised country. Of the two legs, the footwall one seems to be the main one, and while the drive E. at bottom of winze has been unsuccessful, it is just possible that a break through the apparent W. wall of the inclined winze might disclose quartz in that direction.

The drive from tunnel S. or S.W. is the best in the mine. Just at its entrance is a shallow winze, sunk 9 or 10 feet below the sole. It was filled with water, and I was told that it had yielded no stone, but just beyond it 6-inch stone was lying on the footwall, expanding afterwards to a body of white quartz the full width of the

level. The reef in this level seems to have changed its dip and turned over to the W. The best gold in the mine is said to have come from this drive, but there has been no stoping. The level has been driven 70 feet, carrying stone varying from 6 inches to 5 feet, sometimes well mineralised, but on the whole sparsely so. Behind the end the stone has gone out of the level to the W., and the end is in hard quartzose matter, with no walls. The backs here are only 40 or 50 feet, but further south these would increase by several hundred feet. I cannot understand why a cross-cut has not been put in behind the end. A cross-cut west is urgently required to discover where the stone has gone to, and where the stone fills the level its full width should be ascertained by cross-cutting.

At surface further N. an underlay shaft has been sunk a little way on the reef, showing a foot of stone at top, widening to 2 feet at bottom. The reef has been surface-trenched at a few points along a line of 400 feet. Eighty feet N. from No. 2 shaft is No. 1 shaft, now under water, said to have been carried down on the underlay 30 feet on 6″ to 10″ stone, with some stoping.

Sufficient work has not yet been done to establish the value and assure the future of this mine. The early work was abandoned just when its continuance was most imperative. Enough, however, can be seen of the reef to produce a conviction that in any other part of the Colony the mine would receive ready attention. All the other old claims in the neighbourhood are also abandoned, and the District consequently does not bear a good name, but the success of one mine would doubtless result in the resuscitation of some of the others. I have seen the others, and I consider the Queen of the Earth the most promising mine of the group. All the mines of this group have the drawback of being in a remote, not easily accessible region, but this disadvantage need not be looked upon as a permanent one.

To develop this mine in a systematic and satisfactory way the underlay shafts and winzes must be discontinued. Such shafts are only preferable when the reef underlies very flat, and has a regular uniform dip, or at least a dip admitting of easy curves in the shaft. These conditions do not obtain here. A main verticle shaft must be sunk, and the best place would probably be to the E. of the tunnel intersection. It could be carried down 150 feet from surface before opening out, and, continued down, opening out at every hundred feet, and driving on the reef north and south. A deep adit further north would enable the reef to be worked lower down. This would connect with the upper workings, and drain that part of the mine. The present south drive must be boldly continued into the hill. A crushing and concentrating plant would eventually be necessary. A small chlorination plant would be part of the programme. The creek, when I saw it, was very low, in fact nothing but a succession of pools, but there seems to be an underground flow, and a good site for a conserving dam higher up the stream. I ought to say that my visit was at the driest time of the year. For work on this scale, a capital of £10,000 to £15,000 would be required, and, as returns would not come in for some time, a calling power of a few thousands more would be advisable.

This plan would decisively prove the mine and exploit the reef. Seeing, however, the small amount of work done to date, it is questionable whether a continuation of tentative work is not the better plan. In this case I should recommend the extension of both main drives, crosscutting from winze and south drive, and sinking in sole of level near or at the point where the present shallow winze is sunk, with any other exploratory work which may suggest itself to the manager in charge. After this the owners would be in a position to judge whether prospects warranted a main shaft and complete reducing plant. A small capital of between £2000 and £3000, if spent on underground work, would suffice for this. The only thing which may be urged against this is that, after all is done, failure of the prospecting work would not justify the utter condemnation of the mine, which may be a satisfactory property at deeper levels. On the other hand, I cannot say that the mine is sufficiently developed as yet to warrant a heavy outlay, and certainly, if the development proceeds in anything like an encouraging way, there ought to be no difficulty in forming a company for work on a larger scale.

My examination of the whole traverse of country from the mouth of the Scamander to Mathinna leads me to anticipate that several reefs in this belt will be worked when the country becomes better opened up. Occurrences of gold-bearing quartz veins seem more frequent in the neighbourhood of the granite contacts than far away from the granite. The farther away they are from granite the more unimportant they are, but this generalisation perhaps needs verifying by a more complete inspection of the country. The whole field has had only a cursory examination, and I have no doubt will repay further and closer inspection.

One or two items of interest may be commended to the geological student. First, these reefs have a family likeness, in that their gold is always largely alloyed with silver, and they may be suspected to belong, within comparatively narrow chronological limits, to one geological age. But what is their relation to the reefs of Mathinna and Mangana? And what connection have they with the argentiferous lodes of the northern and eastern parts of the Scamander field? We seem to be here in a silver country, and a little out of the line of the great auriferous slate-belt of the Colony, though in strata of the same geological system. As these reefs have not been worked yet to any great depth, their behaviour at deep levels is at present a matter of conjecture, but the fissure lodes will doubtless extend down into the subjacent granite.

Another question is whether these granites differ in age from the coarse porphyritic granite of the Derby field. They differ in being harder, finer-grained, and carrying less white mica, but I do not see that much stress can be laid on these differences, for the differences among the more northern granites are equally great. If we place the granite of the New Carthage Mine on the Scamander side by side with that of Mussel Roe, South Mt. Cameron, we shall see that they are almost identical; both are characterised by an abundance of black mica, and are practically indistinguishable from each other. Yet porphyritic granite is abundant at Mt. Cameron. The point to verify is whether transitions can be found. These physical differences need not involve difference in age, as it is well known that different parts of a single granite *massif* generally vary a good deal both in texture and composition. My present view is that the general mass of the north and east coast granite, apart from elvans and other dykes, is of one and the same age, probably Devonian; but all facts bearing on the point I have now mentioned should be carefully noted.

Another question is the age of the quartzose grits, sandstones, and conglomerates, which lie in horizontal beds on the highly-inclined Silurian sandstones on Hogan's Track and Mt. Victoria. These occupy a position between the Silurian and the marine strata of the Permo-Carboniferous Systems, but it is not yet settled whether they are Devonian or basal members of the Permo-Carboniferous. Fossil evidence is wanted, besides which it is desirable to know whether they have anywhere been penetrated by granite or quartz reefs, as this would have a bearing on the age of our granites. Fossils, apparently spirifers, have been reported from the grits or beds associated with them, but the precise beds were not shown to me.

The country between the coast and the foot of Gentle Annie is a succession of timbered hills rising higher to the west, but no great elevation is reached before arriving in the neighbourhood of Hogan's Track. My aneroid readings (in fine weather) on this traverse were as follow :—

	Above Sea-level. (Feet.)
Robinson and Delaney's Camp on Scamander, 8 miles from coast	150
River at foot of Gentle Annie on Hogan's Track	300
Queen of the Earth Mine, in creek	750
Brilliant Mine	1500
Ridge Hill Track above the Brilliant	1700
Mathinna Township	900
Ridge between Mathinna and New Golden Gate	1000

The annexed plan and sections of the Queen of the Earth Mine will show the workings to date.

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

W. H. TWELVETREES,
Government Geologist.

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

PRELIMINARY REPORT ON THE DEEP LEAD OR INFRA-BASALTIC STANNIFEROUS GRAVELS OF THE RINGAROOMA VALLEY NEAR DERBY.

Government Geologist's Office,
Launceston, 26th February, 1900.

SIR,

PURSUANT to your instructions, I proceeded to Derby on the 23rd January, and now have the honour to submit this Report of a twelve days' inspection of the country between Derby and Mount Cameron, and more especially of the high basaltic plateau to the north of the township, which is supposed to conceal large deposits of tin-bearing gravel accumulated in an ancient bed of the Ringarooma River. I was accompanied on my journey by Mr. S. Hawkes, of Scottsdale, who was appointed by the Government to facilitate my inspection of the ground, and to aid me with the local information which he has collected during many years. By guiding me directly to the various outcrops noticed, and in some cases discovered by himself, and in placing at my disposal the fund of information which he undoubtedly possesses, Mr. Hawkes rendered valuable service in this geological traverse. Mr. M. J. Griffin, of Gladstone, Inspector of Mines for the Eastern and North-Eastern Districts, joined us on the plateau near the Pioneer, and I have to thank him too for assistance and useful information readily given.

The geology of this district has been dealt with so often by former Government Geologists that I need not go over old ground, and repeat what has already been described. It will be enough if I indicate geological considerations as I proceed.

The Ringarooma River takes its rise in the high land between Ben Nevis and Mount Saddleback, whence it flows north to near Branxholm, thence meandering N.E., E., N., and finally N.W. to Bass Straits, into which it falls at the Port of Boobyalla. During the lower and principal part of its course, it either runs in stanniferous granite or receives tributaries, which feed it with the detritus of stanniferous granite country. Consequently it is not at all surprising that tin-bearing wash has accumulated in its bed. What is surprising is that from Branxholm downwards the modern river does not keep to its ancient bed, but has struck out a new course and carved a new channel for itself. It is not at first glance apparent that this is so. It is not until we become aware that a belt of deep alluvial drift exists outside the banks of the present river, and much deeper than its present bed, and diverging greatly from its present direction, that we recognise that the present channel is not the ancient one. The questions which now suggest themselves are, how long has the river flowed in its present bed, and what caused it to change its course? There is a well-known physical phenomenon which comes to our aid, for in places it marks off the times of the old channel from those of the new one. I allude to a sheet of basalt which has largely protected the subjacent gravels from waste and destruction. This basalt has not overflowed the country here, burying hill and dale under a widespread lava sheet, but has apparently confined itself to the ancient river valleys, filling them up, and concealing the river gravels beneath a stony covering. There seem to have been intermissions and repetitions of this flow, as may be seen in the faces of the wash at Derby. The fact that the lower sheet of basalt is covered again by wash denotes that the first flow had not completely filled up the river valley, but that, even as late as the final eruption, the valley continued to exist as a stream channel. The extreme thickness of the lava cap still surviving is, perhaps, 100 feet, or even more, but in many places it is now only a thin skin, and has often wasted quite away, leaving only the red soil and decaying kernels of rock to indicate its former presence. In the Derby mines we see the weathering and disintegration of basalt characteristically exemplified in the undecomposed kernels of hard lava which have survived the process of decomposition. The remainder has been converted into the red and brown clays, which are the ultimate stage of decay *in situ*. Microscopical examinations of specimens from the lower basalt mass at the Brothers' Home show the rock to be an olivine basalt, in which the felspar is mostly porphyritic, and the groundmass largely consists of small brownish-violet tinted crystals of augite. A slice from the upper sheet shows the same groundmass, but the porphyritic mineral is olivine, which is very plentiful. Notwithstanding the difference in the larger crystals, the identity of the groundmass leads to the inference that the two lava sheets issued, though at different intervals, from the same geographical source. Where was this source? Various centres suggest themselves. Mount Horror, for instance, the lava of which has a coarse doleritic texture like that of an old volcanic plug. But the lava of the Briseis and Brothers' Home mines evidently obeyed the law of gravitation, and descended the channel of the Cascade. The drainage of the Cascade country gravitated then to the N.W., as it does now, and the lava stream must have flowed in that direction. Bullman's Bluff, near Branxholm, was mentioned to me as an extinct volcano, and a likely source. I had no time to ascend it and ascertain its nature, but if it is really a volcanic pipe, and not a capping, it may have supplied the lava which covers the wash at the Arba mine. But I am somewhat suspicious of extinct craters in Tasmania. Up to now we do not know of any. The cinder cones of such as may have existed have long since been removed by denudation, and the tops planed down to a uniform level with the surrounding country. They may have been fairly numerous at one time, for Tertiary basalt of nearly every variety known to petrographical science is found almost all over Tasmania. For the present, it may be conceded that we are unable to locate the foci whence the Ringarooma lavas emanated.

While the ancient valleys were being gradually filled with their gravel deposits the land was slowly subsiding. This sinking movement, though gradual, helped to impede the scour of the streams, and allowed the tin-bearing wash to settle and accumulate. Towards, and at the close of this period of subsidence, the basalt volcanoes emitted their lava, and slowly filled up the water-courses. That active vulcanism was spread over a long period may be deduced from the intermission of activity which admitted of the deposit of intermediate beds of river wash.

We do not possess in Tasmania the alternations of sedimentation which would warrant us in adopting the time-honoured triad, Eocene, Miocene, Pliocene, as divisions of our Tertiary beds. Excepting the isolated occurrence of beds at Table Cape, now definitely established (by Prof. Ralph Tate) as Eocene, we are unable to divide our Tertiaries, with any degree of confidence, into more than early and later Tertiary—Palæogene and Neogene of Mr. R. M. Johnston—and the period of basalt eruptions may be taken as the dividing line. Practically, our divisions of Tertiary time are pre-basaltic and post-basaltic. The fact that our pre-basaltic Tertiary estuarine and freshwater sediments may be of any date from Eocene to Miocene, is of itself sufficient reason for excluding the European scheme of classification. We find that all through Australia basaltic eruptions have taken place at the end of the Palæogene period. I have had an opportunity of consulting a series of fossil fruits in Mr. W. F. Petterd's collection, named by the late Prof. M'Coy from the Miocene auriferous drifts of Haddon goldfield, near Ballarat, and of comparing them with fruits found in the Beaconsfield auriferous lead and the Flinders' Island tin-drifts: some of these are evidently identical, viz.—fruits named *Plesiocapparis* and *Celyphina M'Coyi*, found in the auriferous deep leads of Victoria. But when we begin to distinguish our pre-basaltic beds from Eocene on the one hand, or Pliocene on the other, we find ourselves involved in difficulties, which convince us that we cannot confidently classify the Tasmanian Tertiaries otherwise than by a dual division. Mr. R. M. Johnston's most recent classification of these beds is so little known, that I reproduce it here:—

Stratigraphic Rock Divisions.	Local Characteristics.
NEOGENE (PLIOCENE).	
1. Later lignites and contorted clay and sand-drifts of the Henty River.	Pebble terrace-drifts on the plateau or upper undisturbed slopes of the main valleys contain fossil woods of the older rocks as well as of the older Tertiary period
2. Older terrace pebble-drifts of the older Pluvial period.	Moraines and erratics of the subalpine valleys and plains of the western highlands, as at Mount Tyndall, Murchison River, Lake Dixon, Mount Pelion.
3. Glacier moraines of subalpine regions.	Contorted clays and sandstone formation, with intercalated lignites, containing remains of fagus, acacia, eucryphia, and phebalium, hardly separable from existing species.
PALÆOGENE (EOCENE TO MIOCENE).	
1. Basalt sheets (olivine), tuffs, and breccias.	Basaltic sheets and tuffs intruding and spreading over Tertiary marine deposits at Table Cape, and generally found capping the Tertiary lacustrine deposits, as at Table Cape, Magnet Range, Mount Bischoff, Breadalbane, Geilston, Cornelian Bay, Glenora, One-tree Point.
2. Fluviatile and lacustrine deposits.	Lacustrine deposits, often of great thickness and extent, composed of sands, clays, lignites, travertines, and sometimes including rich auriferous and stanniferous drifts. Contains the remains of a flora, rich, varied, now extinct. Examples:—Launceston, Derwent, Macquarie Harbour Tertiary formations.
3. Marine formation of Table Cape, Flinders Island, Montagu, and Cape Grim—*(Eocene)*.	Marine beds, composed of alternating bands of shelly limestone, calcareous sandstones, coral rag, ferruginous, gritty. and pebbly sands, replete with fossil shells, corals, foraminifera, echinoderms, sharks' teeth, bones of marsupials, and sometimes stray leaf impressions, some of which are identical with those in the purely lacustrine areas. Only from 1 to 2 per cent. of the shells are identical with living species.

When the volcanic forces had declined in energy, and the eruptions were coming to an end, or thereabouts, the subsidence of the land in this part of Tasmania seems to have ceased also, and an upward movement began. This elevation continued down to a very recent period, and, for all we know, may be in progress at the present day. The raised sea-beaches above high-water mark all along our northern coast point to very recent movements.

Ever since the out-pouring of the lavas, the Ringarooma River has flowed in a fresh channel. It is reasonable to infer that when the old channels were choked with basalt the streams would be diverted to fresh courses. The general trend of their flow towards the sea would, doubtless, not be very different from what it is now, but the water would of course follow any new natural line of flow created by the surface features of the land. Such a line would be found along the edge of the invading lava sheet. This line would give the stream its new initial direction, and its subsequent course would be determined by the configuration of the country. This is just what we observe in the Ringarooma River, above Derby. Between A. H. Boyd's 198 acres and the township, the land on the north bank is all capped with basalt, as is also Kirkland's Hill on the south side, and there is every appearance of the modern river having worked its way downwards and northwards from the contact line of the basalt with the granite, cutting down through the sandstones, and eventually excavating a bed in the solid granite itself. Close to and above the bridge at Derby the granite rock is seen descending into the stream, and the large bosses of granite above the township have every sign of wear by water, when the river flowed at a higher elevation. The river continues to flow in solid granite, interrupted only by the main creek lead, but resuming its granite channel down to Gladstone and beyond. Just to the west of the township of Derby, where there is a small dam thrown across the Ringarooma, we find evidence that the old and new channels cannot have been other than two very different lines of flow. A mile higher up the river, at the old Ringarooma Valley Company's works, the ancient bed has been bored through 106 feet down to soft granite, on the north side of the road. But that bed could not possibly have extended to where Derby is now, because lower down at the dam just alluded to, the river runs in hard slate and sandstone rock. These yellow and light-coloured sandstones with iron stains belong to the Silurian system. They are vertical, and strike across the river N. 5° E. I was told by Mr. M. J. Griffin, Inspector of Mines, that they reappear to the north of the Brothers' Home Extended mine. On the south bank the sandstone of the river bed is covered by about 3 feet of sand with large sandstone pebbles, forming a recent shingle bed, and this again by 4 feet of soil. Higher up the hill on this side the soil is besprinkled with white granitic detritus, concealing the sandstones beneath, which mount to about 80 feet above the river, when the granite protrudes and forms the remainder of the mountain range.

A journey along the road to the west, towards Branxholm, discloses certain facts bearing on the river course. The flat below the road on E. G. Clarke's 49 acres has not been bored, and is probably shallow. Just opposite, on the north side of the river, we see what is called Gunton's Gap, but it has the appearance of being a depression or wearing down of the front range rather than a real gap, as there is higher ground at the back. On E. G. Clarke's 40 acres, and E. Button's land adjoining, to the E. of the road, there is a high spur of wash capped with basalt. By boring

SKETCH MAP OF DERBY DEEP LEADS

40 30 20 10 0 20 40 60 1M 20 40 80 2M

Scale of Chains

5 cm

INDICATES Slate and Sandstone

. . . Lead-not under Basalt

. . . Granite

. . . Basalt (the closely dotted shows probable course of Lead)

W. H. Twelvetrees — Government Geologist

Granted to The Tasmanian Mineral Exploration Co. Ltd.

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T. Woods

T. Collins

L. Collins

Gunton

M. S. R. Hardman

R. McKimmie

A. Parker

A. Parker

E. E. Bamford

MOORINA

M. Normoyle

D. Normoyle

Crichton

J. H. Pitchford

J. Hall

Brown

W. H. Tilley

E. A. Rattray

W. H. Rattray

A. H. Boyd

W. J. Graham

Charles Krushka

F. Williams

Charles Krushka

Beswick

M. Grace

W. Krushka

DERBY

School Res.

T. M. Evans

H. Forrest

Scott

Scott

J. R. Scott

G. T. Scott

J. R. Scott

FENGHERS CREEK

BLACK CREEK

Cemetery Res.

D. Murray

D. W. L. Murray

BRANXHOLM

BRANXHOLM CREEK

M. Evans

W. St. Paul Gellibrand

W. Gellibrand

W. St. Paul Gellibrand

WARRENTINNA

TROUT CREEK

SOOBYALLA RIVER

DAVIDSON CREEK

BRADSHAWS CREEK

PIONEER

Old Moolyella

Newmouth

WYNIFORD RIVER

TO GLADSTONE ROAD

RINGAROOMA RIVER

FROME RIVER

WELD RIVER

MAIN

GREEK

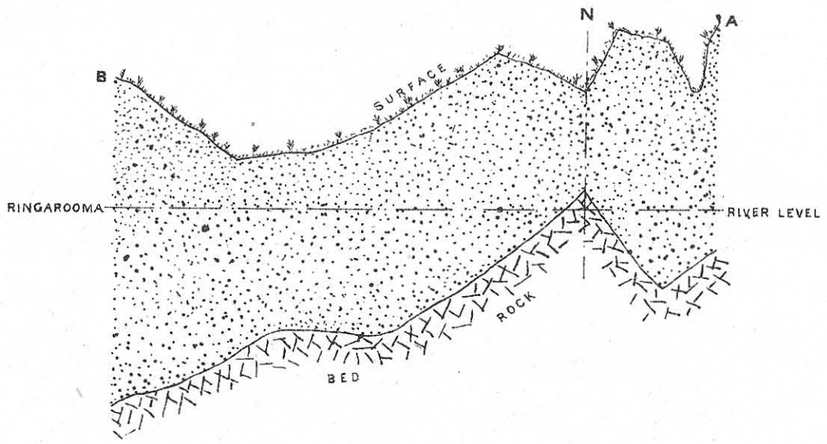
CASCADE RIVER

5 cm

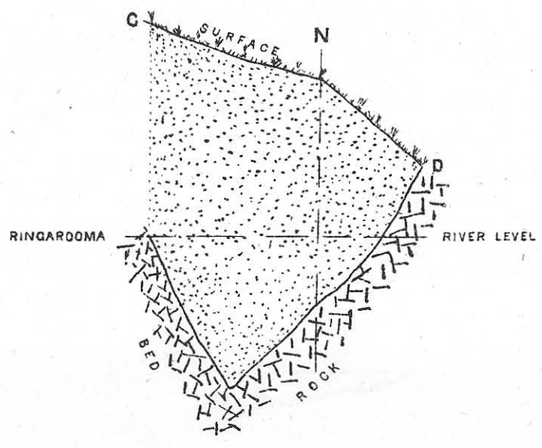
PIONEER MINE

Section along line A-B North West - South East
Showing fall of bed rock to West

Scales Chains 6 5 4 3 2 1 0 6 12 18 22 Horizontal
Feet 20 10 0 10 20 30 40 50 60 70 Vertical



Cross Section of Lead at N - along line CD

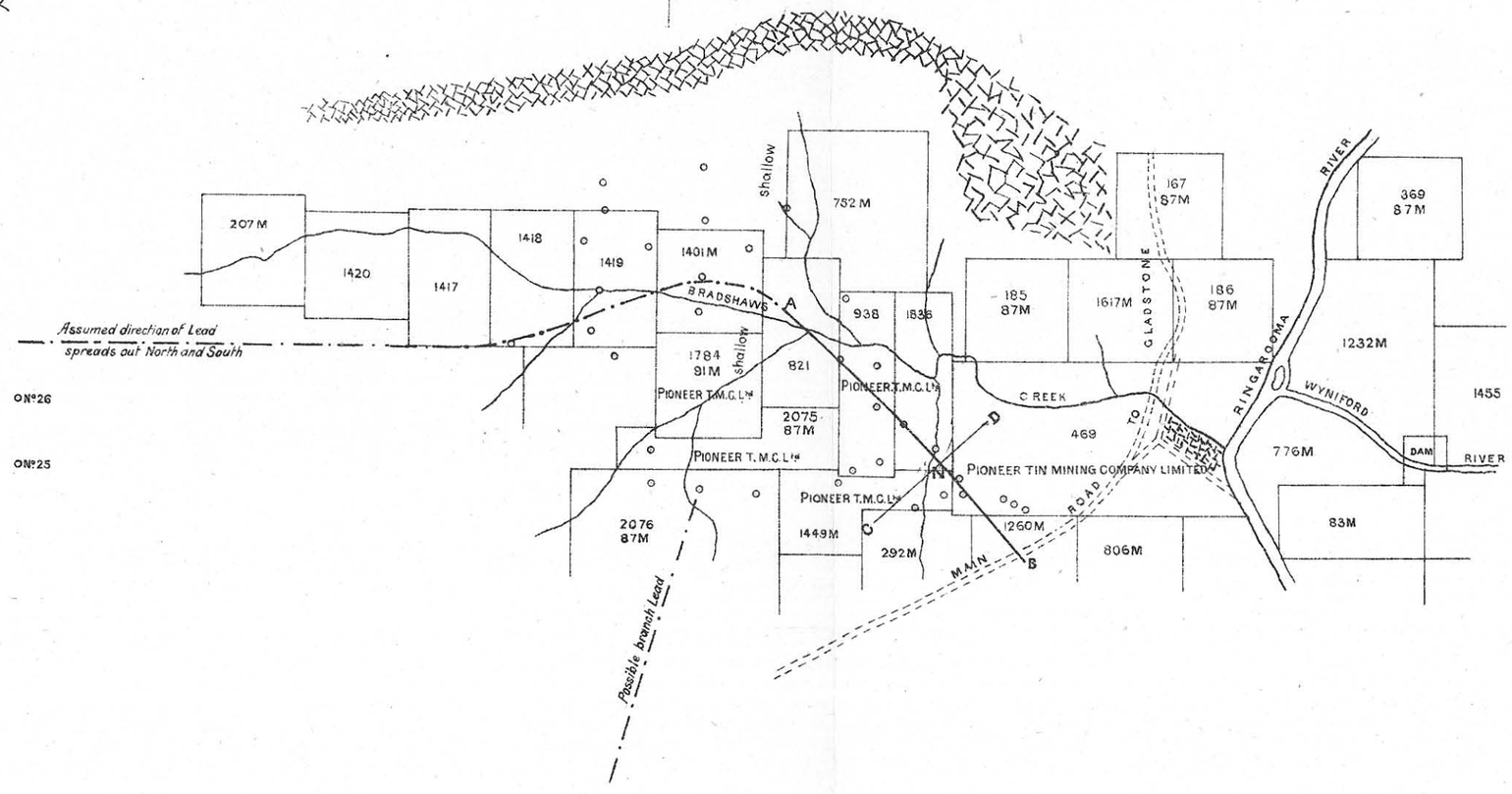


THE PIONEER LEAD

10 5 0 10 20 30 40
Scale of Chains

W. H. Twelvetrees Government Geologist

INDICATES Granite
o . . . Bores



and tunnelling it has been proved to contain a little tin ore. It is a ferruginous quartz wash, resembling that at the Briseis and Brothers' Home mines. The formation comes right down to the road and below it, showing in its face false bedding, the signs of former eddies and changing currents. This is O'Doherty's land. A tunnel has been put into the wash below the road, and prospects obtained. On this land the granite comes down to the road again, and looking at the wash it seems to occupy the embayment thus formed by the rim rock. Opposite Bryant's land a spur of granite descends N.W. towards the river. The road bank here is all granite. Just south is the alluvial deposit of the old Ringarooma Valley Company, which is a tongue of deep stanniferous ground running up the hill E. We know the ground is deep on the N. side of the road, for it has been bored through 10 feet of modern wash, and 96 feet of ancient drift, into soft decayed granite. In the east end of the workings a section is seen of the shingly modern wash lying on the top of the ancient alluvial. About 400 tons of tin ore are said to have been taken out of these workings, as well as a little gold. Three or four chains up the gully beyond the end of the workings the wash runs out, and there is not a vestige of it further up, but as it descends in the flats towards the Ringarooma it widens out. The granite rock is very steep to the west of the deposit, and bounds the drift on that side with an abrupt fall. This spur of granite descends to the road, and would seem to have thrown the river off to the north. As the old channel could not have been on the south side of the present river, the Valley Company's deposit must have fed the main lead.

Where the modern river parts company with the old channel can be guessed at approximately. The old stream, with a gutter 100 feet below the level of the present river, could not have flowed to where Derby is now, because that direction was blocked by the sandstone and granite. The granite also prevented it from turning south, which would have been contrary to the fall of the land. There was thus no opening for it but to the N.E., and, accordingly, in this direction we find plenty of evidence of deep ground under a basaltic covering.

I have not investigated the country above Branxholm, and cannot describe the exact point where the present river first diverges from the ancient bed, but for the present purpose it is enough to know that near Branxholm the two courses are separate. The ancient one seems to correspond with a part of Branxholm Creek, south of the road, and its deep ground can be traced north into the Arba Company's property. I believe it to pass, as laid down in Mr. Thureau's map (Sept. 1884), across the Ringarooma at the east end of the Arba tailings area, and to preserve a N.E. direction parallel with the present river through A. H. Boyd's 198 acres, when it begins to form the basalt-covered plateau, which extends for some 12 or 13 miles N. and N.E. of Derby, with an average width of about a mile. This sheet of basalt, though now maintaining an average height of 300 feet above the bed of the Ringarooma, conceals a deep river valley filled (under the basalt) with wash down to the gutter, which must be at least 100 feet below the present river. The rise of the land has elevated this plateau to its present height above the sea (700 feet according to aneroids), and aided the Ringarooma in cutting its way down from that level to its present rocky channel, far below. If we reflect a moment, we see that this basalt mass marks out for us the direction and width of the valley which it inundated, and by tracing the trend of the slates and granites which bound its margins we are able to guess the course of the ancient river deposit, the deep lead of the Ringarooma.

