TASMANIA.

REPORT

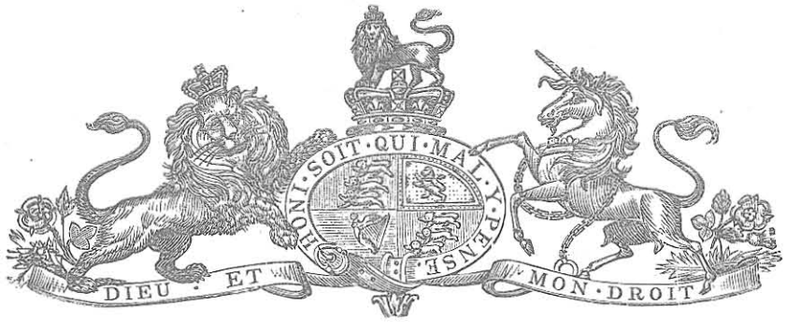
OF THE

SECRETARY FOR MINES

FOR

1898-9,

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



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1899.

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REPORT OF THE SECRETARY FOR MINES.

Mines Department, Hobart, 11th August, 1899.

SIR,

I HAVE the honour to submit my Report upon the Mines Department, and the progress of the Mining Industry of the Colony, for the year ending the 30th June, 1899.

Appendices.

Appended will be found Reports from the Commissioners on the condition of the Mining Industry in the Divisions under their charge; the Reports of the Inspectors of Mines; the Annual Report of the Mount Cameron Water-Race Board; a Report on the Tasmanian Smelting Company's Works, with a plan of the works; the Mount Lyell Mining and Railway Company's Works; a Report on the Magnet Silver Mine; the Government Geologist's Reports on the Bell Mount and Middlesex Mineral Fields, on the Penguin and Dial Range Mineral Fields, on the discovery of Gold at Port Cygnet, and on the Alluvial Tin Mines at Derby; Papers by Messrs. Twelvetrees and Petterd on Limurite in Tasmania, Haüyne-Trachyte and allied rocks in the Districts of Port Cygnet and Oyster Cove; Notes on Humeri of Tasmanian Labyrinthodonts; the Felsite and associated rocks of Mount Read and vicinity; Supplementary Note on Limurite in Tasmania, Nepheline and Melilite Rocks from Shannon Tier, and on Mesozoic Dolerite and Diabase in Tasmania; Returns showing the operations of the Diamond Drills; the Examination Papers set at the Examination for Mine Managers' Certificates; and Returns showing the yield of Gold, Coal, Tin, Silver ore, Blister Copper, Copper ore, and Iron ore; the Number of Persons engaged in Mining; the Number of Leases and Area of Land held under lease for mining purposes; the Net Revenue paid to the Treasury from Mines; the Number of Miners employed during the year; and the Total Amount of Rents and Fees received by the Department during the year.

General Remarks.

It is very gratifying to note that the rapid progress of the mining industry which was recorded in my last Annual Report has been fully maintained during the year just closed, and mining throughout the Colony is in a very satisfactory condition.

The rise in the London market price of tin, which has exceeded £48 10*s*. per ton during the year, has given a great impetus to the tin-mining industry, and has induced prospectors to go out in search of new ground, while some of the old abandoned alluvial tin-fields have been retaken up with every prospect of paying handsomely while the price of tin remains so high. In order to encourage the industry, large areas of tin-bearing country have been allowed to be taken up under prospectors' licences, free of rent, for periods of six months, renewable upon proof being supplied that *bonâ fide* operations have been carried on during that period; and this has resulted, in many instances, in the discovery of payable tin deposits, and a large number of sections have been taken up under lease.

Prospecting operations are still being carried on in many places with most encouraging results, and it is only reasonable to expect that during the next year the output of tin will be very considerably increased.

Many river claims have been applied for during the year, and this new industry is likely to prove very successful in some of our rivers.

The Tasmanian Tin Dredging Company have just completed the pontoon and erected machinery thereon, and are about to start active operations on the Ringarooma River at Derby.

Although the dredge has, so far, only had a trial to test its suction-pump and machinery, and has a large accumulation of tailings to treat before reaching the natural bed of the river, most encouraging results were obtained.

Dredging claims have also been applied for along the foreshore at St. Helen's Point and Medea's Cove, George's Bay. The ground has been thoroughly tested by prospecting shafts and bores, from which good results have been obtained.

The total value of minerals and metals raised during the year is £1,277,740, being an increase of £361,857 as compared with the previous year, and the amount paid in Dividends is £282,700 15*s.*

The amount of revenue received by the Department for the year ending 30th June, 1899, is £24,696 10*s.* 5*d.* The quantity of gold won is 84,189½ ozs.; of this amount, 24,823 ozs. has been obtained from the blister copper from the Mount Lyell Mining and Railway Company's mine.

Mount Lyell.

The Mount Lyell Mining and Railway Company have exported during the year 6079 tons of blister copper, an increase of 1017 tons over the previous year. The future prospects of this mine are most encouraging. A winze put down 25 feet from the No. 5 tunnel is in good ore, which gave a bulk assay of 14 per cent. copper, 17 ozs. silver, and 3 dwts. of gold per ton.

The aerial trams are working satisfactorily, and about 800 tons of crude ore are treated every 24 hours.

Further particulars will be found in a report from the General Manager attached.

At the North Lyell Mine the principal work is opening up on the surface, so that the mine can be worked upon the open cut principle. I believe it is the intention to discontinue sending their crude ore to London for treatment.

The Lyell Tharsis Company have completed their aerial tramway and are working two shifts, sending about 100 tons of ore daily to the smelters at Queenstown.

The South Tharsis Mine is looking very well. The Company are erecting a very extensive concentrating plant for treating the ore before sending it to the smelters.

There are several other mines at work, particulars of which will be found in Mr. Commissioner Fowell's Report, which is appended.

Mount Zeehan.