From Boyd's land the basalt passes N.E. through Crighton's farm, and the river valley was apparently kept N.E. by the rim-rock of slate which hems it in from the Boobyalla basin on the N.W. corner of that farm. Further north, it is still blocked off on the N.W. by slates to the N. and W. of T. D. Peters' land, while it cannot rejoin the Ringarooma between Main Creek and Moorina on account of a granite barrier which is exposed on M'Kimmie and Sandberg's lands. The granite in the S.E. part of R. M'Kimmie's farm crops out at a level of about 230 feet above the Ringarooma, and a couple of hundred yards north of the homestead. It is the usual coarse, porphyritic, dark mica granite (= granitite), and is connected by a nearly N. and S. line with Sandberg's (O'Reilly's) granite a mile further north. Back to the S.E., a few hundred yards from the house, and at about the same level as the exposure just mentioned, there is another outcrop, which seems to be connected with the bedrock falling away down to the Ringarooma. Paddy's mine is a little below this, where some tin ore has been found in shallow drift. The surface soil at M'Kimmie's house is basaltic, and a little to the W. a shaft was sunk 30 feet in basalt without reaching any underlying drift. This was in the flat to the W. of road, and was suspended on account of water. A little further north, beyond M'Kimmie's house, on the west side of the road, decomposed granite is found under six feet of granitic drift, which has been used for blinding the road. This line of granite plainly forms the rim rock to the east of the lead, and confines the old stream to its north-easterly course through Hardman's, Johnson's, Peters', and Shelley's sections. On Alf. Collins' farm, 220 feet above Derby, basaltic soil prevails, but it is rimmed by granite and slates forming the higher ground to the N.W. There is a granite ridge here running N. and S. along the west boundary of G. T. Johnson's land. The creek at the eastern base of the ridge has cut its bed down to a level of only 80 feet above the bridge over the Ringarooma, at Derby. Higher up, on the flank of the hill, we found granite *in situ*. Nothing has been done on this ground in the way of boring. The ground being so low suggested a suspicion whether there was any outlet for the lead in a north-westerly direction from Alf. Collins' farm. The drift would have to be much lower than the granite bottom of the creek referred to, but, from the fall of the creek, I dare say we could have found a granite exposure a good deal lower. Such an outlet would divert the lead into the Boobyalla country, *viâ* the Trout Creek line. It would be well to devote some attention to this run of country, and if a few lines of levels were run across this plateau by the Survey Department, they would be helpful: however, I do not think this gap was the outlet. Certainly we are here on the west side of the watershed down to the Boobyalla, but though the Trout Creek, which flows into that river, has some alluvial at its junction, it is bounded by slate on the S. and granite on the N. in its lower reaches, while, higher up and further E., that creek and its forks flow over granite, which continues into the Commercial Bank's 317 acres and the country to the north of it. The southern portion of the Commercial Bank's land is all basalt; the northern portion, all granite. This granite country completely bars the lead due north, and, consequently, if the latter does not turn west to the Boobyalla, which is improbable, it keeps on its north-easterly course, in a distinctly widening channel, into the Tasmanian Mineral Exploration Com-

pany's block, where the basaltic plateau is about 550 feet above sea-level. Half way up this block we have the farms of Messrs. J. Harrison, Jno. Simpson, and Wagner, from east to west, all on fine basaltic soil, and enjoying a favourable climate for agriculture. The farmers complain bitterly that the Government does not connect the block by a good road with the road to Bradshaw's Creek. Mr. Simpson has a well on his farm sunk in basalt to 80 feet. To the N.W. of Mr. Wagner's homestead is a knob or hill of basalt, which extends as a ridge for a mile northwards. Going west from Wagner's into Stevenson's land and beyond, we find the head of the north branch of Trout Creek flowing through a yellow, clayey soil, with granitic detritus. There is a small shaft sunk here, on Wagner's land, in white, angular granite detritus. This betokens that granite cannot be far off; and a little lower down the creek, first, huge granite boulders occur, and then granite rock *in sitû*. Mr. Wagner has sunk a 34-ft. well in his orchard. It first passed through 28 feet soil and soft basalt, then through 6 feet yellow pug, finally entering the drift. The basaltic sheet is evidently thinner here than on Mr. Simpson's part of the estate. Following up the trend of the basalt and its boundaries in this simple but convincing way, we see that it certainly comes through this large block of land. Standing on this plateau, a break is visible in the country northwards, and though this has no necessary connection with the ancient drainage, it seems to be the direction of the lead. To get behind the Mineral Exploration Company's block to the north, we examined the country along the road running by Hurst's and Kolosque's land. Eastwards from Kolosque's, the country is granitic, but westwards and south, basaltic, probably the edge of the lead. Following the road due north, we have yellow, slightly-bedded quartz sand, until She-oak Hill is reached, where there is white, apparently marine, sand and quartz grit, cemented with oxide of iron, often nodular. Looking westward, slightly S.W. from this hill, the low gap in the country alluded to on the Mineral Exploration Company's block is seen. To the N. is Mt. Cameron, a bold granite mountain, 1800 feet above sea-level, thrusting its underground prolongation of bedrock southwards. All this granite country to the N. and E. effectually disposes of any idea that the former course of the river was to the east of Mt. Cameron. Just past the She-oak Hill there is granite *in sitû*, about a chain west of the road, as also on the hill to the W., running south. At the west end of Mt. Cameron the granite comes down to the road, which may be 30 or 40 feet above the eastern branch of the Boobyalla. The granite along this N. and S. line may be taken as the eastern boundary rock, which the old river could not break through.

The further tracing of the lead north of the Tasmanian Mineral Exploration Company's block could not be undertaken on this journey, and as the basalt thins out in that direction, and the country expands into low plains, the delimitation of the old river-course will most likely be attended with some difficulty. All that can be said at present is, that the lead debouches from the northern part of the Exploration Company's block into the catchment basin of the eastern branch of the Boobyalla River, and runs towards the sea, west of Mt. Cameron. This sketch of its course, as roughly defined by its rim-rocks, is as much as I am able to submit for the present: the detailed delineation of its boundaries can only be accomplished by the expenditure of more time than that at my disposal, and, of course, with the goodwill of the occupiers of the farms. Those whom I had the pleasure of meeting were most obliging and hospitable.

That the main lead of itself is stanniferous is proved by the Arba and other works higher up its course, but its value is greatly enhanced by its receiving the tributary leads of the Cascade, Main (Weld and Frome?), and Wyniford rivers. These have flowed for ages from the south-east, washing down granite sand and tin from the high ranges in which they have their source. The Ringarooma River, from Derby downwards, has cut across their course. The principal tributary lead is that of the Cascade, at Derby, where it is worked by the Krushka Bros. (Brothers' Home), New Brothers' Home No. 1, and Briseis mines on the south side of the Ringarooma, and the Brothers' Home Extended on the north side. The Briseis originally worked along the bed of the Cascade before they found their deep ground. The wash there was a modern one, and not more than 10 feet deep. Between the Cascade River and the deep ground of the Briseis Mine the ridge is granite, and this falls rather abruptly into the Briseis drift. The granite range rises to the south of the Briseis workings, so that the old lead runs up between granite walls towards higher ground, and feathers out in the Company's most south-easterly section. The basaltic overburden forms a capping of varying thickness, but attaining a depth of from 60 to 100 feet, under which, on the face opposite Derby, a vertical filling of 200 feet of wash, extending across the Krushkas' and Briseis mines, is exposed between granite sides down to the bottom works. I was told the bottom of the gutter had not been reached at the base of this face, but judging from the small distance between the granite sides at the bottom, it cannot be more than 30 feet or so deeper. Consequently, at this point the vertical thickness of the wash must be about 230 feet. The low horizons are, as might be expected, the richest in tin. I saw some parts forming a gravel of small quartz pebbles, which seemed to be highly stanniferous. Layers of tin ore may be seen concentrated at different horizons in the wash, and these often run some distance and then thin out, after the manner of stream deposits. Some silicified wood is found embedded in the drift, but its nature has not yet been determined. I was informed that some shells (bivalves) had been found once in the old Triangle workings, but this is the only occurrence of shells which I heard of throughout this journey. The basalt is much decomposed: much of it was columnar. Fragments of rudely-formed hexagonal columns are plentiful in the *debris* heaps. The horizontal line of demarcation between the reddish brown basalt cap and the white quartz wash below is very plain. A layer of pug is often found, sometimes just below the basalt, sometimes lower down in the drift, from 2 to 6 feet thick. Boulders of decomposed granite are found in the wash, but they have fallen from the adjacent ranges, and owe their present position, to gravitation; at least, I see no reason for ascribing their occurrence to ice-transport, of which there is no evidence whatever in this district. The occurrence of decayed granite floaters associated with basalt kernels in white quartz-drift at the west end of the workings admits of an obvious explanation. The idea of solid granite overlying drift, as was mentioned to me on the spot, is an impossible one.

On the hill to the S.E. of the Briseis, there is some deep ground lying to the W. of the Cascade and its granite margin. In this ground there are a couple of old shafts, one of which struck the granite after passing through 26 feet of drift. The other is in 56 feet of

drift and no bottom. East of this is only granite, which bounds the lead in that direction. Some have supposed deep ground to exist eastwards from the Briseis towards Main Creek, but, so far as I know, this has not been proved.

Looking across to the Brothers' Home Extended and Triangle works, we see that those deposits are a continuation of the Briseis and Brothers' Home wash: in other words, it is the Cascade lead or drift laid down in the old channel of the Cascade River. The modern Cascade communicates with the modern Ringarooma River by a granite channel to the E. of the old lead. The granite which is seen in the eastern part of Brothers' Home Extended is the continuation westwards of the ridge of granite which separates the modern Cascade stream and the Briseis workings. The granite bottom is seen dipping into the Extended N.W. at the entrance to the workings, and the drift dips that way too, as might be expected. The face of wash exposed is about 100 feet high, with a capping of 50 to 80 feet of basalt. The wash between these works and the river east of bridge goes down to a good depth below the present river. This is apparently along the line of the Triangle workings, and the deepest ground has run along that line parallel with the present river. Mr. M. J. Griffin formerly put a bore (No. 1) down here, which bottomed at 101 feet, and went six inches into hard granite, the brace of bore being 26 feet above river. In No. 2 tunnel on Beswick's freehold, 8 feet above river level, just opposite the *Dorset Hotel*, a bore was put in to 60 feet below the floor of the tunnel. The tunnel was in drift, and the bore got into a boulder wash. This bore would have to go 22 feet 6 inches more to reach bottom of lead at level of No. 1 bore, mentioned above. Coarse bands of shingle occur in the wash at different levels, in which pebbles of sandstone are numerous. It looks as if the ancient river had cut through the Silurian sandstone which once covered the granite round Derby. Light-coloured pug is noticeable in layers in the wash: this indicates tranquil sedimentations. Various bores have been put down ahead of the works, disclosing tin-bearing wash, but the trials do not seem to have been conducted systematically, and do not furnish much useful information. Further, W. Weir and party bored on the ridge above race on north side of the Ringarooma, and are said to have gone down in wash below the river without bottoming. The drift was tin-bearing, but poor.

It may be taken as demonstrated that the Cascade lead runs parallel with the Ringarooma through T. Beswick's land N.W., illustrating in a striking way the difference of the drainage at this point now and then, for the Ringarooma River is now running in exactly the opposite direction. The Cascade lead, prolonging its course on the same line, must inevitably fall into the old lead of the Ringarooma, and, as far as we could see, it would do this on F. Williams' 202 acres.

The present fall of the Ringarooma is 9 to 10 feet in a mile, assuming, for the sake of getting an approximate idea, the ancient river to have had the same rate of fall, and the clay in the wash seems to show that sometimes, at least, it was not greater, then, by the time the main lead arrived at where F. Williams' land is now, the bottom would be 110 feet (minimum) below the present river bed opposite the old valley workings, and the Cascade lead would fall into it at that depth. I am aware that we cannot be certain that the old leads ran in direct lines; they were probably sinuous to some extent, and possibly meandered a good deal in the lower parts of their course. The effect of any great deviation would transfer the junction of the two leads to W. J. Graham's land further north.

The main lead receives further tributaries during its course towards the sea. The first after the Cascade is that of the Main Creek, which apparently goes through C. Krushka's land under the basalt, and falls into the main lead in Hardman's 312 acres. The next is the Frome and Weld lead, which has originated the deep ground at Moorina. Up the valley to the S.E. there are still patches of basalt on ancient wash. There is an opinion to the effect that this lead bends northwards, and connects with the deep ground further north at David's Creek, but we did not trace its course on this visit, and I merely mention it for the sake of completing our view of the ancient system of leads. The last lead going northwards is the important one of the Pioneer, at Bradshaw's Creek, opposite where the Wyniford River falls into the Ringarooma. This lead is not protected by a covering of basalt, and the upper parts of it may not be quite so ancient as the others, but it plainly began to form in the old pre-basaltic times when the fall of the country was setting towards the Ringarooma main lead. Mr. Cecil Ryan, the engineer in charge of the Pioneer Tin Mining Company's works, has lately established this very clearly. The dip of the old lead is conclusively demonstrated by the numerous bores which he has put down with the view of proving the true direction and depth of the channel. The whole series of bores put down here from time to time number 52, of which Mr. Ryan has sunk 30. In the eastern part of the workings bare rock is exposed; westwards the ground deepens first to 33 feet, then to 88 feet, and bores more to the west bottomed at 104 ft. and 108 ft. Bores nearly two miles west still show deep ground, thus: No. 25, not completed, is down to 104 feet, still in wash containing much black pug, with organic matter, sticks, leaves, &c. The sand carries quantities of fine iron pyrite. No. 26 is 114 feet deep, and bored 3 feet into a close-grained granite, not the ordinary country granite. Between here and the township, the lead seems to turn towards the south, but the exact continuation is unknown. It is a matter for speculation whether the alluvial to the south is a feeder or a part of the main gutter. At all events, the Pioneer lead cannot now be affirmed to be a marginal part of the Ringarooma lead. It is clearly a tributary of it, and, I imagine, must join it somewhere in the Mineral Exploration Company's block. Mr. Ryan's work has done more to elucidate its position and direction than any previous work here. He was good enough to give me some interesting information respecting his work. All the bores have been put down in 3-ft. sections, so as to form a reliable idea of the ground passed through. The gutter has been proved for ¾ mile down the lead. As long as the gutter is kept to, gravelly wash prevails, but away from it fine sand is met with. A long way off the gutter some rotten wood and small pieces of lignite have been found. The shingle is coarser near the Wyniford River, and grows finer going west. No shells have been found in the Pioneer wash, but since my return, Mr. Ryan informs me that two obsidian bombs have been discovered. These interesting and mysterous objects will doubtless turn up more frequently now that they are attracting closer attention. The tin in this lead is coarser on the bottom, but nowhere really coarse, being, all through, fine ore well rolled. Tiny topaz stones occur, but very few sapphires. In the Wyniford tin sapphires are plentiful, and topaz is found there also. The ore is evenly distributed in

veinlets and layers. The hardest ground in this deposit is a three-feet cake of cement at the top. There is no basalt to be stripped off, but tin is found at the grass roots.

The top of the Pioneer workings are only 300 feet above sea-level now, and there is no doubt, that subsequently to the filling of the gutter in early Tertiary times, the sea has flowed over this surface, re-arranging and distributing drift some distance away from the true channel of the stream. This conclusion is confirmed by an examination of the country round Gladstone and Mt. Cameron, which presents the features of a plain of marine denudation. The absence of marine shells is puzzling, but loses much of its apparent force by being merely a negative argument which the discovery of a single shell might overthrow.

The width of the main Ringarooma lead at surface, as indicated by the basaltic sheet, is from 1 to 1¼ miles in the southern half of the table-land, increasing to 1½ miles and upwards in the northern part. This surface breadth will increase the difficulty of locating the trend of the gutter through this area. The only way of locating it is to put down lines of bores from N.W. to S.E. a hundred feet apart, in a straight line right across the basalt capping. The cores will not prove the value of the wash, and we must not be led astray by thinking that they will. We know from other parts of the lead that the tin ore is distributed through the drift irregularly in nests and layers and veins, and that portions are nearly barren. If, therefore, barren cores are brought up, they need not shake our confidence in the existence of large accumulations of ore in the deeper parts of the buried lead. That payable drift exists in the tributary leads is an absolute fact, and these tributaries must have contributed their quota to the main lead, which ought to be richest just at or below the junctions. The course of the Cascade lead from the bridge at Derby to where it joins the Ringarooma lead, is within two miles in length, and it is difficult to believe that all the tin had been exhausted before the junction was reached. At that spot a concentration would take place, the impact of two streams of different velocities inevitably causing the deposition of material held in suspension. The first line of bores might be put down across the farms of F. Williams and Jas. Crichton, to determine the gutter there. The next line would be across M.S.R. or Thos. Hardman's farm. The height of the plateau here is 750 ft. above the sea, and the gutter would, I think, be struck between 450 and 500 feet from surface. The next line would be across the farms on the Tasmanian Mineral Exploration Company's block, where the land falls, and the gutter might possibly be found at 400 feet. Somewhere between this and the previous parallel another line might be put down, and these four lines might be expected to locate the underground lead and gutter fairly well. They would also demonstrate the angle of dip of the containing rim-rock, which is an important thing to know before setting out plans for shaft-sinking or tunnelling. If the gutter is anywhere near a steep rim-rock, then the shafts must be sunk in the solid, and drives put in under the lead, for there is reason to believe the lead holds a good deal of water, and sinking straight into it before draining would throw an enormous strain on the shafts. I am afraid the body of wash is too great for the use of ordinary iron boxes and screwjacks with rectangular shafts. The safest way in the end would be to resort to the somewhat expensive system of circular shafts lined with segmented cast-iron cylinders. Brick-lined shafts are apt to get out of plumb. A pumping station would be best established towards the lower end of the main lead in the Exploration Company's block, and the whole lead drained if the work is to be conducted on a scale corresponding with the extent of ground. When the water which has collected in the drift from the Ringarooma River (the gutter, be it remembered, is below the bed of that river) and from the surface catchment of the plateau, is once pumped out, the chief part of the trouble would be over, and it ought not to be difficult then to cope with the current supply. Another difficulty which needs consideration is to find water on the plateau for sluicing. There are only David's Creek, several small temporary creeks, and a few which are all but temporary, so that the water question requires very careful examination as a first and important preliminary. In a few places, perhaps, the stuff might be brought up to the mouth of the shaft and conveyed down to the nearest water, but the plateau is so large that this plan would be inconvenient as a rule, and extremely expensive; and when we see that the gutter necessarily lies at least 400 feet below the general level of the plateau, it is impossible not to recognise that mining this lead must be attended with heavy expense. Large stores of tin brought down from the stanniferous granite ranges undoubtedly are distributed through the mass of the wash, deposited not only by the parent stream, but also by the tributaries which fed it. The practical question, however, after all our examinations and hopes and wishes, is whether the deposit is rich enough to reward work after reimbursement of expenses. Of course it is impossible to forecast the tin contents of the lead with anything approaching accuracy. I have made numerous inquiries as to estimates made of the richness of the drift in existing and past mines on the lead and its tributaries. Though some of these I believe to be perfectly reliable, I am afraid they are not altogether systematic enough to be very useful. I am credibly informed that a large quantity of drift handled at one of the mines on the Cascade lead averaged 4 lbs. to the cubic yard, or one-sixth per cent. Mr. J. B. Mackenzie, C.E., estimated the whole drift above a 20-ft. deposit next to the bedrock in the New Brothers' Home No. 1 mine at 3½ lbs. per cubic yard = about one-seventh per cent. For the 20-ft. layer next the bedrock he adopted the estimate of 12 lbs. per cubic yard = about one-half per cent. Mr Lewis had previously estimated the average value of the wash in that mine at one-half per cent. In the Cascade lead, it must be remembered that the top 30 or 40 feet of drift is very poor, while the wash resting on the gutter is proportionately rich. There is reason to believe that the tributary leads are richer than the higher part of the main lead. I should not be surprised if the average of the latter, prior to receiving its feeders, does not exceed one-eighth per cent. By excluding successively higher horizons of the drift from the calculations, successively higher percentages may be obtained, but, even taking the lower or bottom half of the lead only, I think the average contents of tin may be safely assumed as below one-half per cent. It is true that, with hydraulicking, even one-twentieth per cent. and less will pay, but it has yet to be proved that with underground mining, such as is necessary on this plateau, drift averaging less than one-half per cent. can be considered as payable.

Some further examination of the basaltic plateau is desirable, and the country to the north of it requires special investigation. I shall be glad if any information or hints conveyed in this Report will result in leading

those resident in the district to devote time to the collection of reliable information and data bearing on the plateau and its buried lead. I shall always be pleased to receive communications from those interested in the matter, for the outlines sketched in this Report are sufficient to show that the subject is not yet exhausted.

It is clear, however, that the exploitation of the lead on a proper scale is a work hardly likely to be undertaken by individuals. Its magnitude leads the inhabitants of the district to invoke the aid of the national resources. I am well aware of the expectations of many who wish to see the birth of a new industry in this part of the Island, and I remember, too, that tin is a quasi-precious metal, which can bear high mining costs. I have endeavoured to take a just, sober-minded view of the deposits. I am ready to affirm that every geological consideration points to the existence of large quantities of tin ore being held in the concealed drifts. At the same time I am of opinion that the expense of draining and working these on private land, with the gutter at a great depth, and with a scarcity of water on the spot, introduces an element of risk considerable enough to lead the Government to pause before undertaking the work. If, however, individual associations care to select spots (approved by the Department) with the view of doing what they can to prove the value of the deposit, and are able to establish satisfactorily their *bonâ fides* and financial strength, then, in view of the desirability of a practical test, and of the great benefit to the East Coast and to the Colony which would result from success, I think the Government might be fairly considered justified in encouraging individual enterprise and granting some aid to the undertaking.

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

W. H. TWELVETREES,
Government Geologist.

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

OBSERVATIONS REGARDING THE RECENT DISCOVERY BY G. THUREAU, F.G.S., OF A FOSSIL REPTILE IN THE MERSEY COAL MEASURES AT RAILTON.

By R. M. Johnston, F.S.S.

Mr. G. Thureau, formerly Government Geologist of Tasmania, has kindly submitted to me a carefully prepared cast of the remains of a fossil reptile discovered by him in the spoil-heap from a (then) new main shaft sunk by a Sydney company near Railton, in the Mersey Coal Measures, and, therefore, of Upper Permo-Carboniferous age. The original was placed by Mr. Thureau in the hands of the late Professor M'Coy for identification; but the regrettable death of the Professor soon after prevented this investigation, and Mr. Thureau is now anxious to make known his important discovery to the Members of this Society; because—as Mr. Thureau thoughtfully observes—the possession of this interesting fossil from our rocks—now in the Melbourne Museum—"rightly belongs to Tasmania."

The cast referred to—now submitted for the inspection of the Members of this Society—represents portion of the central and caudal vertebræ of the reptile, with the simple gently-curved ribs of the central part perfectly connected. The central or pre-sacral vertebra number 13 or 14, with a length of three inches, and greatest breadth one and a half inches; vertebra of the tail thicker, more pronounced, four to five in a length of nearly one inch.

The absence of the head, limbs, and caudal extremity, and the absence of definite knowledge regarding the articulation, form, &c., of the vertebræ, make it impossible to do more than assign its position to the great family of Labyrinthodonts, whose range in Europe is generally determined as from the Carboniferous to the Trias, and are especially abundant in the Permian. It is stated by Nicholson and Lydekker that only one genus (*Rhinosaurus*) persisted to the Lower Jurassic.

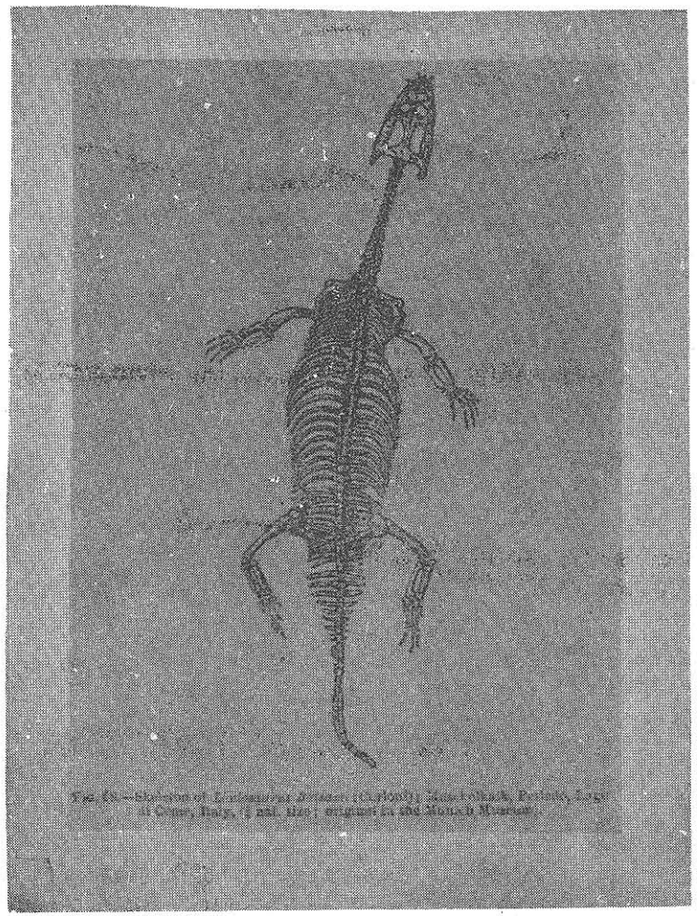
The Pterodactyls or winged reptiles, to which Mr. Thureau suggests a reference, had not the elongate central vertebræ of the form whose cast is now before you, and there is not the slightest evidence of the characteristic bones of the manus. Moreover, the Pterodactyls only make their first appearance in Europe in the rocks of Upper Jurassic age, whereas the fossil skeleton of the reptile now considered, if obtained, as stated, from the Mersey Coal Measures, undoubtedly belongs to Permo-Carboniferous age.

It is to be hoped that Mr. Thureau may be able to obtain the original for the Tasmanian Museum, to which, by right, it belongs, when the opinion of our best European or American specialists may be obtained as to its exact affinities among the reptilia. My own opinion, which I have great diffidence in expressing, is, that it probably comes within that group of the Labyrinthodontia, embraced within the Sub-order *Microsauria*. The Labyrinthodonts included in this Sub-order, resemble Lizards in outward appearance, and have the centra of the vertebræ more or less elongated, and long curved ribs.

One genus of this order, *Limnerpeton*, of the Permian of Bohemia, possesses characteristics of the vertebræ of the central and caudal parts, which come very close to our Tasmanian representation from the Permo-Carboniferous Coal Measure of Railton, Tasmania.

I am sure the Members of this Society will agree with me in thanking Mr. Thureau for his valuable cast of the reptile, and for his promise to endeavour to secure the original for the National Museum of the Country where the skeleton was found.

For the sake of reference, and as a compliment to Mr. Thureau, I propose in the meantime to refer always to this, the oldest known remains of a vertebrate in Tasmanian rocks, as "*Thureau's Microsaurian.*"



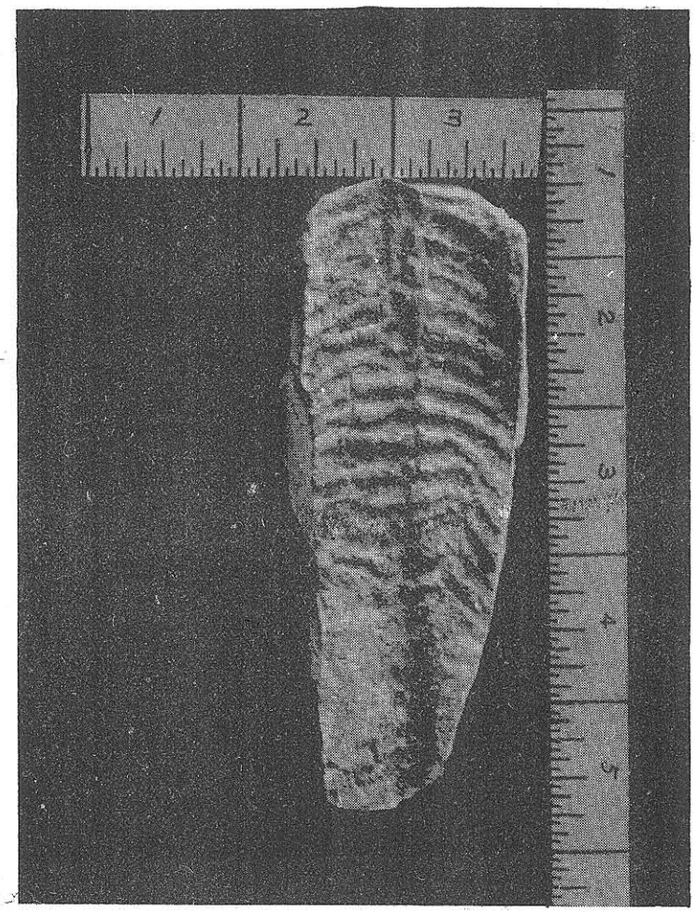


Photo-Algraphy Process.

SKELETON OF *LARIOSAURUS BALSAMI* (Curioni)
Muschelkalk, Perledo, Lago di Como, Italy ($\frac{1}{3}$ nat. size; original in Munich Museum).

5 cm

FURTHER NOTES ON THE "PERMO-CARBONIFEROUS CLIFFS" AT DARLINGTON, MARIA ISLAND.

By R. M. Johnston, F.S.S.

Maria Island, lying to the east of Spring Bay, must be regarded as the most southerly outline of the great granite axis forming the eastern fringe of Tasmania, traceable northwards through Schouten Island, Freycinet's Peninsula, Bicheno, Falmouth, St. Helens, Eddystone Point, to Gladstone. Crossing the narrow Banks' Strait it may be further traced through Clarke Island, Cape Barren Island, Long Island, Goose Island Hummock Island, the Strzelecki Peaks, and Killicrankie Range of Flinders Island, and the elevated masses of granite forming the interesting cluster of islets known as the Kent's Group. From this point the granite axis is again traceable through the rocky shoals, reefs, and islets to the most southerly limit of the Australian mainland at the granite headlands of Wilson's Promontory.

Maria Island, like Bruni Island, is divided into two parts—North Maria and South Maria. The two divisions are connected, between Oyster Bay on the west and Reidle Bay on the east, by a narrow strip of sand two or three miles long, giving the island, as a whole, somewhat the appearance of an ancient hour-glass. The greatest length lies between Cape Boulanger on the extreme north, and Cape Peron on the extreme south, covering a distance of about 15 miles. The greatest breadth, about 10 miles, lies in a line between Long Point on the west, and Ragged Head on the east; that is within the larger division of the North Island. Maria Island, as a whole, covers an area of about 38 square miles, and, as its mass in the north rises rapidly, with fantastic outline, from the sea to a height of over 3000 feet, it presents a very imposing appearance as seen from the nearest part of the mainland, six or seven miles distant.

The general geological features of both North and South Divisions of the island are very similar, and closely agree with those of the Schouten Island and Freycinet's Peninsula, with which at one time, no doubt, they were connected.

Thus, in all, we find the easterly half entirely composed of grey and, sometimes red, granites, often coarsely porphyritic. The large tabular crystals of the various kinds of felspar are particulary conspicuous in places. Flanking the granites on their western side, in a more or less well-determined north and south trough or valley, occur metamorphic rocks of Archæan age, together with schists, slates, and close-grained limestone, probably of Lower Silurian age. In such situations stream-tin has been sparingly found, both on Maria Island and on the Schoutens. The great mass of the western half of both divisions is occupied mainly by the prevailing diabasic greenstones of the country, and form, as elsewhere throughout Tasmania, its loftiest and most characteristic physical features. The border of the greenstone ranges, in the southern and western portions of the northern division, is low-lying, composed of scrubby sand-dunes, enclosing marshy lagoons. Towards the north-east, at Darlington, occur fine sections of limestones, mudstones, and conglomerates of Permo-Carboniferous age.

Nowhere throughout Australia and Tasmania are there so complete a series or finer sections of the marine rocks of Permo-carboniferous age exposed than those occurring in the grand precipitous sea-cliffs near Darlington, at the north-western extremity of Maria Island. Darlington, the only settlement, wherein live a few families engaged in pastoral occupation, is most charmingly situated underneath the shadows of the two curious lofty peaks of Mount Maria, nearly 3000 feet high, whose well-known features, as seen from the seaward side, have suggested the fanciful idea of "Bishop and Clerk," a name by which they are now known. The northern outlook from the settlement is especially grand, as it embraces the distant outlines of the fantastic chain of serrated granite ranges of the Schouten Island and Freycinet's Peninsula. Away to the extreme north these crests melt away towards the cultivated settlements around Swansea and Great Swanport, at the head of Oyster Bay; while to the left stands out the bold coast-line of the mainland, lying between Cape Bernier and Okehampton, near the entrance to Spring Bay.

Immediately to the north and east of Darlington, along the coast-line, occurs a low-lying spur of the diabasic greenstone, which suddenly terminates at the western shoulder of the great cliff-encircled half-moon bay lying directly under "The Bishop and Clerk."

From the point where the diabasic greenstone spur terminates, the coast-line north and east encircling the half-moon bay is walled in by perpendicular and partly overhanging cliffs, composed of stratified marine beds of the Permo-Carboniferous system. Looking downward from the crest of one of these perpendicular cliffs, in the direction of the "Bishop and Clerk," whose slopes and crest, composed of diabasic greenstone, rise abruptly from above the 400 feet perpendicular stratified fossil cliffs to a height of nearly 3000 feet, the half-moon bay and its environing fossil cliffs present a scene of exceeding grandeur. Along the base of the cliffs of stratified rocks there is a narrow marginal strip of low flat rocky ledges, upon which have accumulated, at certain points, vast quantities of fossiliferous blocks of limestone and mudstone, which, by the continuous undermining action of the great open sea-rollers, have been detached from time to time from the overhanging ledges on the face of the beetling cliffs.

The huge blocks which have fallen from these overhanging cliffs are strewn about or tumbled upon each other in the wildest confusion, while the fossils on the surface of the limestone masses, by the weathering action of sea and air, stand out in bold relief in greatest perfection.

The genus Pachydomus, with its large globose specific forms, is especially noticeable. Blocks, 40 and 50 tons in weight, seem at first sight to be made up of a compacted conglomerate of these large fossil bivalves; but a closer inspection reveals the presence of numerous associates. Originally, in my larger work, on "The Geology of Tasmania," for the sake of convenience in

description, I provisionally divided the various members of the Permo-Carboniferous rocks at this place into three great divisions or zones, part characterised by differences in the *prevailing forms* of fossil life, and partly by a considerable difference in the character and composition of the successive beds or groups of strata.

(1.) *Erratic Zone.*—The lowest beds visible above sea-level have been termed by me *The Erratic Zone.* Composed of more or less impure limestones, frequently studded with great erratic boulders of quartzites, slates, schists, and granites or conglomerates of these older rocks, cemented together by limestone. Some of these huge, angular, erratic granite blocks weigh over a ton.

There is abundant evidence now to show that these huge erratics must have been borne thither by meeting ice-sheets. Similar evidence of glacial action during the age in which these rocks were formed, occur in England; Talchir and Salt Range, India; Dwyka Conglomerates, South Africa: Bacchus Marsh Conglomerates, Victoria; New South Wales; and in many parts of Tasmania, in rocks of the same horizon. Fuller details of glacial evidence are given in my observations on "The Glacier Epoch of Australia," read before the Members of this Society, in the year 1893. (See Papers and Proceedings of Royal Society of Tasmania, June, 1893.)

(2.) *Pachydomus Zone.*—Immediately above the *Erratic Zone* occurs a series of alternating beds of calcareous shale and solid limestones, characterised conspicuously by the prevalence of the large globose bivalves of the genus *Pachydomus.* This series, or *Zone*, is about eighty feet in thickness, and was termed by me originally the *Pachydomus Zone.* It must not be inferred, however, that this genus is solely confined to this division, or that this genus alone is to be found within the limits of the zone so named. All that is intended here, by the classified name, is, that in this group of beds, the genus Pachydomus dominates supremely over all other forms of life, and a forty-feet bed is almost wholly composed of their fossils. The following is a fairly typical list of the Pachydomi of this zone, with their more common associates :—

Pachydomus globosus	J. de Sow.
„ de Koninckı.....	R. M. Johnston.
„ Hobartensis	„
„ gigas.....	M'Coy.
„ carinatus	Morris.
Eurydesma cordata	„
Notomya Gouldii	R. M. Johnston.
„ trigonalis	„
„ Beddomeii.....	„
Aviculopecten limæ formis	Morris.
„ Illawarensis	„
„ squamuliferus	„
„ Fittoni	„
Platyschisma ocula	J. de Sow.
Connularia Tasmanica	R. M. Johnston.
Stenopora Tasmaniensis	Lons.
„ informis	„
Favosites ovata	„
„ sp. indel. forming broad flat patches over a foot in superficial extent.	

(3.) *Fenestella Zone.*—Succeeding the *Pachydomus* beds there occurs a series of thin, friable, shaly, rusty mudstones, more or less decomposed towards the upper surface, and almost wholly composed of the crushed, laminated frond-like layers of the common species of *Fenestella.* These beds are now estimated to be about 124 feet in thickness, and are generally overlaid, as more recently observed by Mr. Montgomery, by a thin band or layer of volcanic ash or tuff, which he describes as being very hard, full of small glittering granules of glassy quartz, felspar crystals common, also fragments of various rocks. It decomposes into a yellowish-brown clayey stone, which still shows the glassy quartz granules very distinctly. As the whole of the beds of the cliff have a distinct uniform dip of about 1 in 15 in a direction south by east (S. 28° E.), this band, traceable at sea-level to the north, may be followed in the same position, continuously, to the higher surface north and west, where at a height of 185 feet, near the cliff top, and at the head of a deep gully or arm of the sea, it may be again observed in a more or less decomposed state. Mr. Montgomery draws particular attention to the position and peculiar character of this band, as he is of opinion it may serve as a valuable datum line by which to recognise the stratigraphical position of the beds further inland, where among a higher series they are to be found—as also along the higher members of the sea cliffs to the east occur the limestone bands, quarried for the Portland Cement Works of the Maria Island Company. The works lie inland, in a valley, towards the head of Bernacchi's Creek.

The common forms, *Fenestella internata*, Lons., *F. plebeia*, M'Coy, and *Protoretepora ampla*, Low, make up the greater part of the *Fenestella Zone.* Associated with them, however, may be found the following typical forms, viz :—

Spirifera Tasmaniensis	Morris
„ Darwinii	„
„ glaber	„
„ duodecimcostata	M'Coy
Productus brachythærus.....	G. Low.
Strophalosia Clarkei..... ...	Eth.
„ Jukesii	Eth. Jr.
Pleurotomaria Morrisi.....	M'Coy.

(4.) *Productus Zone.*—The series of beds overlying the Fenestella Zone are divided by Mr. Montgomery into two groups. The first group in succession termed by him *The Productus Zone* is about 30 feet thick, composed largely of beds of blue hydraulic limestone from 6 inches to 4 feet thick These are the beds chiefly worked at the quarries for the production of Portland cement. The blue limestone bands are separated from each other invariably by beds of calcareous shale and mudstone. The limestones are replete with the common forms of Spirifera, Strophalosia, Productus, Aviculopecten, Stenopera, Crinoids, and Fenestella. Pachydomus, common, but less frequent.

(5.) *Crinoid Zone*—The next and highest groups in position of the Darlington beds are estimated by Mr. Montgomery to be about 320 feet thick, and are termed by him the *Crinoid Zone.* This zone is composed of limestones, consisting chiefly of crinoid remains, occurring in beds from six inches to four feet thick, separated by thin shaly partings. Mr. Montgomery states that this limestone seems very pure, except that it frequently contains bands and masses of chalcedony *(Buhrstone)*, formed by the infiltration and segregation of silicious solutions. The beds of the larger quarry at the Portland cement works are stated to belong to the lower part of this series. The buhrstone referred to might yet prove to be of commercial value for milling purposes, as it is very abundant and easily quarried. It is greatly to be regretted that the manufacture of Portland cement at this place has failed of success, seeing, as Mr. Montgomery has reported, that good cement has already been manufactured there, and that there are good facilities of all sorts for making and shipping larger quantities of it.

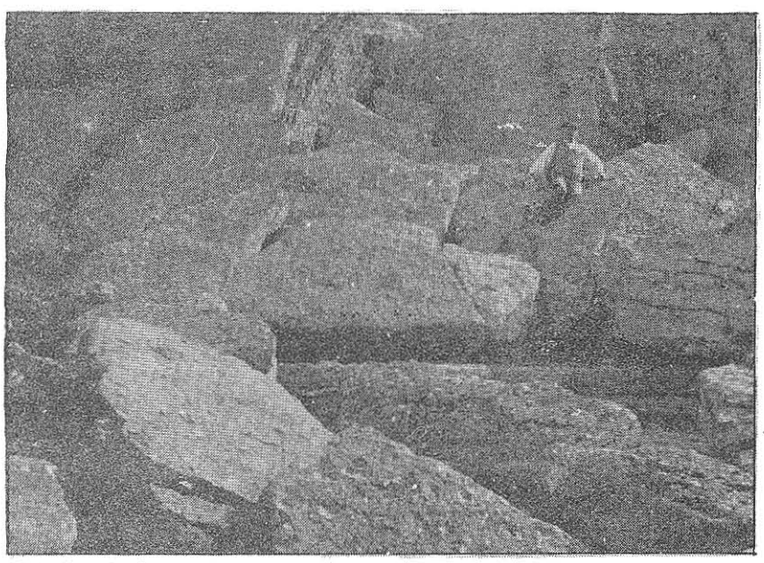
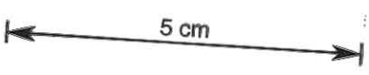
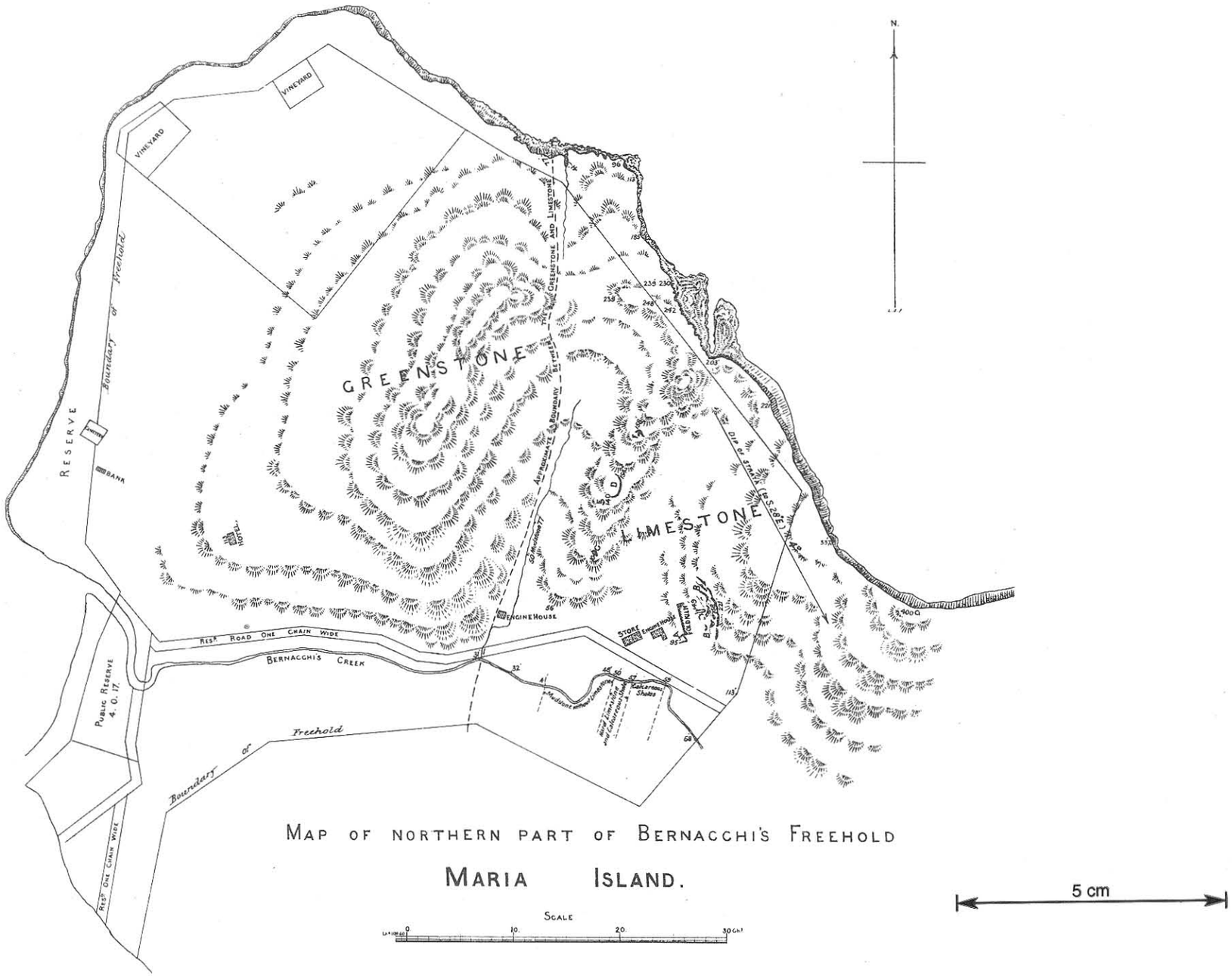


Photo-Algraphy Process.

FALLEN BLOCKS OF FOSSILIFEROUS LIMESTONE
At foot of Cliff, Fossil Cliff Bay, Darlington, Maria Island

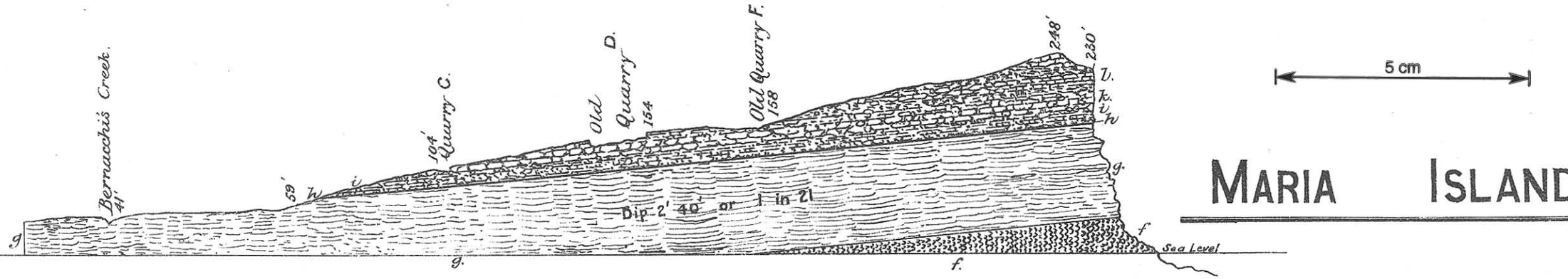




MAP OF NORTHERN PART OF BERNACCHI'S FREEHOLD

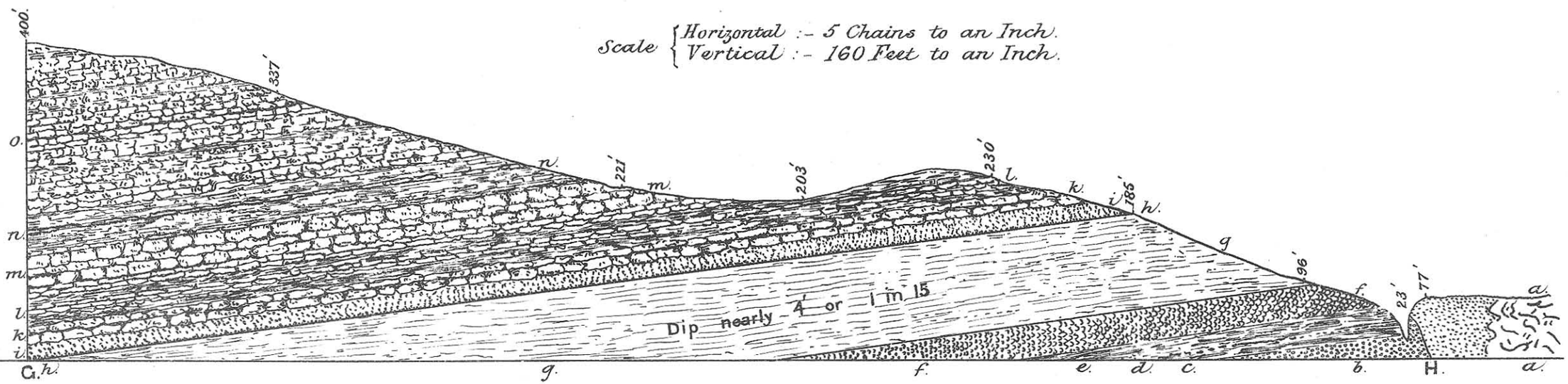
MARIA ISLAND.

MARIA ISLAND.



SECTION THROUGH MIDDLE SPUR FROM CREEK TO COAST.

Scale { Horizontal :- 5 Chains to an Inch.
Vertical :- 160 Feet to an Inch.



SECTION ALONG COAST FROM G. TO H.

a. Greenstone. b. Limestone & conglomerate. c. Calcareous shale & thin beds of limestone. d. Bed of Pachydomus shells. e. Calcareous shales with thin beds of solid limestone. f. Thick bed of Pachydomus shells. g. thick bed of mudstones with very abundant remains of species of Fenestella &c. h. bed of volcanic ash. i. shaly limestone with numerous species of Spirifera, Productus &c. k. thin bedded hard limestones worked in quarries on Middle Spur. l. horizon of limestone beds worked for cement in quarry A. m. horizon of crystalline crinoidal limestones in bottom of quarry B. n. mixed beds of limestone and mudstone. o. beds of hard limestone seen in face of cliff at G.

L.S.B.

To the geologist and palæontologist, the Darlington beds of Permo-Carboniferous age are of the greatest interest. The fossils of these rocks afford a splendid field for further palæontological investigations. Professor Boehm, of Freiburg University, Baden, whom I recently induced to visit this fine section at Darlington, declared to me that to him, as a professional palæontologist, it was the grandest sight that he had ever beheld. The main object that I had in view in recording these observations is that it may perhaps induce the younger members to systematically extend our knowledge of the Permo-Carboniferous age in Tasmania, and especially of these Darlington beds. I am indebted to Mr. Montgomery's paper for the large detailed table of strata appended, and for the sections which illustrate them. (Appendix B.)

For the series of splendid photographic slides of the Darlington fossil cliffs, prepared to illustrate this paper by Mr. Beattie, I am indebted to my friend, your Secretary, Mr. A. Morton, who obtained them when he last visited the island for this purpose, accompanied by Dr. Boehm. The enlarged figures of typical fossils of these rocks, to be shown on the screen, are taken from the plates which illustrate my large work, "Systematic Account of the Geology of Tasmania."

As the limestones quarried by the Maria Island Company for the manufacture of Portland cement are of much interest, from an economic point of view, I have appended (Appendix A) a valuable analytical report of the character of these limestones, submitted to Mr. Wallace, Secretary for Mines, by Mr. W. F. Ward, Government Analyst.

Appendix A.

Government Laboratories,
Hobart, 4th September, 1900.

Dear Sir,

The samples of cement received from you on the 14th ult., and stated to be from Maria Island, have been examined, with results following :—

	1	2	3
Silica, soluble	26·2	26·5	22·4
Silica, &c., insoluble	5·0	1·1	1·2
Oxide of iron	2·6	2·2	1·8
Alumina	3·8	3·4	4·0
Magnesia	1·1	1·2	0·8
Lime, &c., by difference	56·3	63·6	53·2
Carbonic acid and water	5·0	2·0	16·6
	100·0	100·0	100·0

No. 1, cement; No. 2, blue lias clinker; No. 3, crumbling cement brick, 10 years old. No appreciable amount of phosphoric acid was found in any sample; a small quantity only of sulphate of lime is included in the lime.

To render the results more strictly comparable, they have been calculated, excluding the carbonic acid and water lost on ignition in each case, as follow :—

	1	2	3
Silica, soluble	27·58	27·04	26·86
Silica, &c., insoluble	5·26	1·12	1·44
Oxide of iron	2·74	2·24	2·16
Alumina	4·00	3·47	4·80
Magnesia	1·16	1·23	0·95
Lime, &c.	59·26	64·90	63·79
	100·00	100·00	100·00

Variations in compositions of cements from several different countries are added for comparison :—

	Per cent.
Silica	19·9 to 26·1
Alumina	5·2 „ 10·6
Oxide of iron	2·1 „ 5·0
Lime	59·1 „ 67·3
Magnesia	0·3 „ 3·5
Sulphuric acid	0·3 „ 4·2

It will be seen that in the Maria Island material the silica is rather above the maximum, and the alumina rather below the minimum given above. Alteration in these respects would probably mean improvement, but I am inclined to attribute the crumbling of sample No. 3 to mode of preparation of the cement, as there are some limestones which will yield cement or lime according to the temperature at which they are burned. A rotary kiln, very largely used in America, is a great improvement on the old forms of calciners.

Yours faithfully,

W. F. WARD, *Government Analyst.*

To the Secretary for Mines, Hobart.

Appendix B.

Detailed Description of the Darlington Beds, as described by A. Montgomery, M.A.

	Thickness.		Description of Beds.	Total Thickness of Strata.	
	Ft.	In.		Ft.	In.
Crinoid Zone.	320	0	Limestones consisting chiefly of crinoid remains in beds from 6 inches to 4 feet thick, separated by thin shaly partings. This limestone seems very pure, except that it frequently contains bands and masses of chalcedony (*Buhrstone*) formed by the infiltration and segregation of siliceous solutions. The beds of the large quarry at B. on plan belong to the lower part of this series.	608	0
Productus Zone.	30	0	Beds of blue hydraulic limestone, 6 inches to 4 feet thick, worked in quarries at A. C. D. E. and F. on plan, separated by beds of calcareous shale and mudstone, amounting, probably, to nearly half the whole bulk of the beds. The limestones show fossils of *aviculopecten*, *spirifera*, *productus*, and *fenestella* in abundance; *pachydomus* common, but less frequent. Small stones not uncommon	288	0
	43	0	Shaly limestones, very rich in *Spirifera* and *productus*	258	0
Fenestella Zone.	2	6	Dark shaly mudstone	215	0
	1	9	Volcanic ash or tuff, very hard, full of small glittering granules of glassy quartz, felspar crystals common, also fragments of various rocks: decomposes to a yellowish-brown clayey stone, which still shows the glassy quartz granules very distinctly	212	6
	124	0	Mudstones, with but little lime, very rich in species of *fenestella*, *stenopora*, &c.	210	9
Pachydomus Zone.	40	0	Thick limestone bed, almost entirely made up of shells of *pachydomus globosus*, but containing a great deal of sand and large stones	86	9
	6	0	Calcareous shale	46	9
	0	9	Solid hard limestone	40	9
	2	0	Calcareous shale	40	0
	2	6	Limestone and shale with *spirifera* shells and a good deal of gravel	38	0
	1	6	Solid hard limestone	35	6
	5	0	Calcareous shale	34	0
	1	6	Solid hard limestone	29	0
	1	6	Calcareous shale	27	6
	5	0	Limestone, almost entirely composed of shells of *pachydomus*	26	0
	1	0	Calcareous shale	21	0
	2	0	Solid limestone	20	0
	1	6	Limestone full of boulders	18	0
	3	6	Calcareous shale	16	6
Erratic Zone.	4	0	Limestone with a great many stones in it	13	0
	4	0	Conglomerate of boulders of metamorphic slate and sandstone and granite, cemented together by limestone	9	0
	5	0	Impure limestone, with boulders	5	0
			Sea Level	0	0

REPORT ON THE MINERAL FIELDS BETWEEN WARATAH AND CORINNA.

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

SIR,

I HAVE the honour to submit this Report of my inspection of the line of mineral country extending from the township of Waratah, at Mount Bischoff, to Corinna, on the River Pieman, a distance of 40 miles S. and W. from Waratah, by track and road. The geology and mineral features of this district have been reported upon by former Government Geologists (Messrs. G. Thureau, A. Montgomery, and J. Harcourt Smith), but since then some of the mines have been opened out and developed, and this circumstance, taken in connection with the present more favourable market rates for metals generally, has rendered a renewed inspection of the area desirable, with the view, more particularly, of ascertaining whether its geological and mineralogical characters are such as to encourage the hope of its becoming any important factor in the mineral output of the Colony.

Topography.

The township of Waratah is about 2000 feet above sea-level, at the base of and to the south of Mount Bischoff, which rises 500 feet above the Waratah plateau. This is the town for the famous Mount Bischoff Tin Mine, which has its working faces on the mount to within a short distance of the summit, and ts ore-dressing floors in the valley below the township. The road from Waratah to Corinna first runs south-west over basaltic table land for some four or five miles, and then proceeds westward, skirting the southern end of the Magnet Range, rising about a couple of hundred feet to the saddle of the hill at the turn-off into the Magnet Mine, about 7 miles from Waratah. High land rises here on both sides of the road, for the Magnet Range is continued south-west into the Meredith Range. The road then descends 930 feet in three miles, to the Whyte River Bridge. At the hotel near this bridge the old Godkin tram runs off south-west into the Washington Hay, Confidence, and Godkin group of silver-lead mines. Near the hotel is a flat (the 10-mile) being worked for tin, and on the ridge some stanniferous ground is being explored by the Khaki Tin Company.