Mining operations in this district have been very satisfactory during the past year. There has been an increase in the output of silver-lead ore of nearly 9000 tons. This is mainly owing to the completion of the Tasmanian Smelting Company's works, a market being thus established for the sale of low-grade ore, which would not pay to export. This Company during the year purchased 11,863 tons of ore, valued approximately at £32,060, and employs 150 men, irrespective of those employed at the lime quarries and in wood-carting.

Dundas.

With the exception of the Comet Mine, which delivers about 250 tons of ore per month to the smelters, very little work is being done in this district.

Mount Bischoff.

The output of ore from the Mount Bischoff Tin Mine was 1839 tons, and the amount paid in dividends £55,500. The total amount of tin ore obtained since the formation of the Company is 54,462 tons, and the total amount paid in dividends is £1,564,500, being equal to £130 7*s.* 6*d.* per share.

The Magnet Silver Mine, which is situate about seven miles from Waratah, is now making good progress. The total quantity of ore exported is 581½ tons, net value £7462. It is fully expected that within a few months this mine will be able to sustain an output of 200 tons of 1st class ore per month. Appended is a report upon the progress of this mine, which has been supplied by the legal manager, Mr. G. L. Meredith.

North-West Coast.

A few men are employed at the Blythe River Iron Mine, and the owners have just completed the survey of a tramway from the mine to connect with the Emu Bay Line at Burnie.

The tramway will be about 6½ miles in length, and when completed, this mine will add very considerably to the output, which at present averages only about 170 tons a month.

At Middlesex Plains, Bell Mount, Forth, &c., many prospectors are engaged in exploring the region. There are at present only about four settled mining operations, but the only one demanding special notice is that known as the Shepherd and Murphy Mine. Although the mine contains several associated metals, its present principal yield is tin and bismuth. Some 500 tons of ore are estimated to be in sight, and 600 tons of ore have been mined and are ready to be dealt with, and about 300 tons have been sent away by means of pack-horses; but little progress can be made until the difficulties of transit can be overcome by means of a road.

Beaconsfield.

The yield of gold from the Tasmania Mine is 28,137 ounces, an increase of 1969 ounces over the previous year. The total quantity of ore crushed since the formation of the Company is 388,925 tons; total quantity of gold obtained, 457,475 oz. 14 dwts. 7 grs., value £1,664,432 13*s.* 4*d.*; and the total amount paid in dividends, £694,071 15*s.*

There are eight other mines doing prospecting work on this field at various depths from the surface.

A strong Company has been formed in Victoria for the purpose of working the extensive deposits of asbestos in the vicinity. The quality of the asbestos is said to be superior to that produced in other parts of the world. Should it prove to be so, there can be little doubt as to the importance of the enterprise.

Lefroy.

The only mines at present which have attained any depth are the Volunteer and New Pinafore Companies, and all hopes for the future of this field are centred in the efforts of those mines.

The former has been prospecting at the 1300 feet level, and the latter at the 1250 feet level. Should they succeed in obtaining gold at such a depth it would be an incentive to the other mines in the locality, which were once so prolific to a depth of 400 feet, to resume operations.

There are at present about 133 men employed in mining and prospecting on the field.

The amount of gold won for the year is 2145 ounces.

North-Eastern Division.

At Mount Victoria mining operations have been carried on in a very satisfactory manner on several of the claims.

Extensive and costly works are being erected by the Ringarooma Gold Mining Company, with a view of thoroughly opening out the mine so that it can be worked economically and successfully. Electric pumping and winding plants are being erected for this purpose. This company also holds 300 acres of freehold land at New River, upon which gold reefs have been found, and so far have proved payable.

Several other claims in the vicinity are making satisfactory progress.

The quantity of gold obtained was 2273 ounces from 2397 tons of quartz crushed.

At Branxholm much activity is shown in tin-mining, a large number of claims being at work in the neighbourhood of Ruby Flat.

The Arba Company are repairing their water-races at considerable cost, and intend working their claims upon a much larger scale.

At Derby and Brothers' Home the principal tin mines have been continuously worked. The Briseis and New Brothers' Home Companies are surveying races to bring in an abundant supply of water from the Upper Ringarooma River. The yield of tin from the Krushka Brothers and Brothers' Home Mines continues satisfactory. At Moorina a large number of old abandoned claims have been taken up again, consequent upon the advance in the price of tin, and this field is once again yielding very fair returns.

A large area of country in the vicinity of the Ringarooma River has been taken up under Prospectors' Licences, and prospecting for tin by boring is being actively carried on in some of the low-lying flats with most encouraging results. There is a very promising future before this

district. The quantity of tin ore obtained was 887 tons, being an increase of over 118 tons on the previous year.

Eastern Mining Division.

At Mathinna the New Golden Gate Mine is still holding its own, the yield of gold is very little short of last year. This mine is down 1330 feet, and still in a large body of payable stone.

The quantity of gold obtained during the year was 19,690 ounces, value £77,624; dividends paid, £37,600. The total quantity of gold obtained is 134,452 ounces, and the amount paid in dividends £235,200.

Many other claims are being worked in and near Mathinna, with good and encouraging prospects, and a large amount of dead work is being done.

At Fingal the Miami Mine has done a lot of dead work, and expended a large sum in labour, &c., the number of men employed being about 34.

The West Miami and Lady Dora Mines are doing prospecting work with favourable prospects.

Mangana.—The Mangana (Tasmania) Gold Reefs, Limited, are at present erecting machinery at the main shaft, which is down 210 feet. Some very rich specimens of gold have been obtained from this mine.

Several other Companies are working in the vicinity, and about eight men are making good wages by working the alluvial ground about the gullies.

At South Mount Victoria a large area of land has been applied for, and several sections are being worked with encouraging results.