The road continues west to the Heazlewood through timbered, hilly country. At 13 miles, Jupp's boarding-house is passed, where a track turns off south to the Whyte River Gold Mine and the Result and Discoverer sections (the Result is the old Bell's Reward). The Godkin and Godkin Extended can also be reached this way. The track, as far as I went along it—to the Discoverer— is a good one. It was first made by the Government as a pack-track, and afterwards widened for drays by the Bell's Reward people. Drays can get along, but the track would be all the better for a little adjusting in places. On the main road, five minutes west of Jupp's, a footpath through the swamp leads past the Pinnacles Mine across the Heazlewood River to the Nickel Hill, where the Lord Brassey and Jupp's nickel workings are situate, on the top of the somewhat conical hill, 700 feet above the river. A mile further west along the main road is the old ore-shed of the Heazlewood Mine. A track here goes south to the Heazlewood and South Heazlewood Mines, Binks' and Jupp's copper shows, the Castray River gold-workings, and the Mount Hope, formerly Mount Stewart, Mine. This track is five miles long, and, in some parts, is in bad condition for packing, besides which, I think, a better route might have been followed, so as to avoid some of the steep gradients. The main road to Corinna continues falling down to the Heazlewood Bridge, which is 800 feet below Jupp's, and 1700 feet below the 7-mile peg. The road here crosses the river at 16 miles from Waratah, and skirts the Bald Hill for three miles further west, as far as the the roadmakers have got with the construction. On my return at the end of March, the men were giving up work for the season. From the creek at this end a path leads to where Major Hughes' party are washing sand for osmiridium, in the Savage River. The Bald Hill, as its name implies, is now bare of trees, excepting a patch at the western end, which covers some basalt. At the 19-mile, the pack-track leaves the Bald Hill serpentine, and enters slate and sandstone country, well-timbered, from which it emerges on to the treeless button-grass table-land known as Long Plain, 1100 feet above the sea. This plain forms the watershed between the Savage River on the one hand, and the Whyte River on the other, and is famous for the quantity of gold obtained from its detrital capping. At 24 miles from Waratah a newly-made track goes northward to the Specimen Reef gold-workings on Hall's Creek, and 100 yards further west are the Bullock's Head and shelter hut. Here a path turns N. across the plain, and in a mile reaches H. H. Gill's sections, formerly Weetman and Crockford's, where a fair quantity of crystallised gold, perhaps 500 to 600 ozs., has been won.

At the western end of this plain the track descends into the wooded, broken country of the valley of the Whyte River, about 14 miles from Corinna. The bridle-track, for a distance, here, was bad. At 12 miles from Corinna, the roadmakers were constructing the road towards Waratah. The way in which the road was being formed was none of the best, and I doubt whether it will stand much traffic. When I was there I heard talk of impending stoppage of the work, owing to exhaustion of the Parliamentary vote. This would leave a gap of 10 miles bridle track between the two ends of the road, and if the intervening distance is not made available for wheeled traffic, the work already done loses much of its usefulness. At present, the consumer at the Corinna end has to pay more for his stores than the one at the Waratah end, notwithstanding that the sea freight to Corinna, from Launceston, is only 30*s.* per ton, against £3 a ton railway freight from Burnie to Waratah. The completion of the road will undoubtedly bring an improvement in this respect. Mines in this remote part of the island, where the cost of living, risks, and conditions, are so unfavourable, deserve every encouragement. If adventurers are ready to accept the risks, their work should be facilitated in every way ; for it is only by continuous prospecting that the mineral resources of these fastnesses can be explored and exploited.

A little over nine miles from Corinna, a cart-track leads to the Cape Copper Mine, on the Nine-mile Creek, and half a mile further south, the main road enters on Brown's Plain—another button-grass table-land, from 750 feet to 900 ft. above sea-level. The plain extends towards Corinna for about 2½ miles. At 7½ miles from Corinna is the mail-hut of the Rocky River Mine, and a track goes east to the mine buildings at the suspension bridge over the Whyte River. Just within six miles from Corinna, wooded country is again met with, and a small patch of Tertiary basalt is seen. After this the road commences to descend, and falls all the way down to Corinna, on the Pieman. The Pieman, at Corinna, is a noble river, about 400 feet wide and 40 feet deep, with a tidal rise of 2½ to 3 feet. About a couple of miles below the township, the river cuts through the Donaldson Range, exposing lofty cliffs on each side. Here the river is 80 feet deep, and not more than 150 feet wide. The Pieman Heads are 11 miles from Corinna, and the river mouth is faced by a bar a mile out at sea. Vessels of 12 feet draught can pass over the bar, but there is danger of going on shore at the sandspit. Corinna has a deserted aspect, owing to the abandonment of the alluvial workings in its vicinity.

From the above it will be seen that, after the descent from the Waratah plateau to the Heazlewood, the country, to within a few miles of Corinna, is, practically, a lofty plain, 800 to 1100 feet above the sea, rising in parts into high hills. Deep and precipitous gorges have been cut in this plain by the Savage, Whyte, and Heazlewood rivers, with their tributary creeks.

General Geology.

The stratified rocks along this traverse belong to different geological systems. At the Mt. Bischoff end are highly inclined and contorted slates of, probably, the lower Silurian, succeeded further west by fossiliferous sandstones of middle Silurian age. The bed-rock further to the west, from Long Plain to Corinna, consists of slate and sandstone, interrupted only by the Whyte and Rocky rivers' belts of schist. The slates and sandstones may be lower Silurian, and the schists still older. No light is thrown upon their age by any discoveries of fossils. The slates and sandstones are a stratified series, and have, as a rule, been subjected to regional metamorphism. The Mt. Bischoff slates are, perhaps, the least altered; and those on the Long Plains, the most so. The Rocky River hornblende gneiss, and schists have been intensely metamorphosed and reconstructed, and they would appear to have originally been eruptive rocks, though any definite genetic theory is at present attended with uncertainty. Long subsequent to the formation of the Rocky River gneiss, I think we may take it that the whole of the lower Silurian (or, to use a term denoting our ignorance of their age, Cambro-Silurian) sediments underwent varying degrees of metamorphism at the close of or after the lower Silurian period, for the middle Silurian sandstones at the Heazlewood, beyond being hard and crystalline, do not bear the marks of severe regional metamorphism. The fossils in the latter have been preserved as tolerably recognisable casts, while all traces of life appear to have been obliterated in the more altered strata of the older date. These older slates and sandstones on the Long Plain, &c., are not only interpenetrated with silica in veins and sheets, but often so saturated with it as to be simply quartz schists, the laminæ being entirely quartzose.

Subsequent to the middle Silurian, basic and ultra-basic eruptions or intrusions took place, penetrating and displacing the buried sedimentary strata, and forming subterranean masses and dykes of gabbro, peridotite, and pyroxenite. There is no evidence that these deep-seated eruptions ever reached the surface, for we see no ancient basalts in this area, unless the diabase porphyrite at the Magnet Mine is regarded as a lava sheet. The gabbros and allied rocks occupy the central part of the field, from 7 miles west of Waratah to the creek at the 19-mile: consequently, with the strata into which they have penetrated, they form a zone 12 miles wide from east to west. This group of rocks has become much serpentinised, the magnesian minerals pyroxene and olivine having been converted into serpentine. The beautiful green and mottled specimens found near Beaconsfield, in the Forth and Dundas districts, are not common here; still, some varieties are pleasing. Bastite, the serpentinous modification of enstatite, is frequently seen in the serpentine derived from pyroxenites and norites. The pyroxenites and peridotites do not form large masses of rock like gabbros, but dykes and marginal modifications of the gabbro bodies. They sometimes have the appearance of traversing masses of serpentine, as well as intruding into sedimentary strata, but they are all of one geological age, and may be interpreted as differentiations and protrusions from the interior of the gabbroid magma before it had consolidated to the core. There may be some slight differences of age, chronologically, between these dykes, but geologically they belong to one and the same eruptive series. Mr. Geo. A. Waller, Lecturer at the Zeehan School of Mines, in writing to me respecting the relations between peridotites and gabbros, quotes Professor Le Conte's Elements of Geology, as follows:—"Speaking generally, it may be said, that in the gradual cooling of such a mass, the first to crystallise are the more basic minerals. These crystallise first in the outlying parts, where cooling is most rapid, and then similar materials continue to accumulate and crystallise there by migration of the more basic materials to the solidifying parts, leaving a more acid remnant in the centre to solidify last." Mr. Waller then proceeds to say:—"As far as my observations have gone, I have always found the peridotite associated with serpentine on the margin of the gabbro. And my theory is, that the serpentine (*i.e.* pure massive serpentine) is an altered peridotite: and that the differentiation theory shows why the peridotite, and, consequently, serpentine, is always found on the margin of the gabbro." It will be interesting to note occurrences throughout the Colony, and observe whether they tend to confirm this theory or otherwise.

Nowhere else in Tasmania is there such a rich assemblage of rock varieties belonging to the basic and ultra-basic division of eruptives, accompanied, too, by numerous lead and silver bearing lodes. Some more extended remarks upon these rocks will doubtless prove acceptable.

The Gabbroid rocks include—
- Gabbro proper (plagioclase + augite).
- Olivine norite (plagioclase + enstatite + olivine).

The Peridotites include—
- Harzburgite (olivine + enstatite).
- Lherzolite (olivine + diallage + enstatite).
- Wehrlite (olivine + diallage).

The Pyroxenites include—
- Diallagite (diallage).
- Websterite (enstatite + diallage).
- Bronzitite (bronzite).
- Websterite-porphyrite (enstatite + diallage).

The Gabbroid group belongs to the basic series of rocks, with 45 to 55 per cent. silica, and the Peridotites and Pyroxenites to the ultra-basic, with only 39 to 45 per cent.

Gabbro.

This rock, which is essentially composed of plagioclase felspar and a pyroxene (monoclinic, as augite or diallage; orthorhombic, as enstatite, bronzite or hypersthene), occupies, in the basic series, taxonomically the same position as granite does in the acid series, *i.e.*, it is the plutonic member of the series. The intrusive members are comprised in the dolerite (diabase) group, and the volcanic ones in the basalts (and melaphyres). Consequently, wherever we see gabbro exposed at surface, we may be sure that a vast amount of denudation has taken place. As the rock is a deep-seated one, and has consolidated under enormous pressure, its texture and structure are granitic: the crystallisation is in large plates, the crystal boundaries being irregular, through the pressure of adjoining crystals. The felspar is always a basic one, generally anorthite (sp. gr. 2·75), sometimes bytownite (sp. gr. 2·71) or labradorite (sp.gr. 2·69).

As the gabbros have very generally succumbed to serpentinisation, it is not easy to find fresh exposures, but the rock can be seen at the side of the road about 14 miles from Waratah, a few hundred paces west of the Heazlewood ore-shed. Going up the Heazlewood River east of the Nickel Hill, a flat occurs at the mouth of a creek coming down from the hills to the west. This delta is strewn with large stones and boulders of basic and ultra-basic rocks, which must have been swept down to their present resting-place by heavy torrential streams. It is a remarkable collection of such rocks as serpentine, gabbro, norite, saussurite, chromic iron ore, &c. The saussuritic gabbro is a particularly handsome rock, in which the felspar has been converted into milk-white saussurite, leaving the dark crystals of pyroxene scattered through its mass. Some of the dykes, too, between the seven and 10 mile pegs on the Waratah-Corinna road, appear to be gabbros.

Peridotites and Pyroxenites.

These are the plutonic ultra-basic rocks, composed either solely of pyroxene (pyroxenites) or of pyroxene combined with olivine and (or) hornblende, as in the peridotites. There are dykes of this series at intervals all along the main road from the 7-mile to the 12-mile. It is not always easy to see what country these dykes are running through, but I could sometimes see that they were bounded by decayed igneous rock with spheroidal or concentric weathering, most likely gabbro, originally. Not infrequently the intrusions are through sandstones and slates. From Jupp's westwards the rock on the road, for about a mile, is amphibolite, afterwards serpentinised bronzite or bastite, and then passes into a more decided serpentine. There is a good deal of pyroxenite W. of the bridge across the Heazlewood River—sometimes pure pyroxene, at other times, a websterite (diallage and bronzite). These rocks and serpentine continue westwards all along the road cut in the side of the Bald Hill, as far as the 19-mile gully, where the serpentine, slightly asbestiform, comes to an end, and is succeeded by dark Silurian slates.

This great mass of ultra-basic rock is intersected by dykes and veins containing silver-lead ore, copper, an nickel ore, and is the home of the osmiridium found in small quantities in the alluvial of the rivers. Chromite, found in the sands of the Heazlewood and Arthur rivers, is also derived from the serpentine, and occurs, too, very plentifully, in the solid rock, but is not abundant enough to form a workable ore. The various occurrences of mineral will be alluded to below in the descriptions of the mines.

Granites and Syenites.

The relative ages of serpentines and granites on the West Coast have never been determined with any degree of certainty, and on my journey I always had this question in mind. The mutual relations between these two groups are not easily seen in the field.

Granitic or quartz porphyry rocks, in the form of elvan dykes, appear at Mount Bischoff, where they are tin-bearing, and occur again at four and five miles from Waratah, as granitite and porphyritic granitite. As far as can be seen they crop up from below the Silurian slates. Further west, at Jupp's, and on the Heazlewood River, east of Nickel Hill, also on the Discoverer section, syenite, granitite, hornblende granite, and hornblende granitite occur in the area of serpentine rocks, where they are evidently intrusive. Intrusions of granitic rock may be seen along the main road near the 14-mile, and penetrating serpentine on the track to the Heazlewood Mine. These occurrences support the inference that the granitic rocks are later than the serpentines, and the indurated, flinty appearance of the serpentine, near its contact with granite, as seen on the section north of the North Silverstream, near Zeehan, and at Trial Harbour, further confirms it. More observations are still required to enable this relation to be established as a general rule throughout the Colony. It may be recommended to those interested in geology to pay especial attention to sections of serpentine and granite contacts, for they often have a bearing on the continuance of lodes across the contact boundaries.

The serpentines are clearly subsequent to the middle Silurian, for they have lifted sandstones of that age, seen above the S. side of the Main road, near the 14-mile from Waratah.

The geological systems represented in this part of the Island, are as follow:—

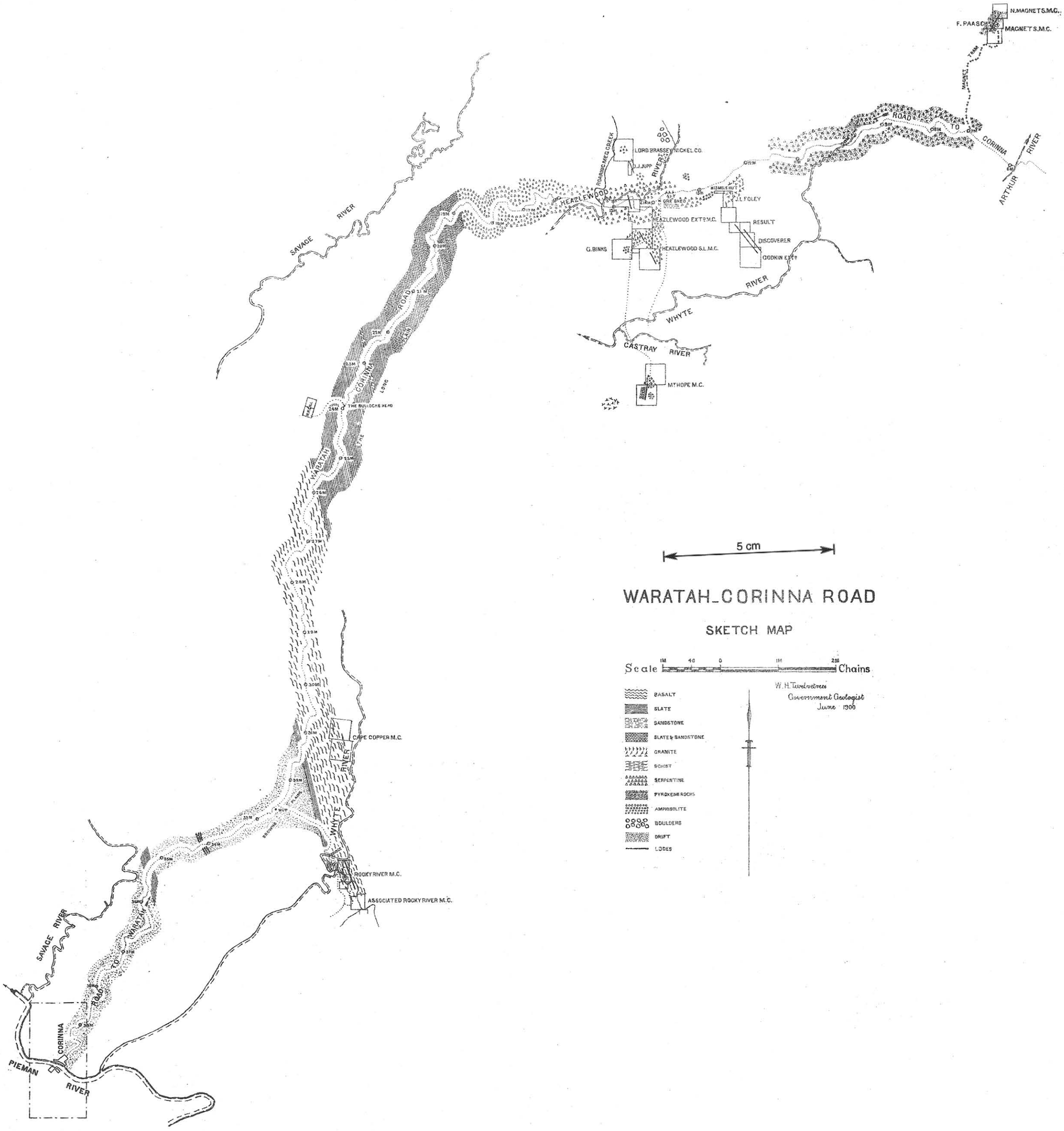
(1.) Pre-Cambrian, doubtfully, at the Rocky and Whyte rivers.

(2.) Silurian slates, and sandstones, everywhere.

(3.) Devonian, gabbroid, and serpentine rocks intrusive into the aforesaid slates and sandstones, and carrying copper, nickel, and silver-lead ores. At a later stage in this period granite and syenite penetrated both slates and serpentine, carrying, in some places, silver-lead, in others, tin-ore.

(4.) Jura-Trias.—The mesozoic dolerite or diabase occurred about a mile N.W. of the Magnet mine, not far from the old track from Waratah. Its structure is identical with that of the same rock in other parts of the Colony.

(5.) Tertiary.—Tertiary sediments occur at Waratah, on the Magnet range, Brown's Plain, and on the fall of the country down to Corinna, and they are all of pre-basaltic age. A good deal of this country was once covered by the coastal sheet of Tertiary basalt. The line of route from Waratah to Corinna was, approximately, its southern fringe, though, on the meridian of Waratah, basaltic country extends further south towards the Pieman. At Waratah, we have a thick capping of this lava at the township, covering up Tertiary sandstones, which contain fossil leaves of the genera eucalyptus, quercus, laurus, and ulmus. About 4 miles from Waratah, on the old track to Corinna,



WARATAH_CORINNA ROAD

SKETCH MAP

Scale 1M 40 0 1M 2M Chains

- BASALT
- SLATE
- SANDSTONE
- SLATE & SANDSTONE
- GRANITE
- SCHIST
- SERPENTINE
- PYROXENE ROCKS
- AMPHIBOLITE
- BOULDERS
- DRIFT
- LODES

W. H. Twelvetrees
Government Geologist
June 1900

SECTION OF DYKE AND LODE

AT THE

MAGNET MINE

LOOKING NORTH

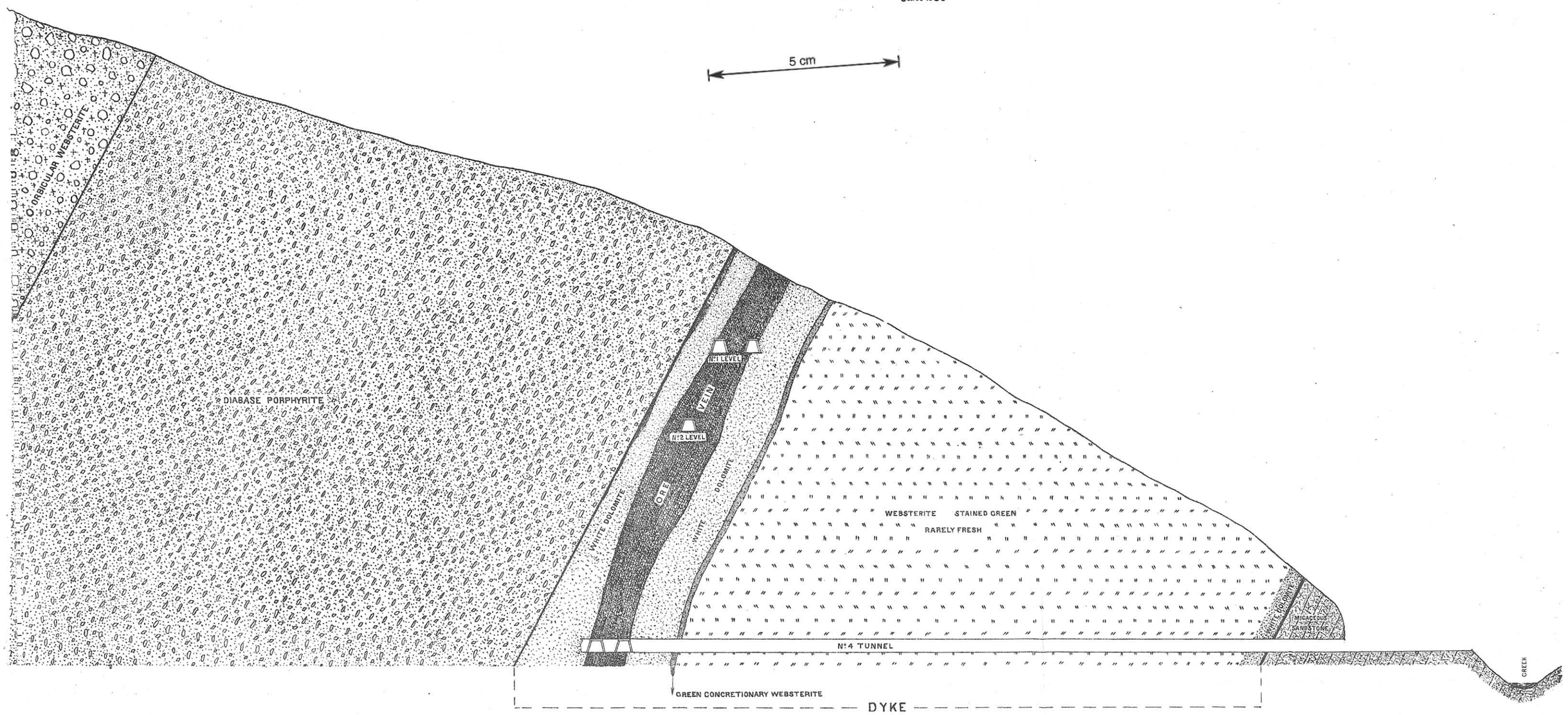
Scale 20 10 0 30 60 90 Feet

W.H. Twelvetrees

Gov! Geologist

June 1900

5 cm



there is a deposit of Tertiary coal overlaid by basalt. It was bored into several years ago, to a depth of 14 feet, but only shaly coal was found, which burns with a bituminous smell, and has a good deal of ash.

On Brown's Plain, the bed-rock has a thin covering of quartz-pebble wash, often cemented into a conglomerate, which, in its turn, has been degraded, resulting in the release of the pebbles. This conglomerate is firmly bound, and might easily be mistaken for a palaeozoic deposit. I could never find the conglomerate itself in contact with the underlying slates which form the bed-rock. I believe, therefore, that the cementation is purely superficial. Among the stones of the wash are some of quartz-tourmaline rock, which must have come from a stanniferous-granite area. The nearest granite which we know of, and the most likely source, all things considered, is that of the Meredith range, on the south side of the Whyte river, but the occurrence of these stones high up above the White, on its north side, is significient of the amount of denudation which has taken place since Tertiary times. There is a similar cement on Long Plain, 300 or 400 feet higher, but on that plain the stones of quartz are angular, not water-worn, and have most likely been derived from the laminæ and lenticles of quartz abounding in and between the slates. It did not appear to me that the quartz detritus seen along the track on Long Plain, was at all water-worn; but directly we came to Brown's Plain the majority of the stones are smoothed or rounded by the action of water. At the west end of Brown's Plain a small patch of Tertiary basalt is cut through by the road. It is not more than 100 feet wide, but is evidently posterior to the quartz-wash. Hence the latter cannot be a recent or later Tertiary deposit, but, may be compared with the infra-basaltic or early Tertiary gravels found in other parts of the Colony. Descending hence to Corinna, the pebbles become larger, and the drift itself looser and heavier, and extensive terraces of a more recent wash prevail. In early tertiary times the sea covered the land here, and subsequent elevation of the land has lifted the pebbly drift to its present height.

I now proceed to refer to the different mines.

Mount Bischoff Tin Mine.

This mine, situate on the slopes of Mount Bischoff, which rises 500 ft. above the Waratah plateau, is too well known to need description. The present company was founded in 1873, nearly two years after the first discovery of tin ore by James ("Philosopher") Smith. The mine has been continuously dividend-paying since 1878, the total dividends paid to date being £1,674,000. The total tin ore obtained to date has been 57,358 tons, value £3,316,528. The output of ore for the past twelve months has been 1945 tons, the average of stuff treated being about two per cent., and the cost of mining, crushing, and dressing, 5*s.* 7*d.* a ton, of stuff. Work is being carried on at the White, Brown, and Slaughter-yard faces, and prospecting on the Queen lode and from the main tunnel. The state of the mine-works is fully described in Mr. Kayser's half-yearly reports, and I need only refer to the geology of this remarkable deposit. Several writers have touched upon this from time to time. *See*

Stanniferous Deposits of Tasmania: Trans. R. S., New South Wales.	S. H. Wintle.	1875.
New York Year-Book of Mineralogy.	G. H. F. Ulrich.	1877.
Quarterly Journal Geological Society.	Chas. Gould.	1875.
Berichte der Niederrheinischen Gesellschaft.	G. von Rath.	1879.
Report on the Waratah Mining District.	G. Thureau.	1884.
Proc. Roy. Soc. Tasmania.	A. von Groddeck.	1885-6
Geology of Tasmania.	R. M. Johnston.	1888.
Jack's Geology of Queensland.	A. W. Clarke.	1892.
Aust. Ass. Ad. Science.	H. W. F. Kayser.	1892.
Proc. Inst. Civil Engineers.	Kayser & Provis.	1895–6.
Catalogue of the Minerals of Tasmania.	W. F. Petterd.	1896.
Introduction to the Study of Mineralogy.	F. M. Krause.	1896.
Proc. Roy. Soc. Tasmania.	Twelvetrees & Petterd.	1897.
Louis Phillips' Ore Deposits.	—	1896.
Zeitschrift der praktischen Geologie.	W. von Fircks.	1900.

The various allusions and descriptions date from different stages in the history of the mine, and it is only of late years that some approach to a comprehension of the nature of the ore-deposit has been made.

In the first place, we must premise that below the Silurian slates there is a hidden granite mass, which is the source of the tin, and which has communicated with the surface by means of intrusive quartz porphyry or elvan dykes. Opinions have differed as to whether the ore-bearing ground is a hot-spring deposit, or the plug of a volcano, or a stockwerk; but microscopical analyses of the ores and rocks have recently thrown great light upon the subject. The aforesaid dykes bound the Brown Face deposit, near the top of the mountain, on three sides, and dip towards the enclosed central area. This underlay suggests that they will form junctions in depth. The central area is fissured slate, and has been worn down into the form of a basin, which has collected the gossanous and stanniferous waste of the dykes and their contained veins for countless ages. The iron of the gossan has, apparently, been derived from the pyrites abundant in the dykes, and trials, 150 feet below the floor of the Brown Face, have shown pyritic veins carrying tin ore underneath the gossan formation of the face. The veins are, no doubt, contemporaneous with the dykes, dykes and veins belonging to one eruptive phase. The ground enclosed by the dykes is fissured by these veins, in which the tin is largely associated with iron pyrites, an association which prevails elsewhere in the district, notably in the North Valley. The Queen lode has the appearance of being subsequent to the quartz porphyry dyke, which it traverses, but still belongs to one and the same series of intrusions. I believe the junction of the dykes in the heart of the mountain is still below the trial drives made underneath the Brown Face. It is impossible to predict exactly what will occur at the intersection, but the normal stanniferous contents of the dykes are likely to improve at that point. We must bear in mind, however, that, while the detrital deposits worked at the three faces average between two and three per cent. of cassiterite, the stanniferous dykes themselves are very much poorer, and a good deal of enrichment would be required for the solid dykes to yield a payable return. The detritus and gossan forming the ore-body of the Red or Brown Face may be described as an immense mass of natural concentrates, which have been worked by the Bischoff Company for over a quarter of a century, and remain still unexhausted. With the lapse of time and continuous work the basin will be emptied of its stanniferous contents, and the solid dykes and veins will constitute the material to which the owners will have to look for their supplies of ore.

Referring briefly to the petrological side of the subject, I may describe the groundmass of the dyke rocks as being granular quartz, sometimes felsitic quartz and felspar, and containing scattered crystals of the same minerals. Magnesian mica has not been found in it, but some secondary white mica occurs. I invite particular attention

to this, for it thus differs, mineralogically, from the nearest granites. The nearest exposure of granite rock is on the road to Corinna, 4 miles from Waratah, where it is strongly porphyritic, with abundant dark mica. Its porphyritic crystals are orthoclase and plagioclase felspars, magnesian mica, and quartz, in a groundmass of orthoclase, quartz, and mica, all three minerals occurring as a second generation. A mile further on the same road, at Wombat Hill, the granite (more strictly, granitite or black mica granite) is composed of the same minerals, with the addition of a little green hornblende. About here, too black tourmaline rock is associated with the granite, and this type of tourmaline is also not met with at Mount Bischoff. It is consequently probable that the Bischoff dykes intersect not only the slates, but also the peripheral portions of the granite directly below them, proceeding from a deeper unconsolidated part of the granitic magma. Such dykes are called, in Cornwall, "elvans," and though excellent authorities have cast discredit on the term, there really does not seem to be any valid objection to its use, so long as we attach to it a definite and well-understood meaning. Rutley uses it very well as a group name,* thus :—

Acid Series (Silica, over 66 %: Orthoclastic Felspars).