Ben Lomond.—At the Rex Hill Mine twenty-six men are employed, and during the year they have sunk a winze 40 feet from the adit, and driven 40 feet in good tin stone. At the end of the drive two chambers have been worked about 70 feet by 60 feet, with a pillar left in the centre for support. The ore, which used to be hauled up by a hand windlass, is now drawn up an inclined haulage line of about 1 in 3, which reaches to the bottom of the chamber.

A large dam has been constructed on Buffalo Creek, about three miles north of the mine; 14 chains of fluming have been erected, and about half a mile of race cut to convey water to the battery.

A ten-head battery, four classifiers, four jiggs, and two frue vanners have been erected.

At Storey's Creek, crushing and concentrating plants are being erected to treat wolfram. After crushing, the ore will be hand-streamed. The output of ore up to the present has only been 2½ tons, hand-picked; value, about £26 per ton.

A large area of tin ground has been prospected and taken up in the vicinity of Avoca.

Mount Nicholas.—The Mount Nicholas and Cornwall collieries have continued steadily at work, and have obtained about 39,141 tons of coal. These mines have considerable trouble through down faults occurring. The number of men employed is about 435.

At Bicheno a large area of land has been withdrawn from the operation of "The Crown Lands Act" and "The Mining Act," in the interest of the Morning Star Coal Company, who, I believe, intend to introduce a Bill during the present session of Parliament upon lines somewhat similar to the East Coast Coal and Harbour Company's Act, passed some years ago.

Scamander River.—The Copper and Silver mines in this locality are again attracting attention, and a number of sections have been again taken up.

At St. Helen's a large extent of land has been taken up for tin near St. Helen's Point and along the foreshore of George's Bay. For some months prospecting has been carried on, and about 30 prospecting holes, from 6 to 14 feet deep, and 45 bores from 6 to 25 feet, have been put down, from all of which I am informed excellent results have been obtained. It is intended to work this property by suction dredges.

Blue Tier.—The Anchor Tin Mine has treated during the year about 18,300 tons of ore, and has obtained 62 tons of tin ore, valued at £4464. The number of men employed was 96.

The Liberator, Cambria, and Australian mines are working with very good results. Further particulars will be found in the Reports of Mr. Inspector Griffin and Mr. Commissioner Dawson.

New Discoveries.

During the year Reward Claims have been applied for as follow :—Gold—Flinders Island and Scottsdale ; Silver—Bathurst Range, Liena, and Rinandina ; Copper—Barn Bluff, Mount Sadler, Nelson River, Sandy Cape, and Whale's Head ; Tin—Flinders Island ; Wolfram—Scamander Range.

Quarterly Reports.

Quarterly Reports on the Mining Industry of Tasmania, compiled by the Government Geologist, have been regularly printed and distributed all over the world ; while a large number is also regularly forwarded to the Agent-General in London for free distribution.

Mine Managers' Examination.

Three candidates presented themselves at the examination held in March last ; one candidate succeeded in obtaining a second class certificate.

Appended will be found copies of the examination papers set.

Zeehan School of Mines and Metallurgy.

The number of students attending the school regularly during the year has averaged 35. The average attendance at the various classes has been as follows :—

Mathematics	12	Students.
Applied Mechanics	6	ditto.
Mineralogy	6	ditto.
Geology	6	ditto.
Ore Dressing	4	ditto.
Theoretical Chemistry	15	ditto.
Analytical Chemistry	14	ditto.
Fire Assaying	10	ditto.

At the beginning of 1899 Mr. R. Montgomery was appointed instructor in Mathematics. Classes are now held four nights a week in this subject, thus enabling the students to devote much more time to it than previously, and also allowing more time to be devoted to Mechanics and Mineralogy.

Many important additions have been made to the Laboratory during the last year, and the space available for chemical benches is completely taken up. The present building cannot accommodate more students in this subject than are at present in attendance. A brick fume cupboard has been erected, and water laid on throughout the Laboratory.

The Committee obtained a very complete collection of minerals and rocks from the Frieburg School of Mines. They have also purchased a collection of crystal models. These collections are proving of great assistance in the Mineralogy and Geology classes. In the second vacation of 1898 a students' Geological excursion was made to Mount Lyell and Queenstown. Twenty-one students availed themselves of the opportunity of making the trip, which proved most instructive. The students visited the smelting works of the Mount Lyell Mining and Railway Company, also the Mount Lyell, North Lyell, King Lyell, and Lyell Tharsis Mines, and were most courteously treated by the officials of the various works and mines, who took the greatest pains in explaining the various processes and the geological features of the ore bodies.

Mineral Products.

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

	Quantity.	Value.
		£
Gold	84,189½ ozs.*	331,414
Silver	24,203¼ tons	217,735
Tin	2006¼ „	189,847
Coal	44,141 „	37,915
Blister Copper	6079 „	467,268†
Copper Ore	1889 „	31,985
Iron Ore	1633 „	1576
		£1,277,740

* Including 24,823 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 £361,859 on the previous year.

The amount paid in dividends was £282,700 15*s*.

Departmental Staff.

During the year the Department has again sustained a very severe loss through the death of one of its most prominent officials. I refer to Mr. James Harcourt Smith, B.A., Government Geologist and Chief Inspector of Mines. Mr. Smith was a young man, and a native of Tasmania, just entering a career of great promise, having obtained a good knowledge of the geology of Tasmania, and gained the confidence of the Department and the mining community. Owing to his death, which occurred while on a visit of inspection of the mineral deposits on Flinders Island in June last, his annual Reports as Government Geologist and Chief Inspector of Mines are not appended.

Owing to the vacancy caused through the death of the late Government Geologist and Chief Inspector of Mines, the Department called for applications for the vacant position, and out of 23 applications, in which all the Australian Colonies were represented, selected Mr. William Harper Twelvetrees, F.G.S., of Launceston. This gentleman is a native of England, and received his education in Germany, and for several years was in charge of copper mines and smelting works in Russia. He has travelled widely in Europe, studying the geology of Austria, Servia, Roumelia, Turkey, and many other places, and for the last eight years has resided in Tasmania, and has made himself well acquainted with its geological features.

Several valuable and interesting papers on the igneous rocks, &c., of Tasmania, prepared by Mr. Twelvetrees, in conjunction with Mr. W. F. Petterd, are, with their kind permission, appended.

The work of the Department has increased very considerably during the year. 5754 letters have been received and replied to, being an increase of over 600 on the previous year, and 960 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, 40 plans have been prepared for the lithographer, 14 of which were new compilations, and 1070 diagrams in duplicate have been drawn on leases, which have been engrossed by the two engrossing clerks.

I have once again to record my sincere thanks to the officers of the Department for their loyal support during the year, especially to those who, through pressure of work, have willingly remained long after office hours to keep their work up to date.

Mount Cameron Water-race Board.

The report of the Board is annexed.

Diamond Drills.

Details of the work done by these machines are appended.

In conclusion, I have much pleasure in reporting that the mining industry has made rapid progress during the year; old abandoned fields have been taken up again and vigorously and successfully worked; new discoveries are constantly being reported; foreign capital is being largely introduced into the mines; and investors and capitalists are daily gaining confidence in the mineral resources of the Colony. Altogether the outlook for the future is most promising.

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

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

The Hon. the Minister for Mines.

DIAMOND DRILLS.

Statement of Work done to 30th June, 1899.

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
1898–9	Blue Tier (Anchor Co.)—For Tin	Ditto	3	265½	Still working.
	Total		43	15,739½	
	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..... 84
Total distance bored..... 27,368½ feet.

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

Hobart, 30*th June*, 1899.

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, *and the first Half-year of* 1899.

YEAR.	QUANTITY.	VALUE.
	ozs. dwts.	£
1880	52,595 0	201,297
1881	56,693 0	216,901
1882	49,122 6	187,337
1883	46,577 10	176,442
1884	42,339 19	160,404
1885	41,240 19	155,309
1886	31,014 10	117,250
1887	42,609 3	158,533
1888	39,610 19	147,154
1889	32,332 13	119,703
1890	20,510 0	75,888
1891	38,789 0	145,459
1892	42,378 0	158,917
1893	37,687 0	141,326
1894	57,873 0	217,024
1895	54,964 0	206,115
1896	62,591 0	237,574
1897	77,131 0	296,660
1898	74,233 0	291,496
1899, for the first Half-year	39,556 0	154,093
TOTALS	939,847 19	3,564,882

No. 2.

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

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, for the first Half-year	34,134	135,714
TOTALS	802,978	3,025,790

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, *and the first Half-year of* 1899.

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, for first Half-year	19,841	18,361
TOTALS	550,498	473,102

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, *and for the first Half-year of* 1899, *compiled from Customs Returns only.*

YEAR.	TONS.	VALUE.
		£
1880	3954	341,736
1881	4124	375,775
1882	3670	361,046
1883	4122	376,446
1884	3707	301,423
1885	4242	357,587
1886	3776	363,364
1887	3607½	409,853
1888	3775¼	426,321
1889	3764	344,941
1890	3209¼	296,368
1891	3235	291,715
1892	3174	290,083
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, for first Half-year	961	107,263
TOTALS	65,205¾	5,720,975

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, *and the first Half-year of* 1899.

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, for the first half-year	15,882	114,577
	141,100	1,538,061

No. 6.

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

YEAR.	QUANTITY.	VALUE.
	tons.	£
1896	41½	1245
1897	4700	322.500
1898	4955½	400,668
1899, for the first half-year	3358	316,101
	13,055	1,040,514

No. 7.

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

YEAR.	QUANTITY.	VALUE.
	tons.	£
1896	34	1020
1897	75	2250
1898	394	8128
1899, for the first half-year	1546	25,387
	2049	36,785

No. 8.

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

YEAR.	QUANTITY.	VALUE.
	Tons.	£
1897	894	812
1898	1598	1598
1899, for the first half-year	987	930
TOTAL	3479	3340

No. 9.

RETURN showing the Number of Persons engaged in Minina during the Years 1880 *to* 1898 *inclusive, and first Half-year of* 1899.

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, first half-year	6484
1889	3141		
1890	2868		

No. 10.

RETURN showing the Number and Area of Leases held under "The Mining Act, 1893," *in force on* 30*th 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.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.
		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
For Coal and Slate, at a rental of 2*s.* 6*d.* an acre	37	6551	37	5946	38	6105	41	5943	39	6002
For Gold, at a rental of 20*s.* an acre	455	4366	602	5712½	615	5789	702	7190	652	6725
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.

No. 11.

RETURN of the Number and Area of Leases under "The Mining Act, 1893," *in force on the 1st July*, 1898, *issued during the Year ending 30th June*, 1899, *cancelled during the Year ending 30th June*, 1899, *and remaining in force on 30th June*, 1899.

Nature of Lease.	In force on 1st July, 1898.		Issued during Year ending 30th June, 1899.		Cancelled during Year ending 30th June, 1899.		In force on 30th June, 1899.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.
		Acres.		Acres.		Acres.		Acres.
For Tin, &c., at a rental of 5*s.* an acre	1290	66,981	612	37,130	695	39,772	1207	64,339
For Coal and Slate, at a rental of 2*s.* 6*d.* an acre	41	5943	6	667	8	608	39	6002
For Gold, at a rental of 20*s.* an acre	702	7190	235	2178	285	2643	652	6725
Water Rights, Mineral and Gold	159	784 sluice-heads.	60	315 sluice-heads.	19	166 sluice-heads.	200	933 sluice-heads.

No. 12.

COMPARATIVE Statement of Net Revenue from Mines, being Rents, Fees, &c., paid to the Treasury for the Year ending 30th June, 1899.

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

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

TOTAL Number and Area of Leases in force on 30th June, 1899.