Volcanic (Rhyolite Group)—Obsidian, Rhyolite.
Dykes and Sills (Elvan Group).—Felspar porphyry, Quartz porphyry, Micro-Granite, Pegmatite.
Plutonic (Granite Group).—Granite and Granitite.

The elvan dykes have been invaded by fluoric and boric vapours during the consolidation of the rock, and these have topazised and tourmalinised it. The topaz is developed in three forms—columnar, prismatic, and amorphous. The columnar form is in radiating aggregates, and has received the name of pycnite. Both the radiating and prismatic forms prevail in the rock of the Queen lode. The amorphous, or allotriomorphous, variety is developed where topaz has replaced the rock as a whole. The quartz sinter found at Mt. Bischoff has been thought to indicate a derivation from volcanic springs, but this is a misinterpretation, for there is no volcanic rock associated with the stanniferous deposit. The so-called sinter is an aggregate of quartz crystals, which are often coated with a cloudy peripheral zone of pseudomorphous topaz. This topaz effervesces slightly with acid. This exhibits a second conversion, that of topaz into prosopite, a double fluoride of calcium and aluminium.

The tourmaline at Mt. Bischoff is a green variety, and was at one time mistaken for chlorite. Minute rods or needles of this mineral sometimes fill the whole of the interior of crystals of felspar. This proves the secondary nature of the tourmaline.

These observations permit conclusions to be drawn as to the relative ages of the minerals concerned in the composition of the dyke-rock. In many instances, topaz and tourmaline have replaced both porphyritic felspars and the quartzose groundmass. Professor von Fircks infers from his examinations that the tourmaline is of a later date than the topaz and cassiterite, and remarks that he has noticed it contemporaneous with siderite. It is quite clear that we have here a good example of pneumatolytic action, but it is difficult to separate physically the moments of topazisation, tourmalinisation, and final consolidation, for the dyke, as a whole, or in parts, must have retained still some degree of viscosity while this complex process was going on.

* Granites and Greenstones. F. Rutley. Page 12.

The following is a list, drawn up by Mr. W. F. Petterd,* of the minerals known to occur in the Mt. Bischoff dykes:—

Apatite.—Occasionally obtained in small crystals, which can be recognised with unaided vision.
Arsenopyrite.—In considerable abundance in the lower levels.
Arsenic, Native.—As narrow blades and patches between the laminæ of siderite, fluorite, and pyrites in lower level North Valley workings.
Azurite.—In bunches of minute crystals, in the Brown Face, with malachite.
Cassiterite.—Colour invariably intensely black.
Chalcopyrite.—The massive form, only known in limited quantity.
Copiapite.—As an efflorescence in the older adits.
Copper, Native.—As thin foil interbedded in fissures in the slate, adjacent to the elvans.
Cyanosite.—On the roof and sides of adit, North Valley.
Disapore.—In the Stanhope mine, but not abundant, as shining, flattened, and brittle prisms of a yellowish-brown colour.
Fluorite.—Variety chlorophane. Somewhat plentiful, occasionally in irregular masses without distinct crystallisation.
Hematite.—Variety Reddle. The common matrix of the stanniferous portion of the surface workings of the mine.
Limonite.—Also abundant.
Lithomarge.—Commonly soft and unctuous, more or less coloured by ferric oxide.
Malachite.—In thin coatings and patches in gossan at the Brown Face.
Melanterite.—Incrustating in the old adits.
Monazite.—In aggregations of small crystals of a light brown colour, with wolframite in the West Bischoff.
Muscovite.—The unaltered mineral is extremely rare.
Orthoclase.—Can only be distinguished by optical characters.
Pholerite.—Met with in masses in the Stanhope Mine. It is an extremely soft aggregate of mineral scales, with a glimmering lustre.
Pyrolusite.—The earthy variety is commonly intermixed with limonite.
Pycnite.—This form of topaz is one of the most characteristic minerals of the Bischoff elvans.
Pyrites.—Abundant.
Pyrophyllite.—Very plentiful, in aggregated, fibrous, radiating masses.
Prosopite.—On the western side of the surface workings this substance is abundant. It usually forms a kaolin-like friable mass.
Quartz.—Of common occurrence.
Siderite.—In opaque, interbedded, obtuse rhombohedra of large size, of a yellow-brown colour.
Sphalerite.—Rare, in small patches, with pyrites and the last.
Stilphnosiderite.—Occasionally met with as thin, varnish-like incrustations of extreme thinness, and of an intensely black colour.
Sulphur.—A somewhat large pocket was met with in the Brown Face.
Topaz.—This has only been detected of microscopic size.

* Proc. Roy. Soc. Tasmania, 1897, pp. 126-128.

Tourmaline.—Invariably of the peculiar dark-green colour characteristic of Bischoff. It is usually in felted masses of minute crystals, which rarely exceed 18 mm. in length.

Vivianite.—Has been obtained in groups of crystals in small fissures in the rocks in one of the adits, and also in amorphous, clay-like masses.

Wolframite.—In the West Bischoff, intermixed with apatite and quartz.

There are evidences of underground tin sources for some distance from Mt. Bischoff. There is tin ground at the Whyte River, 10 miles from Waratah, and the metal is met with at the foot of the Meredith Range, to the south of Mt. Hope. Alluvial tin ore is found at—

Webster's Workings.

This is a claim covering five 40-acre blocks, five miles out from Waratah on the Corinna Road, and a mile south from the turn-off—first across a small button-grass flat thence through scrub. The sections are situated along a creek, which is considered to be a tributary of the Cold-stream, one of the head streams of the Huskisson. This creek is bordered by flats covered with stanniferous wash from six inches to three feet deep, averaging, perhaps, about two feet, though it has been estimated at 2 ft. 6 inches. The flats altogether are about six chains wide by a mile long. In the creek, the wash, as a rule, is shallow, but in places I could see it was 1½ feet deep. Sundry holes over the flat denote former prospecting. Some of the ground, about a chain in length by half a chain in width, was worked several years ago, and three-quarters of a ton of tin ore is said to have been got out. In Webster's worked ground I saw some narrow veinlets of pure tin ore in the granite, as thin as a knife-blade, up to a quarter of an inch thick, and in the creek some dishes were washed, the prospects from which were afterwards weighed, with the following results :—

From creek.....	2½	ounces per dish.
„ „	¾	ounce „
From old hole	¼	„ „

This would give an average value of from £600 to £700 per acre. I should say the estimate of 1½ ounces to the dish is a conservative one. Mr. Downie took several prospects, which he reports as not less than two ounces to the dish, and, in two instances, even six ounces. The question then becomes one of cost of raising. The bulk of the mineral is a fine-grained grey ore, though in the creek which runs through wash about a chain wide, it is pretty coarse. All the dirt would have to be lifted, as it is too flat to ground-sluice. A track or a tram could be made to connect the claim with the Waratah main road without any difficulty, as the ground rises gently towards that road. The great drawback is the quantity of scrub and fallen timber. The scrub can be got rid of without much trouble, by letting it lie a year or two and then firing it, but the trunks of fallen trees which encumber the ground and creek will be extremely difficult to handle, and will prove a formidable impediment. If these obstacles can be overcome without excessive cost, and further prospecting confirms the results obtained on my visit, the present time would be a favourable one for exploiting this claim.

The bedrock is a fine-grained grey granite with porphyritic felspars, abundant dark mica, and a little muscovite. There is a good deal of loose tourmaline in the wash, often seen enclosed in fragments of reef quartz.

Ten-mile Tin claim at White River Bridge.

This is on a small flat about a mile south-west of Green's *Whyte River Hotel*, and is reached by walking along the old Godkin tramway. The Whyte River lies to the N.W. of it, and it is bounded on the S.E. by a high hill ridge on the top of which the Khaki adventurers have commenced prospecting some stanniferous veins since my visit. The tin-bearing ground at the foot of the hill is about 500 yards wide, and seems to run up the slope a little, but gives out to the west, for tin is never found in the river. It was worked recently by the Whyte River Tin Mining Company, but a lot of their ore was lost by allowing the stanniferous clay to ball and roll down the race, collecting tin as it went. I saw many of these clay balls: it is evident the ground cannot be worked without puddling. As a tin show, the claim has peculiar features. The material is not alluvial, but a yellow clay formed *in sitú* by the decomposition of the bedrock, which is serpentine (?). In places there are ten feet of this clay, resting upon rotten serpentine rock, and up the hill-side as much as 14 feet are said to have been passed through without bottoming, but the average depth on the flat is from one and a half to two feet. The included stones are angular, not water-worn, and the tin is crystalline, with the angles very slightly smoothed, and adhering often to sharp vein quartz. The tin ore has not been brought from a distance; on the other hand, no tin has been observed in any of the numerous quartz veins which intersect the bedrock. Several large, loose lumps of lode quartz, very rich in tin, have been found, and this fact indicates the existence of a tin lode near by, but up to the present it has been searched for fruitlessly. No outcrop is visible anywhere, and from this I infer that its discovery will be difficult, for it has most likely been planed down by denudation to the level of the bedrock, and it will not be found until the latter is exposed at the proper place. The presumption that such a lode exists in the neighbourhood is next to a certainty, and ought to incite systematic search for it, as the quality of the fragmental veinstuff leaves nothing to be desired. Serpentine is an unusual rock for tin-ore veins, and the bedrock, though looking decidedly serpentinous, should be carefully examined to establish its nature definitely. At any rate, the veins have proceeded from adjacent granite, and higher up the hill are Silurian clays and sandstones. Granite rock is not seen at surface nearer than the Magnet and Meredith Ranges, the nearest, half a mile off. In this ground excellent prospects are obtained from the grass-roots, and a few dishes were washed on my visit. Perhaps the whole flat would average half an ounce to one ounce per dish. Water for working can be brought from the Whyte River by going one and a half miles further up-stream. The deposit is not of any magnitude, but a few men, either on tribute, or working on their own account, might do fairly well. Leaving the tin deposits, which are so intimately connected with granite, we come to a series of mines whose ores are associated with ultra basic rocks and the serpentine derived therefrom. Though they are not far from granite rocks, the fissures or ore-channels are devoid of free silica, but filled with ultra-basic dyke-matter which can have come only from similar rock magma. Such mines are the Magnet, Confidence, Washington Hay, and certain mines of the Heazlewood group.

A little before reaching the turn-off to the Magnet, a strong lode crops out on the south side of the road, carrying a little pyrites. This will most likely be a silver-lead lode, though there is no distinctive mineral noticeable in the outcrop. Though this lode is barren at surface it,

might very well be prospected, traversing, as it does, a known mineral district.

The Magnet Silver-lead Mine.

This mine owns two sections, four miles west of Waratah, as the crow flies—Nos. 3705-87M., 20 acres, and 2075-91M., 40 acres. The mine works are on the 20-acre block, and are proceeding principally in the direction of the 40 acres. The property can be reached from Waratah by the old track to Corinna, in about six and a half miles, if a little rough walking is not objected to, but the most convenient approach is by the macadamised Waratah-Corinna road, to near the 7-mile peg, and thence by the company's tram-line, two and a half miles in length, which leads into the mine. The company is now having a route surveyed for a steam tramway to connect with the Emu Bay railway line a little below Waratah, in about eleven miles from the mine. The proprietors have hitherto been consigning their first-class argentiferous lead ores only, maintaining the standard contents at about 90 ounces silver, and 25 per cent. of lead, per ton. The ores shipped have also carried about one and three-quarter dwts. of gold per ton. The declared policy of the company is to extend the scale of operations by sending to market the large quantities of gossan ores which have been disclosed by the workings, but left untouched, so far, for economic reasons. An alternative which has been put forward is to smelt the total produce on the spot. In view of the risks and losses so often attendant on the inception of metallurgical works, this alternative is not to be recommended. The new tramway is intended to provide the means of conveying the increased output economically to the railway line. The gossan ores, from their fluxing properties, are in favour with lead-smelters, and when the proposed tramway is completed the company anticipate being in a position to maintain a large regular output of ore, increasing up to 1000 tons per month.

The position of the mine is on the south-eastern slope of a part of the Magnet Range, which itself is a continuation of the Meredith Range. The Waratah-Corinna Road passes over a saddle between the two at the 7-mile. The Magnet Range is not a geological unit, the result of upthrow, for it consists of widely-different rocks, slate, sandstone, diabase, pyroxenites, &c. It is only a geographical feature of the landscape, due to long-continued denudation, combined with the progressive elevation of the land which the northern part of Tasmania has undergone since middle Tertiary times.

The geological formations represented on the range may be stated as follow, in descending order.—

Recent.—Alluvial with waterworn tin, on North Magnet section.

Tertiary.—Basalt, along the old Waratah track, half a mile from the mine. A vesicular olivine basalt, similar to that at Waratah.

Brown coal, on the old track, two miles from Magnet Mine. Underlies the basalt.

Mesozoic.—Dolerite (diabase), north of the old track, a mile from the mine.

Devonian.—Granite.

Websterite-porphyrite, the Magnet dyke. Much dolomitised.

Orbicular or spheroidal Websterite } hanging-wall
Diabase porphyrite = variolite } side of dyke.

Silurian.—Micaceous sandstone, on foot-wall of dyke.

Slate, west of dyke.

Quartzites, on tram-line south of mine.

It is quite possible that some of these references cannot be sustained with absolute certainty. The granites in different parts of the Colony are assigned to the Devonian, chiefly on the evidence of granite intrusive in the upper Silurian, at Middlesex. Granite rock, in the form of a spherulitic felsite dyke, traverses the middle Silurian, at Zeehan. Nowhere in the Island does it penetrate Permo-Carboniferous strata: on the contrary, erratics are enclosed in the lower beds of that system. Its range is consequently confined to the time between the Permo-Carboniferous and Upper Silurian. I have placed it as the youngest member of the Devonian, because, elsewhere, we have reason to believe it intrusive into the serpentine and pyroxenite rocks. Whether the gabbros and pyroxenites are Lower Devonians or uppermost Silurian cannot yet be settled. At present we can only conclude that they are younger than Middle Silurian, for in the section beyond the 13-mile, on the road through the Heazlewood, the serpentine impinges upon, and raises fossiliferous sandstone of that age.

The great feature on the Magnet property is the wide dyke of eruptive rock (porphyritic websterite), enclosing the lode or veins of argentiferous galena. This runs through the Magnet ground, with a mean bearing of N. 26° E. It continues into the North Magnet section till it is lost under Silurian strata, half a mile north of the North Magnet Mine. It has not been seen further in that direction, and has either come to an end there, for dykes do not continue indefinitely, or has been faulted, or for some reason has not reached the surface beyond that point. In the other direction it has been traced southwards as far as the Magnet Proprietary section, where a shaft has been sunk over 60 feet deep on its gossanous outcrop. The stuff on the heap at mouth of shaft consists of slate and greenish eruptive rock. From the yellow websterite rock, a few yards north of the track, I infer that the shaft is on or near the dyke-line, and I do not understand why the Proprietary people do not prospect their ground.

The dyke on the Magnet section is 360 feet wide, and courses, for the most part, along a line of contact, being bounded on the east by micaceous sandstone of Silurian age, and on the west by a dark amygdaloidal and nodular variolite. The relations of this variolite are ill-understood. It apparently constitutes the selvage of a band of diabase-porphyrite, the only felspathic rock in this igneous complex. The dyke does not always keep to the contact boundary, for it is separated towards the south from the variolite by a seam of slaty pug of variable width. This comes in from the south like a wedge, gradually widening out in that direction. I think this arises from the dyke being bounded there on the the west by slate country, as is seen very well on the surface coming down the hill from Pasch's trench, where we have slate on the west side, and sandstone on the east side, of the dyke. The sandstone is decidedly hardened by contact with the intrusive rock. The dyke-rock, in its freshest parts, is dark green in colour, compact and tough, with porphyritic crystals of pyroxene (enstatite and augite). For its absolute determination a specimen was sent to Prof. H. Rosenbusch, at Heidelberg the greatest living authority in petrology, and he has, after microscopical examination, pronounced it to be websterite-porphyrite, *i.e.*, porphyritic websterite, a pyroxenite composed of the two varieties of pyroxene enstatite. His determination of this exceptional rock is so valuable that I quote his remarks :—

"If we follow the rock back to its original and unaltered state, we shall find phenocrysts of bronzite or enstatite (now bastite) in a groundmass of rhombic and monoclinic pyroxenes (now a mixture of serpentine and a chlorite mineral). It is therefore a porphyritic form of

websterite—a websterite-porphyry. Its nearest relations are certain bronzite serpentines (without olivine). In the structure of the groundmass it resembles the South African kimberlite and the mica-peridotites of Kentucky, described by Diller. In this purity of form the type is quite new to me. An analysis is very desirable It must, free of water, give the formula of the Mg—Fe metasilicates, and exclude orthosilicates. Al_2O_3 would only be present in small quantity. Also, CaO would not be prominent."

The dyke has undergone very general decomposition, being partly dolomitised, and contains a good deal of calcite as well. It is stained pale green over considerable areas. This colour has been ascertained to be due both to chromium and nickel. In parts of the dyke, particularly near the hanging and foot walls, the rock has been altered into purely white crystalline dolomite. Mr. F. O. Hill, Assayer at the Hercules Mine, has made an analysis of this dolomite, with the following result:—

	per cent.			per cent.
Ca O	31·72	=	$CaCO_3$	56·64
Mg O.....	15·60	=	$MgCO_3$	32·76
Fe	3·92	=	$FeCO_3$	8·26
Mn	1·80	=	$MnCO_3$.....	3·76
				101·42

Mr. W. A. Macleod, B.Sc., B.A., has also carried out an analysis of the same rock, with similar results.

The dyke is ore-bearing near its hanging-wall. The footwall portion has not been thoroughly explored. The upper part is oxidised, being a ferro-manganese gossan, containing lead carbonate, sulphate and chromate, with some galena, and good values in silver. 0·03 per cent. arsenious acid has been found in the gossan, and it also shows antimony oxide, derived from the jamesonite (sulphide of antimony and lead) present in the sulphide ore. The sulphates, carbonates, and chromate are sure indicators of the primary lead sulphide beneath. Mr. Alexander Orr, F.C.S., of Sydney, has made the following analysis of a sample of the Magnet gossan:—

	Per cent.
Silica	12·00
Oxide of iron	44·80
Carbonate of lime	1·50
Carbonate of magnesia	·80
Oxide of manganese	17·80
Carbonate of lead*...	14·67
Sulphur	·22
Copper.....	Nil.
Alumina	6·50
Moisture	1·20
	99·49

Silver, 34 ounces.

The western or hanging-wall portion of the dyke is conveniently described as the lode proper. There are two periods represented. There was an igneous eruption or intrusion when the molten dyke-material burst through the adjacent rock, and a hydrothermal period when the dyke rock was traversed and permeated with metalliferous solutions. The process of deposit has been partly one of precipitation in small fissures; partly one of substitution, as in the concretionary and ring ores. Thus, we have within the dyke a hanging-wall and a foot-wall of the lode proper, and this is what is meant by those terms in the mine reports. The lode has been driven upon by 4 levels:—

No. 1 upper level.....	259 feet
No. 2 level.....	420 „
Intermediate level	353 „
No. 4 level	310 „

The No 4. is 225 feet from surface, on the underlay, and a lower level, 90 feet vertical below No. 4, will be opened out as soon as the tunnel now being driven from the North Magnet section gives access to the lode. The width of the lode in the different levels varies from 5 feet to 31 feet, and is estimated by the manager to average 18 feet. The shoot of ore at the level of No. 2 is 360 feet long: there is a block of ground to stope above this level of, roughly, 200 feet by 80 feet, and new developments have, I understand, taken place since my visit. The intermediate level is 60 feet below this, with good gossan ore in the north drive, and poorer ore in drive S. The bottom level has opened access to a 115-feet by 320-feet block of ground for stoping. Where the No. 4 tunnel intersected the lode, the ore is beautifully banded with carbonate of iron, affording, perhaps, the most striking illustrations of this structure to be found in the Colony. From just behind the south end in this level, the lode-matter was sampled recently, in bulk, and averaged, for a width of 20 feet, 58 ozs. silver, 10 per cent. lead. Further back, the sampling bulked 60 ozs. silver and 16 per cent. lead. The end is gossany, and has small galena veins running through it. The north drive had been suspended at 160 feet from the flat sheet, under the impression that a slide had occurred, cutting off the lode, and a cross-cut W. had been put in behind the face, but I could see no evidence of any fault here. The ore certainly gives out, and is succeeded suddenly by white dolomite, as in No. 2, but, at the most, all that can be said is that the ore-shoot ceases in this direction, and the drive has not been carried far enough to enable even that to be said with safety. I should recommend this drive to be continued. It is desirable that both N. and S. ends should be driven, so as to establish the true length of the ore-shoot at this depth. The upper level (No. 2) has proved the shoot for a longer distance than this (No. 4), and it is highly improbable that the present length of No. 4 is the measure of the shoot of metal, for the ore pitches south, and we may thus expect its S. limit in the lower levels to be further south than in the upper ones. It will take over 300 feet of driving in each direction to bring the respective ends to the boundaries of the section.

The secondary ores, which predominated in the higher levels, and which are derived from the decomposition of sulphide ore, are giving way to the latter as a depth is attained at which the agencies of decomposition do not operate so freely. Metalliferous gossan, however, is still descending at No. 4 level, and has assayed up to 160 ozs. silver for 40 per cent. lead. The ratio of silver to lead in the Magnet is singularly constant, being 3 to 4 of silver to 1 unit of lead. This is a higher ratio than in any other mine in the Colony. The ratio of the Zeehan field is one or two of silver to the unit of lead. In all probability the deep level from the North Magnet property will show the lode at that horizon to contain a good deal more sulphide than gossan, and once the horizon, vaguely called the water-level, is reached, the deeper zone of purely sulphidic ore will be entered. If the change is not met with in the lower tunnel, it may be looked upon as impending shortly below that. The fine body of gossan which exists in this mine, as much as 29 feet in width in No. 1 level (south), and perhaps wider, shows the oxidising action to have taken place to a remarkable extent. It has been thought that

* Lead, 12·38 per cent.

the water of the creek to the west of the dyke has played an important part in the formation of this gossan, and certainly, if any quantity of water from that source has been percolating for ages into the lode, it would contribute largely to the manufacture of gossan, and, in a minor degree, to the decomposition of the dyke-rock. This decomposition, however, and the transformation into dolomite, is mainly associated with the access of the ore-bearing solutions. In the dolomitic part of No. 4 are curious wires and curved threads of native silver, resulting, probably, from the alteration of sulphide or arsenide.

I have been continually asked what I think of the prospects of this mine in depth, but it is impossible for anyone to predict the behaviour of the lode beyond the limits of observation. The low level from the North Magnet will set the question at rest, as far as the additional 90 feet are concerned. I see no reason why the present shoot of ore should not go down to that depth—a total of 320 feet vertical from the surface outcrop. If it continue down further than that, it will have a very fair length for an uninterrupted shoot of silver-lead ore, and it will probably be accompanied by a correspondingly long extension horizontally. There is no known physical cause to prevent its descent to an extreme depth, but that would be exceptional. If, however, the present size and quality of the ore-shoot are maintained for another 100 feet in depth, it would mean an addition of at least 50 per cent. to the present reserves.

The dyke on its W. or hanging-wall side is bounded by a dark nodular variolite merging into vesicular diabase-porphyrite. The exact relation of this rock to the dyke has not yet been settled. It is the only felspathic rock in the complex, and may turn out to be a later intrusion along the dyke-line. This rock has also been submitted to Professor Rosenbusch, who admits that it is a difficult one to determine. He writes:—

"If a slide be made of the soft dark-green groundmass (which is soft enough to be scratched with a knife), it can be seen to consist of a scaly aggregate, the scales of which can often be recognised as chlorite, with very weak double refraction, and optically positive: optic axial angle very small. Pleochroism weak, normal = green for rays vibrating parallel with the surface of the flake, yellowish-white for those vibrating perpendicular thereto. In it are lying colourless sections, variously bounded, but always with crystallographic contours, long, rectangular, and prismatic, also nearly quadratic, extinguishing sometimes straight, sometimes oblique. In convergent light these often show the emergence of a positive bisectrix of a not very large axial angle, sometimes the emergence of a negative bisectrix of a very large axial angle. In the first case, no structure is recognised; in the second, a more or less scaly or fibrous structure. Their refractive index differs very little from that of the main mass, and there are often seen lying in these apparent crystals green heaps of scales without any clear boundaries, but passing into the colourless substance and having the same optic orientation. In the colourless sections there are also lying homogeneous and homoaxial pseudomorphoses of chlorite, poor in Fe (Leuchtenbergite) after a pyroxene mineral, but I cannot say whether the latter was monoclinic or orthorhombic. Further, in the green mass, there are circular hollow spots (nearly always surrounded by cracks), which were no doubt originally amygdaloidal cavities, but are now filled with mixed chloritic and quartz spherulites of irregular architecture. It is quartz (optically + and uniaxial), not chalcedony (optically − and biaxial). Finally, in the groundmass, are little aggregations of iron ore, which I have not examined more closely. They dissolve easily in HCl, which also strongly attacks the chlorite and leuchtenbergite. Now, if a slice be made through the nodules, which are much harder than the groundmass, and sometimes cannot be scratched with the knife, here and there chloritic spots are seen, containing small sections of chalcedony amygdules. Inside the nodules is sometimes some groundmass. More frequently, however, the nodules consist of colourless substances. Large aggregates of granular, or even radiating, quartz are seen, sometimes without any regular external boundary, sometimes plainly, and, without doubt, showing the form of felspar. These are replacement metamorphoses of quartz after felspar, of such beauty as I only know in quartz porphyries. Between these pseudomorphoses of quartz after felspar there are roughly-radiate bundles and spherulitic crystals of felspar, which, from their optical behaviour, clearly belong to orthoclase or andesine. They are partly converted into sericite, and, when this happens the nodules can be scratched with a knife. Finally, the nodules are much intersected by veins of quartz, the filling of cracks in the rock. Iron ores are absent; but, from the often quadratic and trigonal outlines of the quartz aggregates, I believe we must conclude that the ores have been removed and their place taken by quartz. After all said and done, I regard the rock as a characteristic variolite, but certainly in a much-altered state."

This variolite and diabase porphyrite rock, traversed by veins of quartz, exists as a band, about 300 feet wide, and is succeeded further west by a yellow-brown soft bronzitite or websterite, crowded often with spheres of the same mineralogical constitution, ranging from the size of marbles to that of cannon-balls. These spheres, when broken across, show no concretionary or radial structure, but are exactly similar in apparent texture and architecture to the enclosing rock, from which they are easily released. Pending complete microscopical examination, the rock may be called orbicular or spheroidal websterite or bronzitite—in any case, a pyroxenite.

Mr. W. F. Petterd has supplied me with the following list of minerals met with at the Magnet Mine:—

Anglesite.—In large crystals; some very fine.
Jamesonite.—Occurs in small patches with the galena.
Galena.—Usually with a little antimony.
Cerussite.—Good macled crystals often met with.
Pyromorphite.—Small groups.
Calcite.—Milk-white amorphous patches in dolomite.
Cassiterite.—In alluvial, at North Magnet.
Crocoisite.
Dolomite.—In the websterite dyke.
Limonite.—Plentiful in upper levels.
Massicot.—Abundant.
Minium.—With the last.
Mimetite.—In small brown crystals.
Native Silver.—In hair-like bunches.
Sphalerite.—Amorphous; not plentiful.
Antimonial Silver.—Species. (?)
Endlichite.—Minute hexagonal prisms.
Vanadinite.—Prismatic; colour, bright yellow-red.
Bindheimite.—Pulverulent; plentiful.
Stibnite.—Occurs as a gangue mineral.
Psilomelane.—Found associated with limonite and bindheimite.

The total output of the mine, sold to date, has been 1761 tons 3 cwts. 0 qrs. 2 lbs. silver-lead ore, realising, after all deductions, £20,628 1*s.* 4*d.*

The mine, as it stands at present, has the promise of a bright career. The work done has proved the shoot of ore for 400 feet horizontal length, and at least 230 feet deep. The shoot is still going down, and its length, also,

is not yet definitely proved. Judging from its horizontal extension, there is a justifiable expectation of continuance in depth. At the time of my visit, the blocks of veinstuff, which it was anticipated could be profitably worked, supposing easy means of transport into Waratah, aggregated, according to my calculations, 1,080,000 cubic feet. Allowing 25 per cent. for cavities and other deficiencies in the mass, this represents 50,000 tons ore-stuff; and I am informed that, since my visit, the developments in the mine have been such as to warrant a present estimate of 60,000 tons of such ore. The bulk value of this ore has been arrived at to the satisfaction of the owners by systematic sampling and assaying. They claim that the 60,000 tons average 32 ozs. silver, 12 per cent. lead, 1dwt. gold per ton; assay value, at present prices, £5 18*s.* per ton. They are doing well, however, in negotiating with the New South Wales smelters, to base their calculations on 30 ozs. silver and 10 per cent. lead, in order to keep within the limit of safety. Besides these 60,000 tons of marketable ore, there are large quantities of lower grade vein-stuff, estimated at 40,000 tons and upwards, which will not pay to work for export. This is said to vary from 1 to 7 per cent. lead, and 5 to 15 ozs. silver per ton. Besides these 40,000 tons of low-grade ore-stuff, there are large quantities of oxidised material of a still lower grade, viz., below 10 ozs. silver, and below 5 per cent. lead.