MINERALS.	NUMBER.	AREA.
		Acres.
Gold	652	6725
Silver	406	20,850
Tin	238	8684
Coal	21	3243
Iron	7	428
Limestone	15	1727
Lithographic Stone	2	417
Slate	2	715
Nickel	1	40
Wolfram	5	280
Asbestos	5	316
Precious Stones	1	80
Copper	100	5864
Minerals	440	27,280
Marble	1	317
Graphite	2	100
TOTAL	1898	77,066

AVERAGE Number of Miners employed during the Year ended 30th June, 1899.

	EUROPEANS.	CHINESE.
Northern and Southern Division	944	...
North-Eastern Division	272	180
Eastern Division	599	63
North-Western Division	297	...
Western Division	3825	...
	5937	243

MINING Companies registered during the Year ending 30th June, 1899.

NUMBER OF COMPANIES.	CAPITAL.
41	£91,162

TOTAL Area of Land applied for during the Year ending 30th June, 1899.

MINERAL.	NO. OF APPLICATIONS.	AREA.
Gold	293	2637
Silver and other Minerals	444	25,318
Tin	291	9735
Coal, Limestone, &c.	5	350
TOTAL	1033	38,040

In addition to the above, 77 applications for Dredging Claims, 31 applications for Mining Easements, and 131 applications for Water Rights (612 sluice-heads of Water) were received.

TOTAL Amount of Rents, Fees, &c., received by the Mines Department during the Year ending 30th June, 1899.

HEAD OF REVENUE.	AMOUNT.
	£ s. d.
Rent under "The Mining Act, 1893," for Gold	5969 8 9
Fees " " "	708 6 6
Rent " " for Minerals	15,544 9 9
Fees " " "	2470 10 2
Survey Fees	4788 14 6
Rent of Diamond Drills	3 15 3
TOTAL	£29,485 4 11

(No. 69.)

MINE MANAGERS' EXAMINATION.

MARCH 28TH, 29TH, AND 30TH, 1899.

Questions set.

SECTION A.—MINING.

1. What precautions would you observe in approaching old workings full of water by means of a drive?
2. Under what conditions do you consider the employment of rock-drills economical?
3. Name the most common and dangerous gas in the lode mines of this Colony, and how is its presence detected?
4. In this Colony, and also in the other Australian Colonies, it has been observed that when north winds prevail many mines are troubled with foul air. Give reasons why gases accumulate under the conditions mentioned, and describe fully some mode recently adopted by some of the mines of Victoria for removing foul air.
5. Describe the conditions under which deep-lode mining can be conducted more economically by the underlay shaft system than by vertical shafts.
6. Make a sketch plan and section of any displacement of lodes that has come under your notice.
7. In a mining district, where lodes have proved payable to a depth of 1000 feet, it is intended to sink a new vertical shaft for the purpose of working three lodes striking N. and S. and underlying E.—
   (*a*) In what direction from outcrops, and at what vertical depth, should lodes be intersected in the shaft?
   (*b*) State dimensions of shaft required for working lodes mentioned in question (1), assuming it is intended to install a 16″ Cornish pump. State also the dimensions of each compartment of such shaft; the most suitable distance between levels; the height, length, and width of plunger plats.
   (*c*) State the vertical distance in shaft at which plunger workings are usually fixed, and the reason why.
   (*d*) In the event of underground balance-bobs being used, at what depths should they be fixed, and the height and length of bob-plats?
   (*e*) Assuming it is intended to mine to a depth of 2000 feet, and that 16″ Cornish pumps are to be used, state the most suitable material for main rods, and dimensions of same, and the length, width, and thickness of strapping-plates required.
8. Describe the different modes of shaft-timbering with which you are acquainted, and state some of the advantages and disadvantages of the several modes described.
9. Assuming rotten ground is encountered in sinking a main shaft at the point or depth it is intended to open out, describe fully how work should be conducted preparatory to opening out.
10. When putting up a rise in rotten ground, describe in detail how you would proceed.
11. Make a rough sketch and describe a method of ventilating a drive by means of water under pressure.

SECTION B.—ORE-DRESSING AND SAMPLING.

1. Two lodes, A and B, contain ores suitable for concentration. In A the valuable portion is finely disseminated, and is only 2 per cent. to 4 per cent. of the bulk. In B the valuable ore is coarser, and is 12 per cent. to 20 per cent. of the bulk. What system of crushing and concentration would you adopt for each?
2. How would you ascertain your losses in a concentrating mill? From what parts would you take your samples, and how often?
3. Describe any automatic slime-dressing machine that you are acquainted with.

SECTION C.—MINING GEOLOGY.

1. Explain the terms:—Strike, Outcrop, Gossan, Fault, Crosscourse, Slickenside, Horse, Gangue, Tuff, Stockwork.
2. Give instances of Deep Leads in Tasmania, and explain fully how they have been formed. What deduction may be drawn from the fact that the bottom is in some instances below sea-level.
3. Distinguish between Fissure Veins, Bedded Veins, Contact Veins, and Gash Veins, and explain briefly how they have been formed.
4. In what kinds of rocks are deposits containing Copper Pyrites, Cinnabar, Cassiterite, Galena, and Gold respectively usually found, and with what minerals are they most frequently associated?
5. State your views as to the influence of depth on the productiveness of lodes.
6. State and explain Zimmerman's Law for recovering the faulted part of a lode. Illustrate your answer by diagrams showing right-handed and left-handed heaves.

Section D.—Mining Surveying.

1. Explain the terms:—Magnetic Meridian, True Meridian, Declination, Azimuth, Latitude, and Departure, and describe a method for accurately determining the True Meridian.
2. Describe the construction and mode of adjusting and using the Transit Theodolite.
3. What precautions should be taken in making a survey with the magnetic needle in the presence of iron. Write out the field notes of such a survey, having at least six stations, and show how the correct bearings of all the traverse lines may be obtained, provided any one station is free from local magnetic attraction.
4. From the bottom of a vertical shaft A, the following traverse is made:—

A to 1	bearing	63°	distance	189 feet 6 inches
1 to 2	„	153° 30′	„	72 feet
2 to 3	„	179°	„	136 feet 3 inches
3 to 4	„	195°	„	117 feet

Calculate the co-ordinates of the points 1, 2, 3, and 4, and find the distance and bearing from the top of the shaft to a point on the surface vertically above 4.