These latter quantities cannot be estimated, even approximately, and I do not think they ought to be taken into account at all, because, even if mixed with richer ores and smelted on the spot, they would reduce the profit to less than that expected on the 60,000 tons, which it is now intended to send away for treatment. My opinion is that it will be safer for the company to stick to the present idea, and sell all ore of the 60,000 tons grade, which, once the tramway is finished, ought to realise, at present prices, a profit of certainly over 35*s.* a ton. The low-grade stuff is not available as an asset at present. It could only be utilised in the event of the erection of smelters, which I would strongly deprecate before this mine grows into a much larger concern, and other shows are developed at the 10-mile into permanent mines. When the mine works descend into the purely sulphide zone, concentrating works may be thought of. The oxidised ores, as a whole, cannot be advantageously concentrated, being soft, friable, and having a low specific gravity. The concentration of this class of ore would result in excessive loss of silver. It would involve a preliminary process for leaching out the silver in the wet ores, and leaching the tailings of the dry ores. The loss of silver in dressing is conditioned largely by the nature of the ore, being disproportionately large in light and brittle ores. The sulphide ore of this mine, with a carbonate of iron and dolomitic gangue, is well adapted for concentration, but as the proposed steam tramway will enable the company to get both sulphidic and oxidised ores away at a profit, there seems little doubt that the rational policy would be to export the whole output for smelting on the other side of the straits—at any rate, for the present.

North Magnet Mine.

This mine has its works on a forty-acre section, south and adjoining the Magnet. The line of dyke from the Magnet comes into the section, and is marked by a course of gossan several chains in length. The dyke runs for half a mile north, but has not been traced north of the section. The bottom tunnel in this mine is designed to allow a drive to be put in south on the course of the dyke, and continued into the Magnet property 90 feet below the No. 4 low level in that mine. When I was there this tunnel, a wide one, for a double line of rails, had been driven 174 feet, and it was estimated that another 300 feet would bring it to the intersection of the lode. The driving since has brought it to within 80 feet. The approach to tunnel is through 75 feet of soil, and the adit is then in the footwall country of grey sedimentary grit, with carbonaceous matter, and carrying veinlets of pyrites. The drive on the lode, when the latter is reached, will pass through the south boundary of the section in about 5 chains. There is gossan above all along this line, assaying 3 to 12 ozs. silver, and 2 per cent, to 10 per cent. lead. Carbonates descend 40 feet from surface. There are surface exposures of both lead, carbonate, and sulphide near the southern boundary.

One hundred and eighty-six feet above the low adit, an upper tunnel (No. 1) has been driven into the hill about 360 feet. The first 200 feet were through sandstone, after which the websterite dyke was cut through as far as 76 feet, the last 16 feet of which were in white dolomite. The reef is bounded on the west by diabase porphyrite. Its hanging-wall is slickensided, and divided from the porphyrite by 2 feet of pug. A drive goes 64 feet south on the slickenside, carrying 14 feet of gossan in the far end, but no sulphide ore: this is 94 feet vertical from surface. The quality of the gossan is the best met with, so far, on the North Magnet, but does not exceed 9 per cent. lead and 12 ozs. silver. There are surface signs of better gossan ahead: the gossan on this line appears to pinch going North, and opens out towards the South. There is a chance that ore may be found in continuing the main drive into the Magnet property.

Gregory's Galena Mine.

This is a small show nearly a mile west of the Whyte River Bridge, and situate on the main road. The country rock appears serpentinous. The outcrop, where it has been cut into, shows well-defined walls 4 to 5 feet apart, and the veinstone is quartz with disseminated galena. This cut is an open drive for 14 feet on the course of the lode, which bears east of north. The quartz capping carries some blende, but the ore is free from blende lower down. The lode was cut in the tunnel below the road, but the ore was bunchy. Lead carbonate is present, and the galena is banded with carbonate of iron. To develop the mine a tunnel should be put in where the lode crosses the road, then drive on its course.

Between the Magnet ore-shed and the Whyte River Bridge a number of gabbro and pyroxenite dykes cross the road cutting through slates, sandstone, and basic, igneous rock; a good deal of the latter is in an advanced state of decomposition, weathering concentrically.

Confidence Mine.

This is on a 40-acre section, 671-93M, formerly the Washington Extended, now called the Confidence, and held by H. P. M'Creery. It is situate on the Whyte River, two miles south-west of the hotel, and can be reached by walking along the old Godkin tramway. The lode which has been operated upon is a silver-lead ore, running in an eruptive dyke of a basic or ultra-basic nature, and thus presents similar features to other lodes in this district. The ore gangue is the green nickel-stained rock of the

dyke, carrying a good deal of calcite. The lode has been attacked by three tunnels—upper, lower, and intermediate, and the Godkin tramway goes past the mine below the latter tunnel. The greatest width of dyke is 75 feet.

The upper or No. 1 tunnel has been driven eastward into the hill, and intersected the lode at 200 feet. The gossan outside the entrance to the tunnel is considered worth 40 to 60 ozs. silver; it contains too much iron to dress easily. 21 lbs. of galena, mixed with an equal weight of gossan, were sent to the Queensland Smelting Company, who bought the mixture on the following assay :—171 ozs. silver, and 45 per cent. lead. The galena by itself assayed 252 ozs. silver, and 52 per cent lead. A parcel of a ton of seconds sent to the same company assayed 107 ozs. silver, 25 per cent. lead. The lode has been driven upon north and south. The south drive is a short one, and has no metal in the end. The north drive has followed the lode a little east of north for 157 feet. At 30 feet a rise 60 feet to surface gave some good ore, and underfoot there is said to have been 1 foot to 15 inches galena, when last seen. A seam of galena 2 inches to 8 inches wide was found along the footwall at about 120 feet in the drive, also going underfoot. Remnants of galena are seen on wall; this is 90 feet from surface. The lode has split, and the wrong branch apparently followed. The eastern leg has not been followed at all. Just at the split a shaft was begun and 6 tons of ore raised, which is reported to have returned 94 ozs. of silver per ton, but the water was found too heavy, and sinking was suspended.

Since my visit Mr. M'Creery tells me that further work has resulted in proving several inches of galena underfoot on the hanging-wall for 85 feet—nearly all the way from the flat sheet to the winze. In some places he says there is 6 inches to 8 inches of galena, and 1 inch to 3 inches of pug, the latter assaying 112 ozs. silver, and 13 per cent. lead. Samples of galena and pug assayed by Mr. Ward, GovernmentAnalyst, gave respectively—lead, 43 per cent, silver, 106 ozs., 19 dwts., 16 grs.; and lead, 8 per cent., silver, 95 ozs., 7 dwts., 17 grs.

The intermediate tunnel is 40 feet below No. 1, and was driven 187 feet, cutting the lode and continuing across it. There the dyke was found dipping W., and contains a little galena. The rock is hard and massive,—to all appearance, unfavourable for metal. The dyke here is 8 to 10 feet wide. It has just been tested a little towards the N., but with no result. As the ore pitches N., about 150 feet more driving would bring the drive under Thorne's winze, as well as under shoots of metal at surface. The country in this tunnel seems to be serpentine, the lode-matter gossanous, with a little galena and carbonate of iron.

The lower tunnel, No. 2, is 40 feet above the Whyte River, and 60 feet below the intermediate one. It has been driven N.E., and the lode met with at 160 feet in. Some doubt has been expressed as to whether the dyke has been quite cut through in the tunnel; but it appeared to me that the serpentine country had been reached on the other side. After driving 80 feet N., the lode widened, and the drive was continued along the hanging-wall for 100 feet, with splashes of galena now and then, mostly on footwall. Since my visit, the drive has been extended 30 feet: the lode is wider, but not yet payable. The end was striped with dolomite, hanging-wall ragged, foot-wall smooth and puggy. Some distance behind the end, a wall goes off to the E. Up to here, the former workers followed the hanging-wall, but at the split of the lode they crossed the level, and drove on the foot-wall. A mistake has been made in not putting in crosscuts: though the dyke is only 10 feet wide where first intersected, its width is known to be variable, and there is no guarantee that all veins in it have been followed in the drive. No crosscutting has been done for the last hundred feet, and lode-stuff may very well exist alongside: indeed, the water coming through where the lode was first cut in the tunnel suggests this.

Authentic records show that several years ago three tons of ore from here were treated at the Dry Creek Smelting Works, and returned 144 ounces silver and 48 per cent. lead per ton. Picked samples gave a higher assay. In 1892 three tons were sold to the Queensland Smelting Works, for 98 ozs. silver and 37 per cent. lead.

The ore is galena, with accessory lead sulphate and carbonate (anglesite and cerussite). Associated with it are zinc blende and siderite. The gossan is ferro-manganese.

Washington Hay Mine.

This silver-lead mine is north of the Confidence, but I am not sure whether it is on the same line of dyke as that mine. The dyke-matter is similar, stained green with nickel and chromium, with secondary deposition of dolomite and calcite. I regret that it was too late in the day for me to make a proper examination of this mine. I saw blocks of good dressing ore, as well as clean galena, lying outside the mine. About 50 tons are said to have been sent away from the Confidence, and 20 tons from the Hay; but both these properties have been abandoned for some time. However, ore has been shown to exist here; and this, together with the encouraging nature of the ore-channel, ought to induce further prospecting. As at the Magnet, the dykes here have proceeded from a gabbroid, not a granitic, source.

On my way to these mines from the Whyte River bridge, I noticed a formation crossing the tramway and consisting apparently of altered country rock, with manganese oxide. This is about 15 feet wide, and deserves some attention.

Result Mine. (Formerly Bell's Reward.)

At the 13-mile, Heazlewood, there is a line of lode running N.W.-S.E. through the result, Discoverer, and Godkin sections. The Result sections comprise a 40-acre, 3925-93M, and a 20-acre block, 3952-93M, about half a mile south of Jupp's. The mine used to be known as the Bell's Reward, and the workings are on the 20-acre section. The main adit has been driven about 500 feet S.W. to cut the Godkin Extended lode-line, which bears N.W.-S.E. The roof has fallen in, and I, consequently, could not enter the tunnel, but Mr. W. R. Bell described to me the ground passed through in driving, and his description enables me to form some idea of what really has been done. The adit entrance is in soft slate, and the strata then traversed are as follow :—

Limestone, barren	about	130	feet
Soft slate	„	25	„
Sandstone, with chloride of silver	„	15	„
Sandstone	„	7	„
Ferro-manganese gossan	„	24	„
Limestone, charged with galena and blende	„	130	„
Quartzite and hornblendic rock	„	169	„
	„	500	feet

In this series the gossan is the representative of the lode, and the limestone has been impregnated therefrom.

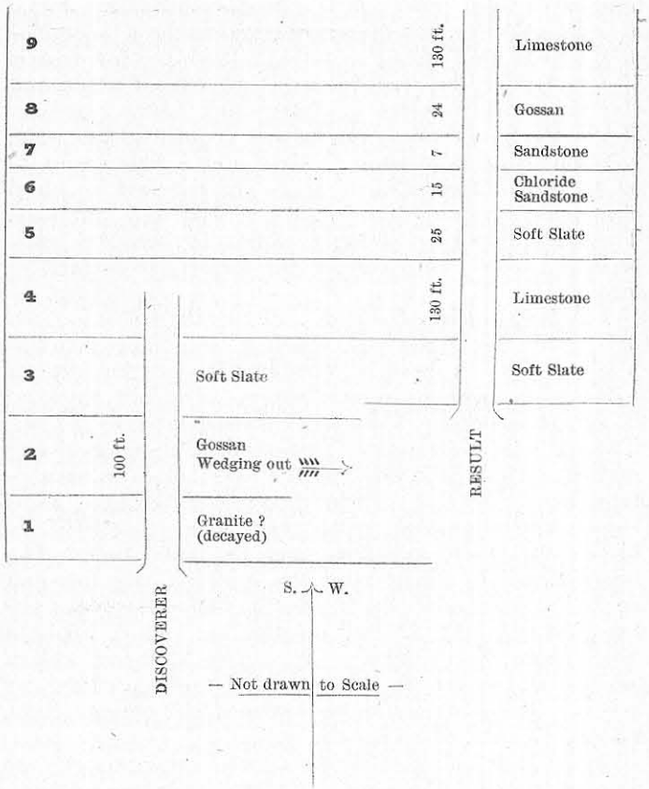
Another tunnel, the northern upper one, has been driven about 80 feet, passing, first through rotten, puggy limestone, then decomposed slate, then a bed of sandstone, with chloride of silver, then 7 feet of sandstone, carrying galena, then 24 feet of gossan, with a couple of strings of galena, and finally into a bluish-grey, limestone. At surface the gossan is hidden under clay. A main shaft, well timbered, and with three compartments, has been sunk 154 feet, and, it is said, passed first through 70 feet of decomposed rock, then into solid limestone. The decomposed rock is cavernous, and driving from the bottom was suspended, owing to flooding from a sudden burst of water when the reservoir was tapped. Future work will probably include driving along the course of the gossan cut in the main adit. What I am rather afraid of is that the backs gained in the drive will not give sufficient depth for the sulphide ore to be met with, as we know that in this district the gossanous zone extends to considerable depths. If, however, the water-level is reached, some enrichment may be looked for. As far as I can learn, a few tons of ore were sent to market formerly with between 60 and 70 ounces of silver per ton.

Discoverer Mine.

To the S.E., and adjoining the previous, is the Discoverer or Smith's section, traversed by the same gossan lodes as pass through the Result. There are two bands of gossan and two tunnels, both of which intersect one of the gossan bands. This band is supposed to be the Godkin lode. In the tunnels it is about 100 feet wide, but, going north, it wedges out, and is only 25 feet in width in the creek opposite the main tunnel of the Result. I could not trace it further north than that. It is, accordingly, not cut in the Result, being outside the adit. The gossan lode which is cut in the Result is not yet intersected in the Discoverer, but is still ahead of the tunnels there.

No. 2 is the bottom tunnel, which has been driven S. 37° W. for 370 feet, first through 150 feet of decomposed, clayey, eruptive rock, the nature of which it is difficult to determine, but I think it has been either syenite or hornblendic granite. It then crosses the band of ferro-manganese gossan, dipping about 50° E. In the gossan are patches of soft putty-like clay, or kaolin, often forming vughs. This occurrence is strongly suggestive of the gossan band having originally been part of a dyke of eruptive rock. On the footwall of the gossan is a band of black pug, derived from clay-slate. This is succeeded by limestone, apparently conformable with the gossan. There is a foot of pug just behind the end, which is now in hard limestone. It is intended to drive this tunnel to intersect the Bell's Reward (Godkin Extended) lode cut in the Result. When this is reached, the tunnel will have 200 to 300 feet of backs. No. 1 tunnel is 120 feet above the preceding, and has been driven through 100 feet of gossan, brough the slate, and is in the limestone; in all, about 170 feet. It is blocked by a fall of ground.

The relations of the zones passed through in the drives on these two sections (Result and Discoverer) may be conveniently and approximately shown by the subjoined :—



No work was being done on these sections when I was there, but, in view of the persistence of the gossan outcrop along a great length of line, I am told that resumption of operations is contemplated. The gossan itself seems very poor, but I think it likely that, when the limit of the oxidation zone is reached, there will be the usual enrichment by leaching from above. If, as I surmise, from the width of the gossan and the aluminous patches contained in it, it is an igneous dyke, it may, in depth, carry more than one ore-vein.

The creek up this valley has been worked, off and on, for gold, with some success. At one time the whole ground was pegged out for gold, with quite unreasonable expectations. What gold has been obtained was, most likely, derived from the little bunches and veins of quartz in the dioritic and other hornblendic rocks of the range along the east side of creek. These rocks also contain veinlets of copper ore.

Whyte River Mine.

This is a silver-lead mine on Section 109-93M, 34 acres, about a quarter of a mile S.E. of Jupp's, and 13 miles from Waratah. On the N. side of the hill two tunnels have been driven to the lode, and a third one, on the S. side, 80 feet below the lowest tunnel on the N. side, with which a communication was being made when I was there, by a rise and winze. I hear they have since holed through. The first tunnel put in was the No. 1, a shallow one, not more than 30 feet from surface, near the top of the ridge. At 100 feet in a lode was struck in the form of decomposed ferro-manganiferous rock, carrying disseminated lead, carbonates, and chromates. The formation widens from 2 feet in the back to 5 feet in the sole of level. The bearing of the lode is N. 21° W., and the dip N.E.

No. 2 tunnel was then driven S. 25° W., and the lode cut at 160 feet from approach. This tunnel is 60 feet below No. 1. The lode has been driven on 200 feet S.E. The tunnel passes through decomposed igneous rock, which,

from its decayed condition, is difficult to identify. Some of it is serpentine, and some, after examining a microscopical slice, I am inclined to think, is diorite. The drive is also in these rocks, and follows a thin seam of quartz and clay on which a winze has been sunk (Jupp's winze). Below the level the lode can be seen about 6 inches wide, lying on a smooth footwall. Most of the lode seems to be in serpentinous rock. It is characterised by lead chromates, carbonates, and oxides of lead and antimony. The lead sulphide is strongly antimonial, and the ratio of silver to lead is 3 ozs. of the former to the unit of lead.

The deep tunnel on the S. side of the hill has been driven 500 feet to the lode, which it has struck 110 feet below No. 2. A drive N.W. then followed the lode for 170 feet, but without payable results. The lode seems to be still in serpentine, and stronger here than in No. 2 level The walls are 6 feet apart—footwall defined, hanging-wall ragged. The first 300 feet of the tunnel were in serpentine, then a dyke of diorite was passed through, afterwards serpentine was again met with, succeeded by black slate, then serpentine and the lode itself. The occurrences of diorite raise the question whether that rock intruding into the serpentine has not been the ore-producer. At 32 feet up the rise, which has been holed from No. 3 to No. 2, a vein of 6-inch galena was cut and driven on N., but found to be of irregular width. The assay of this has returned 22·7 per cent. lead, 63 ozs. 17 dwts. silver per ton.

Some rich silver chlorides have distinguished the secondary ores in this mine. Unfortunately, the workings have not disclosed a lode which can be described as payable. A few tons of ore-stuff have been broken, but the vein is too irregular to warrant much hope of a payable lode being found in the present levels. The deepest workings, however, are not more than 130 feet below the crown of the hill. The hopes raised by the rich secondary ores have not been justified by the subsequent prospecting, and I am afraid there is not any great chance of improvement at the depth attained.

Heazlewood Silver-lead Mine.

Following the road westward from Jupp's a line of lode is crossed at the 14-mile below the ore-shed, running west of north in serpentine country through the Heazlewood Extended, Heazlewood, and South Heazlewood sections. A main lode has been described as being continuous through all these properties, but I think a little attention will convince us that the positions of the alleged lode are at variance with the notion of it being one and the same on the several blocks. I think we have to do with parallel veins more or less discontinuous on their strike. The most northerly of these is the Heazlewood Extended, bounded on the south by the Heazlewood sections, 1309M and 1310M, 80 acres each. The 1309 section is the most important one. A main shaft has been sunk here, 170 feet deep, with which No. 3 tunnel, driven along the lode from the S.E., connects in 390 feet of driving, coming into the shaft at 55 feet from the surface. From here to surface the ground has been stoped out. On the other side of the hill, at nearly the same level, the No. 4 tunnel has been driven about 350 feet towards the main shaft, and short crosscuts put in S.W. and N.E. before reaching the air shaft, but with no result.

A low-level tunnel had been begun, but abandoned, together with all other work on this mine.

The lode proper, *i.e.*, the ore-vein, has not been more than from 2 to 3 inches wide on the whole, though it has widened to as much as 6 inches. The ore is galena, sometimes antimonial, with which is associated a little zinc blende, but not sufficiently so to cause trouble in the treatment. The ratio of silver to lead is not high, as an assay of the clean ore returned 69 per cent. lead, and 95 ozs. silver. The vein is encased in a serpentinous enstatitic dyke, the width of which I could not well determine. The country to the E. of it is serpentine, and to the W., syenitic, with much hornblende and a large development of actinolite. I regard the syenite, or hornblendic granite, as posterior in date to the serpentine and the enstatite dyke, and, consequently, can only consider the juxtaposition of the latter as purely accidental. Just to the E. of the dyke the syenite contains abundant radiating aggregations or bundles of slender prismatic crystals of actinolite two and three inches long. The bearing of the dyke and lode is N. 18° W. The veinstone has the characteristic nickel colouration of these dykes. In past time a few hundred tons of galena were raised and sold from this mine, returning between 50 and 60 per cent. lead and 80 and 90 ozs. silver per ton. A sample, however, taken by myself, and assayed by the Government Analyst, yielded only 56·21 per cent. lead, 53 ozs. 11 dwts. 11 grs. silver.

On the south section, in serpentine country, an upper tunnel on the main lode has been driven over 500 feet, of which 400 feet were on the course of the lode. A slide was reached at that point, and the drive turned off E. instead of W.: the continuation then became useless. The walls are good, four feet apart, dipping N.E.: the hanging-wall is especially well-defined. In the drive, the lode has been six inches to one inch of galena, banded with carbonate of iron. I saw some nice blocks of this banded galena, four or five inches thick, on the tip outside tunnel. The galena is freely mixed with blende. The gossan of this lode has the usual green nickel stain. The level has 50 or 60 feet of backs, and will eventually have between 200 and 300 feet. A crosscut tunnel from the E. communicates with it, and 40 feet below is Bottrill's crosscut adit. No ore appears to have been sent away in bulk, and the assay results have not given high returns in silver—not more than 40 to 60 ozs.: my own sample, assayed by the Government Analyst, returned 67·55 per cent. lead, 36 ozs. 18 dwts. 6 grs. silver per ton.

On the South Heazlewood ground a good deal of trenching and driving has been carried on. I examined a prospecting tunnel, driven W. 300 feet. Not far from mouth a drive was put in N., on manganese gossan, but in the end there is only a gossan vein crossing the face. An opposite drive S. is in gossan all the way, and the face shows country rock, with a foot of iron pyrites on the E. side. The gossan is rather massive, but there are no walls or other signs of a lode, the country rock—a decomposed igneous one—appearing to be cracked or fissured in the direction of drives. The gossan weathers coal-black, and carries a good deal of carbonate of iron, besides traces of galena and blende. At surface, the hillside is covered with this gossan, which I could not connect with any particular lode. The country rocks seem to be serpentine, limestone, sandstone, and quartzite, but in the short time at my disposal I could not unravel their relations. Further S. are a couple of lodes parallel with the main lode, with a capping of soft gossanous matter, chrome-stained, carrying a little chromate of lead. The western lode is about one foot wide: a little galena has been found in one of the eastern lode-trenches.

I am not at all certain that any one of the lodes worked in the south section is a true continuation of the Heazlewood lode in the north block. The direction of strike

does not seem to be exactly preserved, and all the lodes require to be carefully traced on their strike into the adjoining sections before they can be positively asserted to be identical. At the same time, the fissured mineral-bearing zone strikes through all three properties, and even further N., across the Heazlewood River.

Heazlewood Extended.

I had a look at some of these abandoned workings on Sections 4-87M (40 acres), 825-87M (80 acres), and 1596M (19½ acres). Prospecting was evidently carried on pretty vigorously, but with unfortunate results. Several lodes have been cut in different places, showing galena, chromates, and blende here and there, but nothing payable in respect of quantity. A little good ore is said to have been sent away, but I could obtain no details. Fifty feet below the main road is a tunnel, now blocked, and lower down is a deep tunnel from the river, intended to cut and follow the lode in depth. The ore occurs as galena veins in an enstatite dyke rock, stained green and dolomitised, like that of the Magnet Mine, and the country traversed by it is serpentine and gabbro. If this company decide to resume work, they should continue the long tunnel near the river, as the upper one is far too shallow. This will enable them to follow the lode at a very considerable depth, and to explore for parallel veins E. and W. Though a good deal of preliminary work has been done, and without any favourable results so far, the property cannot be said to have had a fair trial, at least not a sufficient trial to warrant its final abandonment.

Binks' Copper.

This is situate to the S.W. of the Heazlewood Co.'s northern block, close to the track leading to the Castray Gold Workings and Mt. Hope. There has been much talk about this copper, but, so far, it is only an exposure, and it is impossible to say what it is likely to become before further work is done. A small cutting into the hill-side has bared a face of iron and copper pyrites, 5 or 6 feet in length and 2 feet thick, running about N. and S. Chips knocked off with the hammer show solid pyrites, highly cupriferous. The purity of the metal and the absence of any veinstone are features of the occurrence. An assay by the Government Analyst returned 39·2 per cent. copper, with traces of gold and silver. The surrounding rock is greatly decayed, and in a highly unfavourable state for determination; but the microscopic examination of a selected specimen points to it being an amphibolite. A short open drive has been put in a few yards lower down the hill, but is not far enough in. It is perfectly useless to leave this lode undeveloped, for there is not enough work done to warrant flotation. It should be opened out without delay, and would then, most likely, be placed easily, for the outcrop is a promising one.

Jupp's Copper.

A quarter of a mile W. of Binks' lode is what is known as Jupp's Copper Show, where a shaft has been sunk 26 feet on a quartz lode containing copper pyrites. At 10 feet down, the lode is wide, but below that to the bottom, the width is not known. Assays of picked specimens are reported to have returned 17 per cent. and 9 per cent. copper, with 7 dwts. and 5 dwts. gold.

Mt. Stewart, now Mt. Hope, Silver-Lead Mine.

This mine is situate 5 miles south of the road at the Heazlewood, on Section 763-93M, 80 acres, on a plateau or flat hill, which is one of the foothills of the Meredith Range, 1200 to 1400 feet above the level of the sea. Work has been recently abandoned here, notwithstanding that the ore won was of a high class, containing as much as 130 ozs. silver per ton for 24 per cent. lead. A few tons were sent away, but the silver contents are said to have been reduced to 98 ozs. by an injudicious preliminary washing. A pack track, five miles long, and in none too good condition, connects the mine with the Heazlewood ore-shed, on the main road, 14 miles from Waratah. Though the transport cost to Waratah is quoted at 50*s.* per ton, it is questionable whether any considerable quantity could be got away under £3, for it would not take much traffic to knock the present track to pieces. However, it seems certain that the ore is worth, at least, £15 per ton, and if there is any quantity of such ore within five miles of a main road, it is also tolerably certain that means will be devised for getting it to market.

Six chains south of the northern boundary of Section 763-93M, 80 acres, a shaft has been sunk 43 feet on a galena lode, which runs through the property, with a bearing slightly to the west of N. The country-rock is slate, presumably of Silurian age, striking N. 5° W., and dipping at a high angle to the W. The lode appears to run with the country on a strike, and with a dip parallel to those of the enclosing slates. In the bottom of the shaft, which was unwatered for my inspection, the lode consists of alternate bands of quartz and galena. From west to east the formation is six inches quartz, a few inches of country-rock, 18 inches of quartz, and six inches of silver-lead ore, the best ore being on the footwall side, and seeming to widen out of sight on that side (E.). There is no defined wall on the W. side, the lode there being interstratified with country. The quartz crystals are in combings at right angles to the veins. The lode in the upper part of the shaft consists of crusty quartz and galena, with zinc blende, and has improved going down. Lower down the hill there is another shaft, about 20 feet deep, but it has no galena to speak of. Two tunnels have been driven to develop this lode, one shallow and useless, the other a long one, which ought to give 100 feet of backs when it gets to the shaft, which is now about 160 feet ahead of the end. This tunnel cut the lode at 100 feet, and has been driven a long distance, not always quite on the lode line. With the exception of one point, where a few tons of galena were stoped from over back of level, no ore was won in driving, the lode line being marked only by a band of quartz throughout a course of several hundred feet. A sample of ore from stope was assayed by Mr. Ward, Government Analyst, returning lead 23 per cent., silver 215 ozs. 12 dwts.

The proper programme in recommencing work on this property would be to continue the long level, so as to come under the 43-feet shaft; then connect shaft with level, and extend the latter to the N. boundary. It would then be seen whether the result justified the starting of lower adits, which would be rather long ones. In driving N., serpentine country would be entered. The rock there at surface is talcose serpentine, and the lode runs into gossan. The N. section, 3299-93M, 80 acres, is serpentine, widely overspread with gossan; but it is by no means certain that it is lode gossan. A good deal of it may be formed by iron derived from the serpentine. The extension of the drive N. of the shaft would also solve the question whether the serpentine cuts the lode off or not. On purely geological grounds, I believe the lode will be found to continue through both slate and serpentine.

Chalcedony and opalised serpentine are found on the serpentine portion of the property. I did not see the talc

vein, which is to the S.W., and which may have some connection either with the serpentine or the beautiful amphibolites which occur about here. The S.E. bank of the river at the mine appears to be granite, but the hill over the long tunnel, or just E. of it, is strewn with blocks of decayed igneous rock, looking like serpentine or amphibolite, and suggesting that the tunnel is partly in that rock, which, however, I did not detect underground, and I did not see any of it on the tip. The main lode has been traced a long way, and is evidently persistent as far as regards its line. A somewhat unfavourable sign is the absence of walls, it being made up of parallel independent bands; but this is not looked upon as so essential now-a-day as it used to be. Still, such a lode is very apt to split up into stringers. The long distance it runs without payable ore is also a drawback, for a good part of the section is thereby rendered unprofitable. Nevertheless, there is an undoubted ore-shoot, which requires developing, and the way to do this is as suggested above. If this trial work is successful it will lead to more prospecting in this locality, which, being near the contact with the granite of the Meredith Range, is a favourable one for deposits of mineral.