5. Explain fully how the surface and underground workings of a mine may be connected (*a*) by means of one shaft, (*b*) by means of two shafts. Illustrate your answer with diagrams.
6. The following measurements are made from the top to the bottom of an underlay shaft:—

	Bearing.	Vertical angle.	Distance measured on the slope.
First line	157°	30°	83 feet
Second line	159°	27°	130 „
Third line	156°	29°	62 „
Fourth line	160°	34°	119 „

Calculate the true bearing between the first and last stations, the vertical depth of the shaft, and the horizontal distance between the top and bottom.

7. State what adjustments are necessary for correct work in using a surveyor's level.
8. Write out Samples of Entries in a Level Book, and plot a section from same.

Section E.—Surface Work.

1. What load hanging from a $1\frac{1}{2}$-inch round wrought iron rod of ordinary quality would be likely to fracture same?
2. Make sketch section for a dry rubble retaining wall that will support 12 feet in depth of tailings, and give dimensions you would employ in interests of economy and safety.
3. The boom of a Derrick Crane is set, first at an agle of 30° from the vertical, and then at an angle of 45° from the vertical; what is strain on boom in each case when a load of 10 tons is being moved? Further, what should be the sectional area provided the ultimate strength of material in boom is 2000 lbs. per square inch, and a factor of safety of 4 is adopted?
4. Make hand-sketch showing construction of fluming for a water-section of 12 square feet carried on four bearers over an opening 25 feet wide without intermediate support, and state size of beams under same condition as to material as in question 3.
5. The water in a reservoir pressing against a dam is 208 feet wide at surface, 100 feet wide at bottom and centre, and with even side-slopes, and a depth of 18 feet; what is total pressure against a line along dam 12 feet below surface of water? Give sketch and dimensions for dam to sustain pressure.
6. You desire to transport an eight-ton boiler across a chasm, and you have decided to stretch a wire rope across for this purpose, suspend the boiler to it, and draw it over. When the boiler is half-way over the rope sags down in the centre so that its two parts make an angle to each other of 170 degrees. Show graphically how you would arrive at the stress or weight on each half of the rope.
7. You have a flow of water of 11 cubic feet per second under a head of 290 feet. What theoretical horse-power is there in this water, and what practical horse-power may you expect to obtain, say by means of a Pelton wheel?
8. Show how you would calculate the spouting velocity of water under the above head, and if the Pelton wheel were 3 feet in diameter give the proper speed at which it should run when under full load. Describe the construction of a Pelton wheel.
9. What horse-power would be necessary to haul 100 tons of ore per hour up an incline 1500 yards long, rising 1 in 8, at a speed of 4 miles per hour? Give the sizes of the engines, and supply the rest of the data yourself.
10. Find the weight of a cast-iron pipe, 12 feet long overall, 18 inches internal diameter, $1\frac{1}{4}$ inches thick. Flanges, 2 feet diameter, $1\frac{1}{2}$ inches thick. Neglect the bolt-holes and the stiffening-webs between. For what head of water would the above pipe be adapted if used as part of the rising main?

SUBJECT F.—BOOK-KEEPING AND MINE ACCOUNTS.

Give specimen pages of the Books you consider it necessary that the manager of a large mine should keep. Under what different headings would you make entries in the ledger?

SUBJECT G.—MINING LAW.

1. What are the regulations under Section 102 of the Mining Act, 1893, as to the storage and use of explosives in mines?
2. What are the provisions of the Mining Act, 1893, with regard to men travelling in shafts, and what is the maximum distance allowed between the stages of a ladderway?
3. What are the duties of a mining manager as to the inspection of a mine under his charge, and the testing of ropes and chains used in connection with raising or lowering men in a shaft?
4. If a lessee discovers gold on his mineral section, what steps should he take to secure the right to mine for gold?
5. In what manner is land required to be marked off before applying for a lease?
6. In what manner is a leased claim required to be marked?

REPORT OF THE MOUNT CAMERON WATER-RACE BOARD FOR THE YEAR ENDING 30TH JUNE, 1899.

5th July, 1899.

SIR,

WE have the honour to present the Report of this Board for the year ending the 30th June, 1899.

The Board wishes to express its deep sympathy on hearing of the death of the late Mr. James Harcourt Smith, Government Geologist, and to place on record the loss it has sustained by being thus deprived of his able assistance in carrying out the work of the Board.

The Board has met as frequently as occasion required.

The total receipts for the year amount to £1017 5*s.* 11*d.*, as against £629, and the expenditure to £614 0*s.* 3*d.*, as against £729 18*s.* 10*d.* during the preceding year.

The supply of water available has been more than sufficient to allow all customers the regulation allowance for nearly ten months of the year. Even in the months of January and February, owing to increased rainfall, the shortage was not so great as in preceding years.

Fixed Scale.—The charges under this scale were altered and reduced, the rate now being equal to 10*s.* per sluice-head, when the English quoted market price of tin is £100, and, for every £1 that the price of tin rises above or falls below £100, the sum of 2*d.* per sluice-head is added or deducted; thus the present cash price of water, with tin at £118 per ton, is 13*s.* per sluice-head.

When this alteration in the cash price of tin was introduced in January last, it was thought that many of the claim-holders would take advantage of it, especially so as a preference is given to cash customers when the water is scarce. The result, however, is not satisfactory, as only 223 heads were supplied at cash rates up to the end of May, since which time no water under the fixed scale has been applied for.

Race.—This has been maintained in fairly good order during the year. The flumings at the southern extension, constructed some nine years ago, are in a far advanced state of decay; repairs have already been effected, and in all probability the whole of these flumings will have to be repaired within the next two years.

Owing to the enhanced value in the price of tin, there is at the present time a credit balance of £403 5*s.* 8*d.*; and, should the present value of tin be maintained, it is probable that there will be a balance of £800 or £900 to be paid to the Public Debts Sinking Fund on the 31st December next.

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			15
Total number of heads of water supplied			4177
Tons of tin ore raised	74 tons 5 cwt. 0 qr. 20 lbs.		
Average number of miners employed—14 Europeans; 36 Chinese			50
	£	*s.*	*d.*
Total receipts for the year	1017	5	11
Cost of maintenance and management	614	0	3
Paid to Public Debts Sinking Fund, 1898	*Nil.*		
Total cost of purchase and construction	34,572	19	0

W. H. WALLACE, *Chairman of the Board.*
C. O'REILLY,
JOHN SIMPSON,
S. HAWKES,
Members.

The Hon. the Minister of Mines.

ANNUAL REPORTS OF THE INSPECTORS OF MINES.

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

In submitting my Annual Report, I regret to state that the accident list is again a heavy one, being 8 fatal, 12 serious, and 10 non-serious.

Several complaints have been made to me during the year, and received prompt attention ; in many instances they were of a frivolous nature.

Legal proceedings were taken in three instances against miners for not reporting miss-fires ; but I only obtained a verdict against one.

Ropes and cages have been examined and tested, and several of the former condemned.

The magazines both at Zeehan and Lyell are in good order, and kept clean. Those at Zeehan must be removed in the near future, as the town is now extended to within a short distance of them. I destroyed four cases of damaged explosives during the year.

A Board, consisting of several members of the M.M.A., A.M.A., and myself, was appointed to draft a fresh code of signals for use in the mines. They received general approval, and are now in use in most of the mines in the district, and, I am pleased to say, giving satisfaction.

The Mount Lyell Mine is now treating about 800 tons of ore per day. Some idea can be formed of the extent of work going on at this mine, exclusive of the smelters, from the following figures, for year ending June 30th :—

Average number of men employed	420	
Length of driving and cross-cutting	3013 feet	
Ore despatched from open cut.....	197,617 tons	
From stopes and drives	19,719 tons	= 217,336
Overburden shifted	288,058 tons	

Amount of explosives used—B1 Powder, 50,065 lbs.; Gelignite, 30,655 lbs.; Rackarock, 32,798 lbs.; Hercules compound, 2250 lbs.; Detonators, 78,700; Fuse, 174,232 feet.

Height from lowest workings to original outcrop, 550 feet.

At the North Lyell, the manager is busy removing the overburden from the ore body. Arrangements have been completed for the delivery of a large parcel of ore to the Mt. Lyell smelters.

At the Tharsis Mine, opening up of the lode is being pushed along as fast as possible ; about 100 tons per day of silicious ore is delivered by aerial tram to smelters, at a cost for delivery of less than 1s. per ton, allowing a fair margin for wear and maintenance.

The South Tharsis will be in a position to add to the output of the field in a few months' time, as the manager is busy erecting an extensive dressing-mill capable of treating 100 tons of ore per day. There are several mines on the western slope of Lyell opening up large bodies of silicious ores, and directly the South Tharsis proves that the ore can be concentrated to advantage, mining must receive a considerable impetus in this direction.

At the South Lyell, main shaft is down over 500 feet; the manager intends to open out after another 50 feet, when he hopes to get a share of the immense body of ore that is being worked by the Mt. Lyell Co.

At the Crown Lyell, sinking and driving is going on. The prospects of this mine are good, as it is near both the North Lyell and Tharsis. There are over 20 mines on the Lyell field, all actively employed.

On the Zeehan field there has been a considerable increase in the output of ore, principally through the agency of the local smelters, who, up to the end of June, had purchased 11,489 tons, valued at £30,426 ; ore exported for year was 14,100 tons, valued at £185,805, making a total of 25,589 tons, valued at £216,231. The Western still holds the premier position. The Montana, Oonah, Argent, Silver Queen, Smith's Section, and Mt. Zeehan are all keeping up a fair output. At the Silver King, with the exception of one tribute party, there is nothing doing ; and I would respectfully draw your attention to the very large area of ground that this company is keeping in idleness.

The Comet Mine at Dundas is still turning out ore for the smelters. There has been considerable improvement in the deeper levels lately. The heavy body of water this company have to contend with is their principal drawback. A tramway is in course of construction from the Brewery Junction to the old Melbourne Proprietary. When completed, it will allow several parties to work to advantage.

The Mount Reid Mine starts sending ore to the smelters at the end of this month.

The Hercules Mine is opening up well. This company is in a position to turn out large quantities of ore whenever it feels disposed to do so.

There are several other mines on the Mount busy prospecting, and with fair prospects.

On the Curtin and Davis Hill a number of miners are working to advantage on the tribute system.

The Fahl Ore group is deserving of a more progressive policy than what it is receiving.

At the Colebrook the diamond-drill is still at work proving the extensive ore-body there. A few months more ought to see this company in touch with the Emu Bay Railway.

At the Rosebery, the Tasmanian Copper is still idle, as the manager has not returned from London.

The Mount Black Proprietary has opened up a good lode, and the manager is now busy erecting a dressing-mill, to be driven by water-power, for treating the ore. This will probably be at work in September.

There are several miners on the hill prospecting, with very fair prospects of success.

The high price of tin has caused attention to be again drawn to Mount Heemskirk and the Stanley River. Several parties are busy at both places.

The Red Hills Mine is opening up well, especially the northern portion of the property, where an extensive body of high-grade copper ore is being exposed. A tram from Argenton round the south side of Mount Dundas would start a number of mines going in this direction.

The new fields at Mounts Jukes and Darwin are opening up with most encouraging prospects. When the North Lyell Railway is completed to Jukes we may look forward to quite a large mining population settling in the district.

In conclusion, I would state that the mining industry of the West Coast never looked brighter than it does at present.