Samples of galena which I took from the shaft have been assayed by Mr. F. Ward, Government Analyst, as follows:—

From bottom of shaft..... Lead, 58·12%.
From stope over tunnel ..... Silver, 83 oz. 12 dwts. 12 grs.

Lord Brassey Nickel Mine.

This is on Section 1758-91M, 80 acres, at the top of a lofty hill of serpentine rock, called Nickel Hill, north of the bridge over the Heazlewood River at the 16-mile. The summit is about 700 feet above the river. Mining operations have been carried on here by the Lord Brassey Nickel Company for winning nickel-ore, which is found in two forms, viz., nickel-iron-sulphide and hydrated nickel carbonate, zaratite. The latter is more abundant near the surface, and often lines the walls of the numerous joints which intersect the serpentine. As a mineral, it is said to be the finest zaratite in the world. Its colour is pure emerald green, changing, in an encrusting variety associated with it, to a greenish-yellow. The sulphide occurs as a new mineral, called heazlewoodite, and is referred to by Dana, in his 1899 appendix to the System of Mineralogy, p. 33, in the following terms:—

"Heazlewoodite. W. F. Petterd, Catalogue of Minerals of Tasmania, p. 47, 1896. A sulphide of nickel and iron related to pentlandite, occurring in narrow bands in the serpentine of Heazlewood, Tasmania. Colour, light-yellow bronze; streak, light bronze. Highly magnetic. H.=5. G.=4·61. Rich in nickel, up to 38 %, but not analysed."

In this mine the heazlewoodite occurs in small veins, running through the serpentine along irregular slickensided planes, and also disseminated in the country-rock itself in the neighbourhood of the joints. It seems often to be associated with a vein matrix of carbonate of iron. The company have spent money very perseveringly in working this nickel deposit, but when I was at the mine, underground operations had ceased, and work was confined to classifying the ores which had been raised, *i.e.*, separating the carbonate from the sulphide. The shaft at the top of the hill is about 25 ft. deep, and has yielded a fair quantity of zaratite. I saw here, too, a piece of the best sulphide vein stuff, being solid-looking heazlewoodite, 2½″ to 3″ thick. The fineness of the grain, and the very light colour, cause the mineral to be overlooked, unless the stone is examined carefully. A tunnel has been driven into the hill S. 48° E. for 570 feet, attaining a maximum depth of 100 feet from surface at the extreme end. At 119 feet in, a crosscut (Skinner's drive) has been driven 90 feet in a crooked fashion to the S.W., and 222 feet further along the main tunnel is another crosscut driven 95 feet, also S.W., and also crooked. Both of these crosscuts have such sharp bends that they now head in a direction nearly parallel with the main tunnel. The entrance to the latter crosscut is just beyond the shaft from surface, and the tunnel beyond this, for 150 feet, is below the surface trenches at a depth of about 80 feet. The tunnel end seems to be about 80 feet from the E. boundary of the section. The nickeliferous veins and bands have been persistently followed in their windings along the numerous smooth planes, the polished serpentine faces of which mimic the slickensides of true fissure lodes. These shining surfaces tell of movement within the rock mass, probably consequent on swelling during the process of hydration. The plane faces also constantly cut off, and displace the veinlets of nickeliferous sulphide, showing that the ore had segregated from the surrounding rock before hydration set in.

The work done so far has not established the existence of ore at a shallow level in remunerative quantities. The present levels, if continued, can gain no additional backs, and a lower tunnel from the Heazlewood side of the hill would be a long piece of work. The usual practice in mining is to aim at depth, but in working this kind of ore, that practice is not in accord with geological theory. We are not dealing now with fissures and injection-veins, but with segregrations of sulphides from a heavy, cooling rock magma. According to Soret's principle, the magmatic ore segregations take place in the coolest portions of the magma. These are the portions near the contact of the igenous rock with the adjacent rocks, into which the former was intruded. The surrounding and overlying rocks have been removed by denudation from the Nickel Hill serpentine, but the parts near the present surface must have been nearer to the original margin of the rock mass than those at a greater depth. The probability, therefore, is that greater success will not attend greater depth. The smallness of the quantity of ore obtained here bars profitable working, though fine nickel, 98-99 per cent., is quoted at £160 per ton. This Heazlewood ore has its peculiarities, and it is not likely that it can be mixed with other ores in the furnaces without disturbing the delicate reactions which are involved in the reduction of nickel ores. On the other hand, this bar may be removed at any time by metallurgical improvements, and as the increased demand for nickel steel is sustaining the market, the search for nickel ore should not be altogether abandoned.

Jupp's Nickel.

This section, 3273-93M (12 acres), situated south of the Lord Brassey property, was formerly held by the Roy's Luck Company, but is now known as Jupp's. It is serpentine country, and, like the preceding mine, is on the flat at the top of the Nickel Hill. Along the north line of the section a tunnel has been driven about 113 feet E., to intersect two veins bearing N. 60° W., which have been noticed and trenched at surface. A shaft has been sunk on the westerly vein to a depth of 24 feet, and the most solid nickel sulphidic ore got on the hill has been obtained from this shaft. At the N.E. angle of the section are veinlets bearing N. 70° W. and N. 25° W., trenched just at the section corner. These run into the

Lord Brassey and Lacey's sections, and are of no use whatever to the Roy's Luck holders. The line of the principal vein is in a diagonal direction across the section, but its continuity must not be assumed without proof. For satisfactory prospecting, the nickel-bearing properties on this hill ought to be amalgamated. One drawback to mining work is the absence of good timber. The serpentine nourishes only stunted trees.

In the triangle formed by the Corinna Road, Heazlewood River, and 13-mile Creek is one of the hills called "The Pinnacles." On the W. side of the creek, about 40 feet up the hill, a short tunnel has been driven W., in actinolitic rock, to cut a copper formation, but was suspended before reaching it. On the side of the hill lumps of oxidised lode stuff are visible. Native copper has been found in the creek below. It is to the E. of the Heazlewood line of lode, and is probably connected in some way with the contact of hornblendic rock with serpentine. N. of this, just below the junction of the 13-mile Creek with the Heazlewood River, there is a low ridge, running N.W., and separated from the Pinnacles by the river. This hard spur has caused the river to make a wide loop, not charted in the map of mineral-sections. The rock is syenite, very rich in hornblende, and has, most likely, some relation to the actinolite rock at the Pinnacles.

Long Plains Gold Mine.

This used to be known as Weetman and Crockford's, and is now held under lease, in the name of H. H. Gill. The reward claims comprise 2-85 (15 acres) and 3-85 (15 acres), on the Long Plain, about a mile in from the Bullock's Head, or 16-mile peg from Corinna—24 miles from Waratah. At the time of my visit, Mr. T.M'Grath was in charge, and courteously showed me round. The only other man on the claim was Chris. Jannsen, who was fossicking in the creek. The mine is on a spur of the Long Plains, about 1100 feet above sea-level, lightly timbered and surrounded by button-grass country. This ridge runs about N. 10° E., and, like the surface of all the plain, is covered with quartz detritus, which has been called alluvial. It is, however, is no sense of the term an alluvial deposit, for the fragments, large and small, are angular in outline, and not a waterworn pebble can be seen among them. In places, there is a prodigious quantity of this covering, which varies from 2 feet to 5 feet in thickness, lying on the vertical edges of the schists or quartzose slates. From this layer of detritus, a good deal of gold has been won from time to time—at least 600 ozs., and perhaps more. The metal is generally found, not lying on the bed-rock, as in alluvial deposits, but on the top of a cemented upper part of the detritus. It has been noticed that when gold occurs upon this cement layer it is most likely to be found below it also. The cement, resembling a breccia of angular pieces of reef quartz, bound by a siliceous paste, is plentiful all over the Long Plain. It is very likely of the same age as the cemented alluvial on Brown's Plain, near Corinna. Now, at the Long Plain Mine it is very easy to see where this quartz came from. Between the laminæ of the schists there are everywhere thin sheets of quartz from ½ inch to 2½ inches thick, and even a greater thickness has been attained where lenticular patches have been formed in the schist. Wherever gold occurs in the schist outside of any veins, it is contained in bands of soft decomposed schist or sand stone, well within the range of surface water, which, owing to the vertical lamination of the country, may descend to a very considerable depth. The gold is found in ragged, peculiar forms. Hollow skeletal, coralloid, crustiform shapes prevail, with a frosted appearance. The specimens are very light, and enclose much quartz, occasionally slate, and sometimes both quartz and slate. In one instance, I noticed a piece of gold enwrapping small pebbles or grains of quartz and green schist, a strong indication that the gold crystallised after the stones had been detached from their parent rock. This, I believe, explains the origin of the specimen gold for which the claim has been so famous. It has been produced by the re-crystallisation in the superficial covering of gold dissolved out of the the quartz lenticles, set free by the disintegration of the bedrock. Incessant dissolution of gold is probably going on in all quartz mines in the upper part of auriferous quartz reefs, and the Long Plains quartz lenticles, wherever gold-bearing, are not likely to form any exception to the rule. But the organic matter of the button-grass soil may be expected to act as a powerful precipitant of any such gold from its solution, and has, no doubt, given to the encrusting gold the peculiar sponge-like and hollow forms so common in the specimens found here. Consequently, wherever the quartz underneath is gold-bearing, patches of auriferous detritus may be expected in the neighbourhood. The idea entertained on the spot is, that sinking in the solid below these points ought to result in the discovery of payable gold: I think this by no means follows. The gold precipitated at surface may have been collected from a wider and a comparatively poor area underground.

Cox's face on this property is an open cut in the schist, in a couple of benches about 25 feet in height altogether. The silvery schist is split up into thin, often wavy, laminæ, between which are sheets of quartz, mostly lenticular. A band of soft decayed quartz schist is said to have yielded the most gold. The quartz in the lenticles is pure, white, dense, and looks unfavourable for gold. I was told, however, that from 70 to 80 ounces had come from this face, with a very primitive arrangement for washing, and altogether too little water for proper sluicing. A tunnel 300 feet long has been driven into the hill from the E., to intersect the formation exposed in Cox's face, but it is believed not to be far enough in. It passes through greenish quartzose, soft slates, or schists. About 50 feet in, a manhole has been cut into the north side, where there is a band of decayed slate, which looks as if it might contain something. Further in, a seam of red and yellow clay, 2 inches to 5 inches thick, has given gold on assay. Just behind the end there is a 16-inch band of rather soft graphitic slate, which has not been tested for gold. The face is in talcose schist. A south drive, 15 feet, has been put in from this tunnel, with no result.

On the western side of the spur, opposite this tunnel, 12 ounces of gold were found in prospecting at surface. A short drive was begun a few feet lower down, but it is very shallow. On this side of the hill a small tunnel has been put in, from which a short drive was extended N.: nothing was obtained from the drive beyond a few colours. The tunnel is in talcose schist. There is an upper cutting, from which a winze descends over 200 feet, as far as 38 feet below the lower of two tunnels below this cutting. The winze is said to go down on two veins, and to have yielded gold. No. 2 tunnel, beneath this, was too wet to enter. It is said to have been driven 1000 feet into the hill, cutting Cox's formation and two or three others, but with no result, except colours only. No. 3 tunnel, still lower down, has been extended 400 feet, cutting a thin vein, which was driven upon N. Where this was intersected it looks like a mere joint. Higher up it was said to be good, but poor when they knocked off work. I was

told the greatest width it attained between the two tunnels was a foot.

The claim appears to have been well prospected in different directions, and of course this work can be continued, but it is difficult to see where the rock warrants any considerable outlay. There are no signs of solid reefs existing at any reasonable depth, and I believe money would only be frittered away looking for them. On the other hand, any day may witness a rush to these plains on the discovery of new patches, with rich surface precipitates. These will almost certainly be found, but, most probably, accidentally. The gold is of excellent quality, realising £4 to £4 1*s.* per ounce.

All the neighbouring creeks have yielded gold. Over 4000 ounces are said to have been collected on these plains, and the gold seems to have come from more than one source. We have a quartz source, as above; but it has also been found in direct association with magnetite and carbonate of iron. This part of Long Plains is just to the E. of the Rocky River and Rio Tinto magnetic belt of country. The whole belt of country between the Rocky and Savage rivers, and up Hall's Creek, deserves a thorough geological examination.

Cape Copper Mine (Mt. Donaldson Section).

This property is charted as Heaps and Simpson's two sections, 1027-93M (79 acres), and 1028-93M (80 acres), on the 9-mile Creek, which falls into the Whyte River, just east of the latter section. The company has made a narrow cart-road, about ¾ mile long, for connecting the mine with the Corinna main road, at a point about 9½ miles from the township. This road terminates at the top of a steep incline tramway, 9 chains in length, which descends the rather precipitous side of the gorge, 350 feet below. The mine-works are in the creek, 80 or 100 feet below the camp. Both sides of the creek are lofty and steep; and this mine, placed at the bottom of the dark narrow gorge, cut almost canyon-like in the table land above, occupies as strange and romantic a position as any in the Colony.

The country-rock may be classed in two groups. The upper and eastern part of the hill consists of quartz schist, inclined to be micaceous. It is light in colour. The schist in the creek, to the south and west, is dark grey and green, and carries copper pyrites. Its foliation planes are glossy with graphite, which, on being rubbed, leaves plumbago marks on the fingers. A little loose porous fibrous graphite (graphitoid?), of remarkable lightness, has been found in a seam in No. 1 level, near the entrance; and a kind of plumbago mud, resembling soot, occurs in the overburden, just above the schist, in the short trial crosscut from creek (above the adit). Some of the schist is massively bedded, especially towards the junction of the creek with the Whyte River. Here dark, and sometimes glistening, crystals of hornblende may be seen in the rock with the naked eye. The rock is one of the crystalline schists, largely actinolitic, is non-felspathic, and requires extended microscopical examination before its exact nature can be safely determined. For the present, it can only be vaguely termed "hornblende schist." Wherever the foliation is most complete, the formation of lenticles and leaders of quartz is most marked. Then, where the quartz leaders and the schists carry iron pyrites, copper pyrites are also apt to occur, though, so far, the latter ore has not been found in any quantity outside the old prospecting shaft sunk in the graphitic schist in the bed of the creek. All through the mine a soft band of this schist is being followed, as a guide in tracking the ore formation. This formation and the enclosing schists run parallel with one another; and, although the soft band is rather constant, I look upon it as indicating a plane of weakness, allowing easy percolation of water, rather than anything of the nature of a fissure, the existence of which is altogether conjectural. The whole mass of schist has a strike N. 20° W., and a normal dip to the N.E., though the latter varies in direction here and there. I believe the whole group of schists will be eventually found to belong to the Cambrian or pre-Cambrian rocks; but the evidence is not sufficient, at present, to enable a definite conclusion to be arrived at.

The first work done on the property seems to have been a small shaft, sunk in an extraordinary position, viz., in the bed of a creek not more than 12 feet wide. The early prospectors sank this to a depth of 22 feet in graphitic schist carrying quartz, barytes, and good copper pyrites. The late Mr. J. Harcourt Smith quotes samples of the pyrites as assaying 28% copper, 8 dwts. gold, and 10 ozs. silver per ton. Mr. F. J. Rich, the present manager, continued the sinking down to 31 feet, leaving the formation in bottom, consisting of a couple of somewhat solid bands of copper pyrites, 3 or 4 feet wide, and 2 feet of mineralised rock. Influx of water stopped further sinking. I saw a few hundredweights of the copper ore from the shaft. It was being sorted and bagged, and I estimated its contents at from 20 to 25% copper. As all the ore has come from this awkwardly-placed shaft, the only course open for the company is to get underneath it as quickly as possible, and the management is doing this in the best way. A new shaft is being sunk on the eastern side of the creek, a few fathoms from the old one. The schist is running parallel with the creek, so that drives will be opened out up the creek, first at a depth of about 60 feet, the same level as No. 1 tunnel, and again at a further depth of 80 feet, where the main adit will communicate with it when driven far enough. The strata dip easterly, therefore the new shaft is on the east side of the creek. This is the most important and necessary work at present proceeding on the mine. It will prove the value of this course of ore in particular, and, I may add, the value of the mine as a whole; for, if the contemplated drives do not disclose anything worth working, the outlook will be far from bright, as I do not see any other point which offers any strong inducement for further prospecting. The one thing about the work in the creek at this shaft which is encouraging and invites perseverance is that fair-quality metal has unquestionably been won here, and the solid quartz, with abundant iron pyrites and a little barytes, are favourable indications. The Whyte River flows over a hornblendic schist bottom, in a narrow gorge, 18 feet vertical below the main adit. The adit is driven 212 feet, first in the massive hornblende schist, then cutting the graphitic schist alluded to above. The schist here has a westerly dip, and is seamed with vertical and horizontal strings and veins of quartz, but the drive has yielded nothing so far except a few little veins of iron pyrites.

About 65 feet above the adit, a short trial crosscut has been put in from the creek. Up to now it has been passing through the heavy overburden of schist detritus which rests upon the bed-rock, but in the face the solid schist is just now beginning to show in the sole.

No. 1 level is 90 feet above the adit, and has been driven 320 feet, first in grey, and then in graphitic schist. In the end is a soft seam of this schist, which has been followed all along. The schist right across the face is veined with horizontal and vertical leaders of quartz, 1 inch and 2 inches wide. Samples of iron pyrites have been obtained from this level, but no copper ore.

No. 2 tunnel, 60 feet above No. 1, has been driven 60 feet in, and levels put in right and left in graphitic schist, but with no result. No. 3 is the top tunnel, 60 feet higher than No. 2, but is only 16 feet in, having been just started.

In the hill detritus are immense blocks of white reef-quartz, which have, apparently, rolled down from higher ground, and a good deal of loose big quartz is seen in the soil between the mine and the Corinna road. It is possible that a reef crosses the track, and it might be worth while to look for it, though the quartz which I saw is pure white, dense, barren-looking rock, devoid of pyrites, and has an unfavourable appearance for gold.

Since my visit I have received news that a shoot of ore has been reached at the tunnel level, 55 feet from surface, about 25 feet long. This is satisfactory, so far as it goes, and further developments will be looked for. It is quite possible that, as a small mine, some success may be attained. Whether there is scope enough in this property for the important company who are now carrying on operations there is another question. This belt of country is cupriferous to some extent, and though no payable mines have been opened in it so far, there are possibilities which it would be foolish to deny.

Rocky River Mine.

This mine is situate in the angle formed by the junction of the Whyte and Rocky rivers. It is reached by turning off the Waratah-Corinna road, at the company's mail hut, 7½ miles from Corinna, and descending into the valley of the Whyte River by a winding course of a couple of miles. A suspension bridge crosses the Whyte River to the mine on the south bank.

The mining works, outside prospecting shafts and trenches, consist of tunnels driven north-west and south-east into the hill from opposite sides to prove a large formation or deposit of copper-bearing magnetite, which, with breaks, has been traced at surface through a long distance of the same country-rock as far, it is said, as 25 miles. At any rate, on a minimum computation, it extends, at intervals, for 14 miles, with a bearing of about N. 20° W. Whether the identical lode is continuous for this distance may well be doubted. That the same belt of country, with similar magnetite deposits, continues on the same strike, is undeniable.

In the No. 2, or main adit, tunnel, at 20 feet above the Whyte River, the deposit of magnetite has been followed S. 18° E. for 796 feet from the entrance. The face of the tunnel is 360 feet below the magnetic iron outcrop at surface. The tunnel, for about 225 feet, follows the course of the lode, about 10 feet E. of it, and then, from the No. 2 west crosscut into the end, another 190 feet, it skirts close along the E. wall of the lode itself. Several crosscuts have been put in from the drive to prove the width of the magnetite, and have disclosed it as forming an elongated ore-body of somewhat lenticular shape, attaining a maximum diameter of 30 feet, and thinning towards the ends. Its bearing and dip are parallel with those of the talcose, quartzose, and hornblendic schists, which enclose it. A great variety of minerals—gold, copper, silver, magnetic iron, nickel, barium, cobalt, asbestos, molybdenum, &c.—have been reported as occurring in the ore-body, some of them of economic value, others of purely scientific interest. But, however apparently unimportant the non-economic minerals may seem, these and the surrounding rocks require attention, as helping to elucidate the genetic history of the ore-body. Such schists as these, and their associated deposits of magnetite in other parts of the world, have been subjects of much debate, and the origin of both is frequently obscure. One fact observed in connection with many of them is noticeable, viz., that these large lenses of magnetite occur in areas of hornblende schist (amphibolite) and gneiss. The same condition of things prevails at the Rocky River. On each side of the ore-body, and separated from it only by bands of more siliceous schist, is hornblendic rock, sometimes a gneiss, with bands of green hornblende, quartz, and plagioclase felspar, sometimes dark, compact, and fissile, plentifully sprinkled with specular iron. To the E. of the line of lode these hornblende schists form the bed of the Rocky River, where they are massively developed. The talcose schists, which accompany the hornblende schists and gneiss, have, I believe, an identical origin. The same rock as the gneiss occurs also devoid of banding or foliation, looking something like a gabbro to to the naked eye, and consisting, as ascertained by micro-optical analysis, of green hornblende, large plates of plagioclase felspar, with apatite, quartz, and a quantity of epidote. The hornblende schists have the same constituents, drawn out into bands, parallel with the foliation. The talc, asbestos, calcite, dolomite, and serpentine present in the rock are secondary products. The schist sometimes occurs in the middle of the lens of magnetite. The proper interpretation of this interesting rock is naturally a difficult task. In such ancient areas of crystalline schists and gneisses, even the mere differentiation into sedimentary and igneous divisions is no easy matter. Igneous rocks become masked and altered by tangential pressure, due to the secular cooling of our planet, by consequent foliation and the development of new minerals, resulting sometimes in the complete reconstruction of the rock. Sedimentary rocks under the same influence are deformed, crushed, and become crystalline to an extent which finally obliterates all recognisable distinctions between eruptive and sedimentary. In the present case we cannot be quite clear as to how the gneissic structure has been induced. Is it the result of a re-distribution, by gravity, of the separate minerals upon recrystallisation of the rock?—or has it proceeded from the crystallisation of certain minerals along planes of weakness, thus giving to the rock the banded appearance characteristic of gneiss? Looking at the microscopical characters of the rock, and taking into account its mineralogical associations, I tentatively advance the theory that the gneiss and the less gneissose hornblende rock are modifications of original gabbro through crushing and shearing; and the enclosing talc schists represent a further stage of metamorphism. Professor Rosenbusch (in his "Massige Gesteine") goes very fully into the metamorphosis of gabbro rock, in which process the augite is completely replaced by hornblende, and the basic felspar is transformed into a granular aggregate of more acid plagioclase and quartz. Such a rock, a marginally-modified gabbro, Rosenbusch would call hyperite-amphibolite. (Hyperite is a rock between gabbro and norite: its constituents are basic plagioclase, augite, hypersthene, olivine, ilmenite, and some apatite.) He refers to hyperite and magnetite-gneiss, where these changes have produced diorite schists and hornblende-gneiss. Gabbro-diorites are such gabbros as have been converted into diorite, with acid plagioclase and quartz. Rosenbusch prefers to call them gabbro-amphibolites when hornblende has been developed in them; or by a shorter name, zobtenite. He says, with reference to Justus Roth's proposal to adopt the term zobtenite for such rocks*:—"If we would adopt this name, it would be, according to Justus Roth's own showing, a collective name for very

* Massige Gesteine: page 326.

heterogeneous things, comprising the gabbro-diorites and hyperite-diorites, or gabbro-ampbibolites and their schistose forms. Zobtenite would then be any amphibolitic rock derived from gabbro through dynamic metamorphism. In this sense, it would be a desirable and short designation."

The mode of origin of lenses or beds of magnetite is obscure, notwithstanding all that has been written upon the subject. Professor Kemp, in his "Ore Deposits of the United States" (pp. 152-3), gives eight different hypotheses:—

1. As intruded masses, *i.e.*, dykes.
2. As segregations during the cooling of basic magmas.
3. As metamorphosed limonite beds.
4. As replaced limestone beds, or as siderite beds subsequently metamorphosed.
5. As submarine chemical precipitates.
6. As beach sands.
7. As river bars: concentration of magnetite sands.
8. As segregated veins: concentration in a state of solution from the wall-rock.

In 1897 the same author advanced a theory of the origin of some magnetites near Port Henry, N.Y.,* supposing them to be contact deposits formed by the influence and stimulus of gabbro intrusions, forming coarse hornblende-magnetite-pegmatite masses, with associated apatites and zircons, during which time heated solutions of iron were emitted, which attacked the wall-rocks, and gave rise to the ore bodies.

Under circumstances surrounded with admitted difficulties, I only advance my own interpretation hesitatingly, and subject to correction upon closer examination in the field. But, if I am correct, it is improper to speak of this magnetite body as a bedded deposit. I am rather disposed to believe it to be the effect of direct differentiation from the cooling magma of ferriferous gabbro, and the lenses to be subsequently stretched forms of the original differentiated masses of magnetite. The progressive separation of the iron from the fused magma would increase the percentage of SiO_2 in the residue, and this may have facilitated the development of the quartz and acid plagioclase during the later metamorphic processes. On this theory, the nickel ore found in the magnetite has originated by the ordinary process of sulphidic segregation from a cooling basic magma.

Assuming the hornblende-gneiss to have been originally gabbro, there are two possibilities, geologically. Is it an injection gneiss, *i.e.*, an intrusive dyke or sill penetrating between the foliation or bedding of the enclosing rocks, or was it an exposed mass *in sitû* prior to the deposition of surrounding sediments, and at a later time involved, together with these, in the earth movements which have converted the whole complex into schists? Microscopical and chemical examinations, as well as field studies, must be conducted before these points can be elucidated. Perhaps, in the future, the services of an officer may be available for purely scientific work in connection with the geological survey of the Colony, and then this district, with others now neglected under the pressure and exigencies of routine work and economic enquiries, may receive the scientific attention which they deserve.

I will now briefly record my notes of inspection of the mine, begining with the No. 2 long tunnel from the Whyte River. This is driven in quartzose, talcose, and hornblendic schist 796 feet, and on the line of the schists. The schist is impregnated with a little copper and iron pyrites and galena. The tunnel comes into indications of magnetite a little over 100 feet from the entrance, but the solid lens itself does not seem to be present much before reaching the No. 1., or nickel, winze, another 200 feet. This winze has been carried down 150 feet. At the 110-feet level it has been driven N. for 100 feet, but work was stopped owing to heavy water and bad air. Some veins of nickel ore, a few inches thick, were found in the winze, with a carbonate of iron gangue in serpentinous-looking rock. In following the vein northwards the grade is said to have become lower. The winze being under water, I could not descend. The ore is an unusual one, and has been referred to in several assays of it published by the company. Mr. A. J. Bolton, the company's metallurgist, and Mr. E. M. Cairnes, were the first to recognise the peculiarity of the ore, and referred it to siegenite, a nickeliferous sulphide of cobalt. I was informed by Mr. Bolton that it has since been determined in Germany as rammelsbergite = nickel diarsenide. As will be seen presently, there is reason to believe that neither of these determinations is admissible. The published assays are as follows:—

	Gold.	Nickel.	Cobalt.
A. J. Bolton	1 oz. 5 dwts.	51·75%	10%
Gilfillan & M'Creery...	1 oz. 6 dwts. 3 grs.	29· 5%	
F. Dunn, F.C.S.....	2 ozs. 10 dwts. 22 grs.	26· 4%	

Mr. O. E. White, of Hobart, has made an assay of this ore, with the following result:—

	Per cent.
Nickel.....	34·8
Antimony.....	2·0
Cobalt	2·0
Arsenic, large quantity.	

Mr. W. A. Macleod, B. Sc., University of Tasmania, further assayed it for gold and silver, when it returned 9 ozs. 16 dwts. silver, and 6 dwts. 12·8 grs. gold per ton.

The new feature revealed by this last analysis is the presence of antimony, which makes the ore an antimonial sulpharsenide of nickel. Mr. W. F. Petterd has pointed out to me that there are two distinct nickel ores in these samples—Kupfer-nickel (nickel arsenide), with a copper-red colour, and the antimonial sulpharsenide, near corynite, of a white, steely colour. With this ore, Mr. Bolton tells me he has found pateraite, a molybdate of cobalt.

At 45 feet past this winze the first crosscut (No. 1. W.) has been driven 56 feet, crossing the magnetite lode, which is here about 10 feet wide, and 15 feet west of level. The crosscut is in hard pyritic schist, and though the lode is fully passed through, much magnetite is not disclosed. 172 feet further in, No. 2 crosscut (W.) has been driven right through the magnetite lens at nearly its thickest part. The crosscut has been extended 360 feet, and goes through to the line of the Sawpit Lode. At 20 feet W. of the main tunnel the magnetite lode was struck, and driven across, proving to be 20 feet wide. The magnetite here is a solid body, showing no signs of lamination, sharply separated from the country, but enclosing in the middle a couple of bands of schist. After traversing the ore-body, the crosscut continues in schist, till the sawpit lode is intersected, on which a south drive has been extended 32 feet. This lode is represented here by a band of pyritic quartz and graphitic schist. Dolomite and a vein of pyrites are seen in the face of drive. Mustard gold is said to have been observed on the carbon. The schist is gossanous and ochreous in colour where exposed in the end, while both footwall and hanging-wall of drive are soft and graphitic. Back in the crosscut, according to an assay made by Mr. Bolton, a 3-feet band of arsenical iron pyrites carried 22 dwts. gold.

* J. F. Kemp. The Geology of the Magnetites near Port Henry, N.Y. Trans. Am. Inst. M.E., 1897.

From this crosscut the main level has been continued south all the way to the end along the eastern side of the magnetite lode, which has been further proved by three more crosscuts, No. 3, No. 4, No. 5, W. No 3, which has been driven at 49 feet further in, has passed through the ore lens at its greatest diameter, it being there 32 feet across. The lode here also encloses a band of schist. Some good yellow copper ore is said to have come from this crosscut. 52 feet further in, No. 4 crosscut (W.) has been driven across the lode, which has already begun to grow narrower, being only 17 feet in width, and enclosing a wide band of schist. 87 feet beyond this is No. 5 cross-cut, which has intersected the lode with a width of only 14 feet. When I was there, this was 10 feet behind the face of tunnel. The ore still continues, as shown by pyritic magnetite seen in the footwall of drive, 3 feet behind the end.

Thus, this lode has been tested by crosscuts for a couple of hundred feet behind the end of tunnel very systematically, but for an equal distance north of No. 2 crosscut (W.) has been left alone and untried.

An upper tunnel (No. 1), about 150 feet above the Whyte River, has been driven S., with long crosscuts E. and W. No copper ore worth speaking of was found here, but the lode, 8 feet wide, is said to improve going down.

The nickel winze workings expose what is called No. 2 lode, and further in, along E. of tunnel, 3 crosscuts E. have cut the extension of the same lode, called here No. 3. Judging by positions, Nos. 2 and 3 appear to be identical. At one time, this line of lode was looked upon as very important, from its nickel, gold, and copper contents in the vicinity of the winze, but though gold has been reported from other parts of the lode, there is no solid ore-body exposed; still, the winze ground requires prospecting. At 98 feet beyond this winze, a crosscut (No. 1) has been driven E. for 50 feet, and at 15 feet intersected the track of a lode with veins of specular iron, reported as assaying 5 dwts. to 1 oz. 2½ dwts. of gold. The face of this cross-cut is in hard rock, impregnated with specular iron, and seamed with pyritiferous quartz. The veins have been driven on a few feet north. About 120 feet further south No. 2 cross-cut (E.) has been driven 27 feet, crossing the same lode track in pyritic schist, with much quartz. Behind the end, in main tunnel, No. 3 cross-cut (E.) has intersected this lode again at 114 feet, but here it is magnetite, about 2 feet in width, and softer than usual.

I did not see any magnetite on the south side of the hill, but I believe the lode-line has been traced across the Rocky River.

On the south side of the hill, No. 3 tunnel has been driven N.W. from the Rocky River about 290 feet on what is called the Sawpit Lode, and this tunnel, if continued, will eventually connect with the south drive from No. 2 crosscut (W.). About another 400 feet of driving should effect this connection. The tunnel entrance is in a bold outcrop of mineralised hornblendic schist. The feature of the alleged lode is the occurrence of auriferous graphite, reported to assay up to 17 dwts. in specimens. The country is mineralised, but there is not any evidence of true lode-matter. About 80 feet in, a winze was sunk 9 feet on a vein of quartz. Mineralised schist and bands of iron pyrites are the characteristics of the cross-cuts, which, if extended, would probably intersect the graphite, as the latter strikes across the tunnel some way in. The face of the tunnel is in schist and what looks like quartzite, with a seam of dolomite 4 inches wide.

The work in this mine which may be said to be naturally impending is—

1. To complete the connection between both sides of the hill, as the Rocky River side is the natural and most suitable outlet.

2. To advance the S. drive on the No. 1 magnetite lode, which is the mainstay of the mine. The extension of this lode must be proved and established.

3. In view of the long line of magnetite already proved, there need be no hurry to start a main shaft, but it will have to be put down to drain the nickel winze and develop that vein. I may here say that, although the nickel ore constitutes an attractive feature, I look upon it as altogether subordinate to the main resource of the property, the cupriferous magnetite.

The magnetite ore taken out in driving has been stacked, partly at the approach to No. 2 tunnel, partly in a closed drive inside the entrance, and is estimated by the manager at 2500 tons. No stoping is going on, as the company intends first to construct its tramway along the Whyte River valley to Corinna. They are, apparently, anxious to refrain from doing anything involving double handling of the ore, but, all the same, as soon as the outlet from the mine at the Rocky River side is secured, it will be well to get ore out, and establish the value of the mine in a satisfactory way. A selected specimen, of very promising appearance, was assayed by Mr. Ward, Government Analyst, and yielded, copper, 0·1 (one-tenth) per cent.; silver, 9 dwts. 19 grs.; gold, trace; while a bulk sampling made by Mr. Wilks, the mine manager, and assayed by Mr. Bolton, is published as returning 5 per cent. copper, and 3 dwts. gold per ton. But it must be borne in mind that this is essentially a low-grade ore, and everything depends upon the sampling being representative of the bulk, as a little difference will affect the result to an extent that would be inappreciable in the case of richer material. There is not enough margin in the ore value to allow any errors of judgment in planning a programme for work. I do not regard mere sampling from a standing lode as a safe method of arriving at the average value of the ore. Small trial shipments ought to have been got away and smelted long ago: the owners would then by this time have had something much more secure to go upon than they have now. After getting in this way a good idea of bulk values, the ore could be proved both above and below adit level, for, although it has been disclosed by that level for a long distance, no horizontal extension can be a satisfactory basis for permanent ore-winning.

But, above all, I am disposed to insist very strenuously upon the necessity for a more satisfactory assurance as to the bulk value of the ore, especially as I have not been fortunate enough to secure samples of it showing payable percentages of metals. Two samples, one a poor looking magnetite (A) ore from the stack outside the main adit on No. 1 lode; the other, a coppery-looking specimen (B), which, from its appearance, looked rather above average quality, were assayed, with the following results :—

B.—*Assay by Mr. W. F. Ward, Government Analyst*—

Gold	Trace.
Silver	½ oz. per ton.
Copper	0·1 %.

A.—*Assay by Mr. W. A. Macleod, B.Sc., B.A., University of Tasmania.*

Gold	1½ dwts. per ton.
Silver	15½ dwts. per ton.
Copper	?

On the other hand, the assays published by the company vary from traces up to 5 % copper, and traces up to 1 oz. 5 dwts. 8 grs. gold per ton, in ore from the same lode.

This only shows the imperative necessity for ascertaining values by means of a bulk shipment of ore taken from all parts of the lode; and I would recommend that this be done before beginning to lay out money in the construction of the tramway to the Pieman. The company has been working steadily for 5½ years, and have distributed a good deal of money in the district. It is now about to spend £20,000 on its tramway, which is surveyed 7½ miles to the Pieman. At the time of my visit, 27 hands were employed at the mine. Since I was there, a new copper lode has been found at the Whyte River, in the 80-acre section. Rich copper ore is stated to be present, and shaft-sinking has been begun. This has been called the Western lode, and is altogether distinct from the large lens of magnetite ore described above.

Rocky River Associated Mine.

This mine is on the west side of the Rocky River, Section 1829, a little above where the celebrated nugget was found. About 30 feet above the river a crosscut tunnel is being driven across quartzose country and limestone. The quartzose country appears to be big barren quartzite. Behind the end is a band of white limestone, 40 feet in width, but green talcose schist is just appearing in the face. At 90 feet in, a 22-feet belt of mineralised schist was passed through: it is intended to drive south upon it. This is supposed to be the southern extension of the Rocky River No. 1 lode, and the tunnel is being continued, in the hope of intersecting the Sawpit Lode, 200 feet further on; at least, the supposed outcrop is traced at that distance, on the top of the hill. The mine is in the hornblendic zone, and massive quartz and hornblende rock forms the bed of the river along here. The owners of this mine are very plucky, because it is by no means certain that the lodes on the property will be found remunerative.

On the adjoining 10-acre section, further south, a quartz-copper lode is being opened upon the opposite side of the river. This is called the eastern lode. The veinstone is the dense white quartz characteristic of these schists, and shows clean, nice-looking copper pyrites, with iron pyrite. The outcrop has been traced some 5 or 6 chains. The drive, if continued, will give between 300 and 400 feet of backs. The intention is to drive another 15 feet, and then put down a trial sink.

The workers on these sections deserve credit for courageously undertaking mining under difficult conditions. Mr. M. Blaney, the manager, took the trouble to show me round.

Corinna Gravels.

At and near the township, the Silurian bedrock lies under sands and gravels, sometimes 50 or 60 feet deep, though often so shallow that the slates rise to the surface. Mr. Harry White informs me that some of his bores on the north bank of the Whyte River, above its junction with the Pieman, bottomed at 36 feet and 60 feet, while another reached 60 feet, without bottoming. The different sluicing companies which began to work the Corinna series of auriferous gravels some years ago have all stopped work, so that there were really no sluicing properties for me to inspect round Corinna. From some of the abandoned claims which I passed over, I should judge that the true bottom ought to yield payable gold in places where there was any action at work tending to arrest the current. There is such an extensive area of slightly auriferous wash, that there is not much hope of payable results outside certain selected spots. These low-level gravels are the result of the destruction of higher-level gravels, so that it is unreasonable to expect any uniformity of distribution throughout the mass. Besides gold, a little tin is present in the wash; but, as far as the country which is fed by rivers from the Meredith Range is concerned, much tin need not be anticipated. It is different, however, with the country to the north. We may safely say that the gold is derived from the degradation of the country which is now watered by the Pieman, Whyte, and Savage rivers, with their tributaries. These creeks and rivers all carry gold; and, before their existence, the same auriferous country was sluiced partly by the sea, partly by other watercourses. The lenticular quartz patches in the schists, the auriferous magnetite, the serpentine country, all must have contributed their quota to the sum total, and account for the gold, despite the singular absence of auriferous quartz reefs.

Osmiridium Sands.

The natural alloy known under the name of iridosmine, or osmiridium occurs as flakes and flattened grains in the sands of the Savage River and tributaries, Badger Plains Creek, and generally in the streams flowing, at some part of their course, over serpentine country. In the Badger Plains sands it used to be as plentiful as the gold, and was looked upon as a nuisance. New uses for iridium have recently raised the market value of the metal, and a party of men are now working the Savage River sands, diverting the streams, etc., and regularly take small quantities in to Waratah for sale; I believe, a few pounds weight per month. The prices realised have gone up from 30*s.* to 50*s.* per oz., and quite a new industry seems to have been initiated.

No analysis of this alloy appears to have been made in the Colony, but it is highly probable that the constitution is iridium and platinum, with a little osmium and the other rare metals usually associated with these. Its source is in our serpentines, and especially such serpentines as have resulted from peridotites and pyroxenites.

The present rise in price is believed to be the result of some new use being found for iridium, but what this is, is is not yet known. It is also reported that osmium is chiefly sought. It is not known, either, whether, the miners are getting full price for their product. Osmiridium and phospho-iridium are used largely for tipping gold pens, and an alloy of iridium and platinum is employed as standards for weights and measures. Iridium has some limited application also in the ceramic art, and phospho-iridium is used for the knife-edges of certain chemical balances. Iridium has been used experimentally for electrical contact points, but there is no demand for it commercially, at present, in that direction. It is also being employed for the anode and cathode points in radiography.

Conclusion.

From the preceding remarks it will be seen that the only mines on this route now sending ore to market are the Mount Bischoff Tin and the Magnet Silver Lead. Looked at from this point of view, the line of country, as a whole, does not present a cheerful aspect, especially when we take into account the number of mines formerly worked and now abandoned. This gloomy view, however, may be discounted, if we find, upon examining the circumstances more particularly, that insufficient prospecting, half-hearted, or injudicious mining, and, sometimes, financial mismanagement, combined with low market rates and defective means of communication, with correspondingly high freights, have been responsible for some of these failures. In these remote places the mere discovery of ore is not sufficient: the discovery must be accompanied by conditions and circumstances which will

allow the ore to be raised and placed on the market at a profit; otherwise, the mineral, whatever the quantity may be, might just as well be non-existent. A pound or two in the market rate for lead may make all the difference between profit and loss: and if an untoward circumstance like this causes work to be suspended on any individual mine, the chances are that it also checks or absolutely prevents the development of others in the vicinity. In this way we see how possible it is for the misfortunes of a single mine to throw a whole district back for years, and to bar the discovery of even richer ore deposits in the same neighbourhood. Because the mines at the Heazlewood and the Whyte rivers have been abandoned in the past, it does not follow that some of them could not be worked at a profit now, when market values and freights are more favourable, and *a fortiori*, it is not safe to assume that the indications of ore in so many places only point to worthless lodes. On the contrary, I think it very likely that the more favourable conditions which at present surround the inception of mining work, will lead to the resumption of exploration at some of these neglected centres. The pyroxene country between the 7-mile and the 16-mile from Waratah is distinctly favourable for lead ores, with a good percentage of silver. The numerous ultra-basic dykes are so many channels, if not stimuli, of ore-deposition: and it may be also that the later granitic intrusions have played a part in influencing some of the ore-carrying solutions. The mere fact that some of the ore-shoots contracted at the shallow depth of a hundred feet from the surface, does not furnish the slightest reason for not pursuing the ore-channel down to reasonable distances. But so it is: and investors look askance on neglected districts, and prefer to take even off chances on a field which is alive. I have not the slightest doubt but that this 9-mile stretch of country will have its turn again, and when it comes, adventurers will wonder how it lay dormant for so long.

The nickel deposits at the Heazlewood are not so encouraging, the country rock,—serpentinised pyroxenite, is favourable enough, being the proper home of the metal, but no solid veins of any thickness have been met with in the superficial, *i.e.*, the more or less marginal parts of the rock-mass, and geological theory rather discourages the idea that greater depth brings increased deposits of this metal; on the other hand, it is from this rock that the osmiridium has come, which is being turned into money on a rising market by a few indefatigable prospectors on the Savage River.

Gold-mining on Long Plains is, I am bound to confess, a precarious occupation, and, I am afraid, will never give permanent work to any considerable number of miners. The field however is still in want of a thorough geological examination. The singular occurrences of richly auriferous patches which I have attempted to explain in this Report may occasion, from time to time, an influx of alluvial miners, and the prospecting work to which such rushes inevitably give rise may lead to results at present impossible to forecast.

There is yet another field on this route, the value of which, in its still undeveloped state, it is quite impossible to estimate, viz. :—the zone of the auriferous and cupriferous magnetite on the Rocky River and Rio Tinto line. The work done so far points to low grade copper ore, but the trials have been insufficient, and it is quite possible that future prospecting may open up more favourable portions of the deposit, which, so far as I am able to judge, belongs to the same series of ancient crystalline rocks as are worked all over the world for their ores of copper and iron.

The alluvial gravels near Corinna, which have been sluiced for gold with unsatisfactory results, do not offer any very hopeful prospects. The only chance is that virgin prospecting down to the bed-rock may strike some richer accumulation than the average. The Whyte River Gold Dredging Company is putting its plant together at the suspension bridge at the Rocky River mine, and the result of its enterprise will be seen shortly.

On the whole, then, these considerations lead me to look upon this part of the Colony as an undeveloped mineral field of considerable promise. The mineral deposits, however, do not simply invite investors to do nothing more than to come and remove them. Mining will have to be undertaken exactly like any other business, with due regard to all the factors of success; the details of working cost and market values carefully worked out: the mining and management must be skilful and well flavoured with business common sense, if disaster does not tread upon the heels of enterprise. Under these conditions, and with a reasonable degree of patience, the field ought to repay exploration, and will, I believe, eventually constitute a by no means inconsiderable addition to the mineral assets of the Colony. Its geological structure decidedly supports such a hope.

I have to tender my hearty thanks to the various mine managers on the fields, and others interested in the resources of this part of the Colony for their readiness and kindness in accompanying me and affording me information: also to the directorate of the Emu Bay Railway Company for facilities and courtesies extended.

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

W. H. TWELVETREES,
Government Geologist.

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

PETROGRAPHICAL REPORT.

Government Geologist's Office,
Launceston, Tasmania, 30th June, 1900.

SIR,

I HAVE the honour to present this Petrographical Report, consisting of notes on rocks which have been examined during the year ending 30th instant. Fresh varieties of rocks are continually being discovered, and I think it desirable to preserve and describe same as far as time and other duties permit. The descriptions will benefit workers in science throughout the Colonies, and the collections will prove useful to the department. I may add that these collections are open to the inspection of any interested in them. Microscopical slides have been prepared from all specimens, but in the descriptions reference is made to the naked-eye appearance of the rock, so as to assist its identification in the field. The numbers are those of the catalogue.

Granite found as a Boulder near Lefroy.

(776.) This was found resting on the Silurian slates and embedded in wash.

It is a medium-grained grey rock, with large fresh-looking crystals of orthoclase felspar. The constituent minerals are orthoclase, oligoclase, microcline, biotite, muscovite, quartz. This is a two-mica granite, therefore a granite proper, and, probably, a tin-bearing one. Whenever our granites become stanniferous, white mica is developed in them, and this fact suggests a secondary origin for the muscovite. The microcline is a triclinic felspar, showing in polarised light its characteristic spindle-shaped grating structure in rectangular bars.

Elvan, or Intrusive Quartz-felsite, Ringarooma Mine, Mount Victoria.

(779.) This occurs as a dyke, 22 feet wide, in the main tunnel of the Ringarooma Gold Mine, at North

Mount Victoria, and is intrusive in the Silurian slates. It proceeds, no doubt, from underlying granite, and is probably of Devonian age. Its colour is light buff, with a slight greenish tinge. It is hard and compact, nearly homogeneous in texture. It has a few blebs of quartz, and, more rarely, crystals of felspar scattered porphyritically in the groundmass. It is also sparsely sprinkled with arsenical pyrites. Microscopical characters: Those of quartz-felsite, the groundmass a holocrystalline granular mixture of quartz and felspar, with an abundance of small flakes, nests, and rosettes of muscovite; porphyritic quartz, with sharply angular, also rounded and corroded, boundaries. A tendency exists towards minutely granophyric structure.

The structure is, characteristically, that of elvans. Rosenbusch defines the Cornish elvans as granite porphyries, with biotite and muscovite (Massige Gesteine, 1896, p. 415). Harker includes granite porphyries and elvan dykes among the acid intrusive rocks, which he describes as "bridging over the difference between the even-grained holocrystalline granites and the porphyritic, largely glassy rhyolites." (Petrology for Students, 1897, pp. 99–105). Rutley, in his "Granites and Greenstones," calls the acid intrusives the "elvan group." Hence, despite the outcry against "elvan" as a miner's term, it can be used with sufficient precision for the needs of the petrologist. It means a dyke which proceeds from a granite mass. These dykes often pass through granite, and must then be supposed to originate from some deeper unconsolidated part of the granitic magma which had already crystallised in its upper portion.

Scapolite, from Serpentine, at Anderson's Creek.

(780.) This mineral, a hydrous silicate of alumina and lime, was found as loosened rounded boulders in a seam of asbestos near Beaconsfield. It was mistaken by the miners for quartz, which it somewhat resembles. It has, however, a slightly greenish tinge, and its hardness is only between 5 and 6. It is soluble, with difficulty, in HCl. Microscopical characters: Confusedly crystalline, with the larger crystal faces obscurely divergent. The crystals often form rosettes. Double refraction

strong; interference colours higher than quartz. Extinction straight in longitudinal sections. No sensible absorption.

Scapolite is mostly found in schists and gneiss. It also occurs in amphibolites and ophites. When it is found in gabbro it has been derived from felspar, and this may have been the case here, though there is some reason to believe that the serpentine was originally a pyroxenite. Scapolite is, undeniably, a secondary mineral, and was here formed during the hydrometamorphic process of serpentinisation.

Diabase from summit of Mount Victoria, 4000 *ft.*

(781.) The usual augite-labradorite dolerite of our Tiers, usually assigned to the close of the Mesozoic. It is holocrystalline, with occasional unindividualised groundmass showing microscopically between the felspars. I take this anisotropic pseudo-groundmass to be felspathic and not vitreous. The augites have a slightly ophitic tendency.

At the top of the mountain this rock is columnar, and forms a mass, apparently capping the summit, 1500 feet thick. The question which geologists have to settle is whether the occurrence, which is matched everywhere on the other mountains of eastern Tasmania, is that of a real cap, the remnant of a volcanic sheet or intrusive sill, or whether it has a downward extension as a core or laccolite column. This is one of those points in theoretical geology which have important practical bearings. Any theory of the origin of these dolerites (variously termed diabase, greenstone, or trap) affects the continuance of our coal seams.

Bronzitite from Anderson's Creek, near Beconsfield.

(784.) This is from the serpentine on the asbestos section at Anderson's Creek. It is a dark, granular rock, composed wholly of bronzite, which shows in glistening crystals. The pyroxene is largely converted into bastite, the serpentinous modification of enstatite, and contains only small grains of olivine embedded in the pyroxene crystals. No felspar is visible in this section. The rock is, accordingly, a true pyroxenite, and is

interesting, as being the parent rock from which a good deal of the serpentine on this field has been derived. I have not seen any gabbro here, but, from the appearance of scapolite referred to above, its existence is highly probable.

Syenite from Heazlewood River.

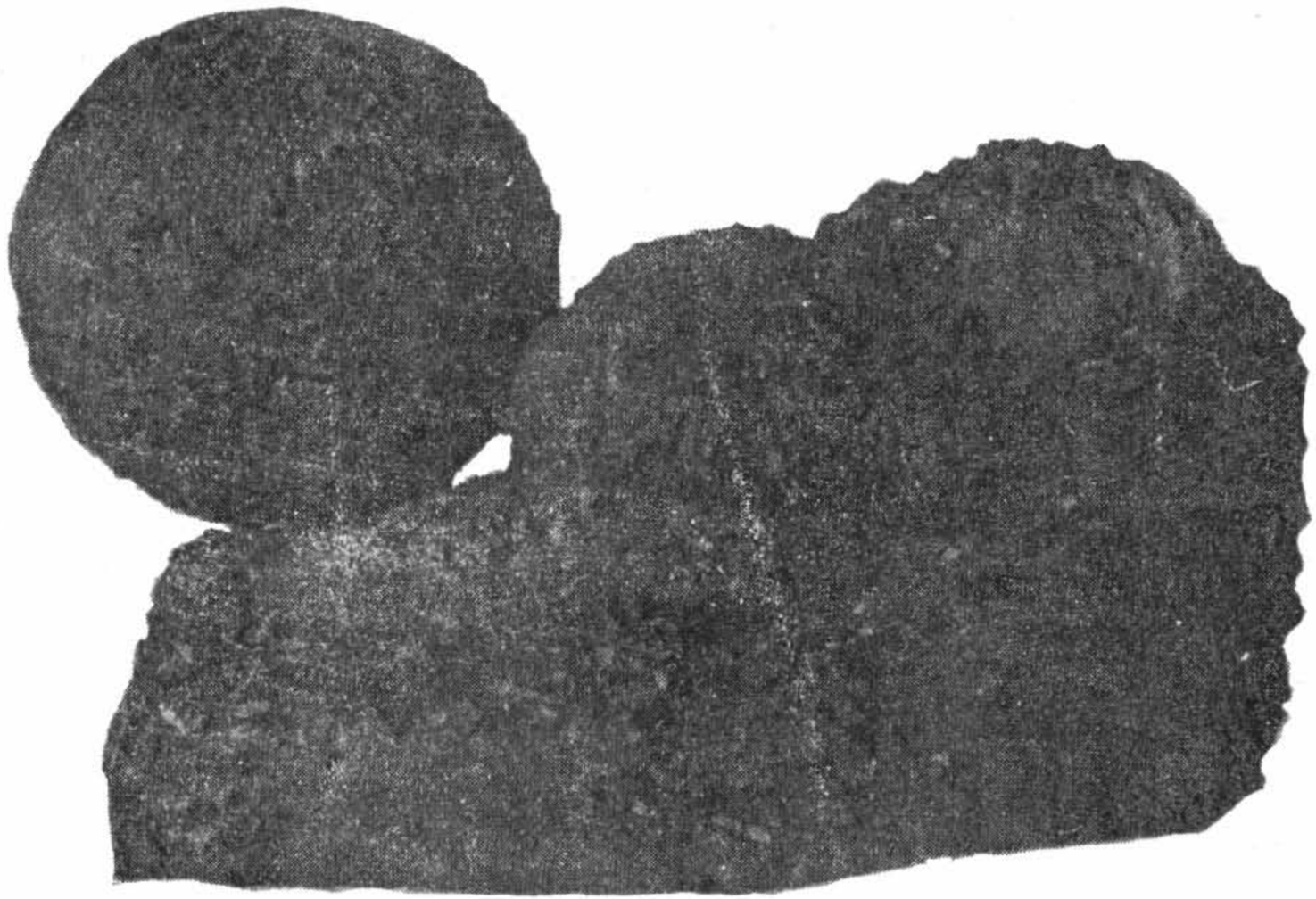
(785.) Found on the north bank of the river, a mile N. of the road at the 13-mile. A light-grey hornblendic granitoid rock, with hornblende very plentiful. Constituents: Orthoclase, oligoclase, hornblende, quartz, and accessory sphene. The quartz is very miarolitic, and beautiful granophyric intergrowths of quartz and felspar are abundant. Mica absent or very rare. The orthoclase seems to predominate over the triclinic felspar, but the rock is, evidently, verging on quartz-diorite.

Websterite from Heazlewood Extended Mine.

(786.) A nickel-stained pyroxenite forming the dyke, which is the ore-channel in this mine. Both microscopically and macroscopically it resembes the dyke-rock at the Magnet Mine. It is composed of pyroxene crystallising in both the monoclinic and orthorhombic systems. The two forms may be optically differentiated under the microscope by the straight extinction and lower interference colours of the rhombic pyroxene. The enstatite is undergoing alteration into bastite. A good deal of chloritic and serpentinous matter, with some talc, occupies the spaces between the more perfectly preserved crystals. It is not easy to say whether the original structure was porphyritic or gabbroid. There is a marked absence of iron ore in the slide.

Gneissose Gabbro-amphibolite from Rocky River Mine.

(787, 788.) This is the rock which is the channel of (819.) the cupriferous magnetite lode at that mine. It is enclosed in talc schists, into which it apparently passes. In places it is a pale banded gneiss; at other spots it is fissile and compact, passing into a hornblendic schist; or, again, it is coarse and gabbroid in texture. Its colours are green and grey in various shades. It consists of a fibrous green hornblende, with



SPHEROIDAL WEBSTERITE FROM NORTH MAGNET

Showing orbicular segregations in the rock. Photo. (natural size), by Mr. F. E. Burbury

large gabbro-like plates of plagioclastic, none too basic, felspar (perhaps reconstructed), apatite, quartz, and a good deal of epidote. Talc, hornblende, asbestos, calcite, and serpentine occur as minerals in its more decomposed portions. The hornblende is often in streaks or bands, giving the rock its gneissose character.

Its nearest allies seem to be the gabbro-diorite of Törnebohm and the zobtenite of Justus Roth, which are amphibolites derived from gabbro by dynamo-metamorphic processes. It is of much more ancient date than the Heazlewood and Mount Agnew gabbros, being, probably, Cambrian or pre-Cambrian. Tasmanian geologists would do well to pay this locality a visit.

Granite from Mount Darwin.

(806.) The specimens taken by me are composed nearly entirely of orthoclase, felspar, and quartz. A little dark mica and hornblende are accessories. Oligoclase is also present. The apparent absence of muscovite would suggest the name granitite, were it not for the abundant quartz, which is a more sparing constituent of granitites.

This rock forms the southern knob of Mount Darwin, and runs N. for some distance along the crest of the mountain, lying between the quartz-felsite on the W. and schist on the E. The point which requires settling is whether it belongs to our post-Silurian granites or is of earlier date. Its actual contacts are not satisfactorily exposed.

Spheroidal Websterite from Magnet Range.

This remarkable rock is exposed along the W. side of the diabase-porphyrite belt to the W. of the ore-bearing websterite dyke on the North Magnet section. It may be seen in a trench along the track half a mile north of the mine. It is yellowish-brown in colour, nearly always in a soft decomposed state, and full of balls of rock from the size of a pea to a cocoa-nut, and which drop out of their cavities readily upon being tapped with the hammer. These spheres split easily in halves, and to the naked eye appear to consist of the same mineral substance as their matrix, and without any sign of a radiated or concentric structure.

The rock itself has the appearance of being a confused soft mass of crystals of enstatite, which are often arranged in a cruciform manner, giving a very characteristic impress to the rock. Under the microscope the only primary constituent which can be seen is pyroxene, chiefly enstatite, with a little diallage or augite. A good deal of talc and chlorite fill up spaces which were once, probably, occupied by pyroxene, and there are occasional vesicles filled with chloritic aggregates.

Spheroidal gabbro is known from Norway, and locally called potato-rock ; but the spheroids are made up usually of concentric layers, and are occasionally radiated. Spheroidal granite, too, is concentric. The balls in the present rock are not always perfect spheres, and, sometimes, have the form of dumb-bells. Evidently their shapes have been influenced during the formation of the rock, and while the latter was still plastic. If this be admitted, we seem shut up to the conclusion that they are the result of a process of segregation.

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

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

JOHN VAIL,
GOVERNMENT PRINTER, TASMANIA.