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

I have the honour to submit my annual report as Inspector of Mines for the year ending 30th June, 1899.

Before commencing this report I desire to place on record my deep sense of regret at the death of the late Government Geologist and Chief Inspector of Mines, Mr. J. Harcourt Smith, which took place in June last, and by which we have been deprived of the valuable supervision of a chief whose kindness and courtesy has at all times been fully appreciated by the officers of the Department.

Mines Inspected.—The whole of the mines in the Eastern and North-Eastern Districts have been inspected four times at regular quarterly intervals during the year. The mines at Beaconsfield and Lefroy were also visited and inspected by me once, in June last, during the temporary absence of the Chief Inspector of Mines.

Accidents.—The following is a list of all persons either killed or injured in the mines of the Colony during the past year :—10 men (nine Europeans and one Chinese) were killed, and 36 Europeans and one Chinese were more or less seriously injured; total, 47, as against 46, of which 13 were fatal, for the previous year. The causes of the accidents were as follow :—

Falls of Rock.—Eight accidents, two fatal and six not fatal, happened through falls of rock in open cut workings. Of the men killed—

James Rogers was employed underhand stoping on a lode in open cut at the Appalachian Tin Mine, and on endeavouring to recover a head board so as to replace a stull piece knocked out by a previous explosion, he incautiously ventured into the cutting and was caught by a large piece of rock that slipped down from the side, his chest, arm, and leg being badly crushed, causing death 36 hours after the accident.

James Robertson was working in open cut at Mount Lyell, when a small piece of rock struck him on the spine. He died the following day of paralysis. Verdict, accidental.

Frank Jarvis received concussion of the spine and was insensible for several hours, through being caught by a fall of rock while working in No. 1 adit at the Mangana Gold Reefs Mine. Jarvis was one of a party of contractors who were in the habit of working too far without timbering up, and was only a short time prior to this accident cautioned by the Inspector to discontinue such a dangerous practice. He is now all right. This accident was not reported by the manager of the mine, nor was it discovered to have taken place by the Inspector until the limit of time for taking legal proceedings had expired.

A. M'Guiness received a compound fracture of the leg by a fall of rock while working in an open cut at Strong's Rush, Pieman.

Wm. Delaney had his leg and arm broken whilst engaged baring down loose rock in the open cut at Mount Lyell Mine.

H. Knight had his leg broken whilst engaged in baring down loose rock at the Mount Lyell flux quarries.

C. Scott, New Silver Crown Mine, Zeehan. Received scalp wound ; not serious.

J. Ward, while working from the backs at the Golden Gate Mine, had one of his legs caught and slightly injured by a fall or slip of rock from the footwall.

Falls of Earth.—Three accidents from this cause—one European and one Chinese killed, and one Chinese injured. Of the men killed—

George Darcey (single) met his death by a fall of *debris* from a greasy head, whilst working in a stope at the Argent Company's Mine at Zeehan. (The information to hand with reference to this accident is of a very meagre nature.)

Wang Ah Chung, a Chinaman, working alone on his (miner's right) claim at South Mount Cameron, ventured too near the face, nine feet in height, on which the nozzle was playing, and was caught and instantly killed by a heavy fall of earth and cement.

Ah Foon, a Chinaman, working with his mates in a tin face at the Weld Tin Mine, Moorina, had his leg broken by a small fall of earth from the face.

Fall of Debris.—Two accidents.

James Hammersly had his leg and arm broken by a fall of *debris* from the face of a drive in the Oceana Mine, Zeehan.

John Rundle, Silver Queen Mine, was working in a shallow open cut when about a ton of *debris* fell from side and smashed his head, which proved fatal.

Falls of Stone.—Three men injured, but not seriously.

John G. Johnson, whilst trucking at the Mount Bischoff Company's Mine, got his hand jammed by a piece of stone falling from off the truck.

George Smith received a severe blow on the neck and shoulder from a piece of stone that fell from an over-filled bucket he was sending up from shaft-sinking work at the Salmon Gold Syndicate's Mine, Mathinna.

James Smith had his leg hurt by a stone rolling from a heap in the Rex Hill Tin Mine, Ben Lomond.

Fall of Timber.—Two men injured.

H. Marsden was struck on the back and slightly injured by a piece of timber that was being lowered to a level in the Tasmania Gold Mine, Beaconsfield.

R. Irving, Mt. Lyell Co., was putting in timber in a stope, when the timber fell and broke his arm.

Falls down Shaft.—Three men severely injured at Mount Lyell Company's mine.

William Blaney slipped into shaft, and fell 75 feet, striking a man named Mulloy who was at work sinking at the bottom. Blaney received a scalp wound, and had his collar-bone broken. Mulloy had his collar-bone broken.

C. Nicholas left gate of shaft open, and walked in. He received a severe shaking.

Fall of Cage.—At the Oonah Silver Mine, Zeehan, the cage got away with four men, named J. Mancey, D. Toomey, J. Macnamara, and T. Polan, in it, through the driver not putting the catch which holds the clutch of the loose drum in proper position. By the time he got his foot on the brake the speed was such that he could not hold the cage, and it fell about 35 feet. Two of the men in the cage had to be removed to the hospital. One had a rather bad scalp wound. Both were reported to be out of danger on the day following the accident. The question of carelessness on the part of Driver M'Arthur, who acknowledged that he could not have put the catch in properly, has been referred to Mr. E. S. Ross, Chief Inspector of Machinery.

Blasting Explosions.—Eight men injured (one fatally) through these causes.

Thomas Statton and Rupert Vaughan, working underground at the Western Silver Mine—Statton, whilst working out the face, must have touched an unexploded charge—probably a miss-fire from the previous charges—when an explosion followed. Statton was very badly burned and cut about, and died seven days after the accident. Vaughan was badly burned about the face, and lost the use of one eye.

At the Mount Zeehan Silver Lead Mines, Wm. Jones received compound fracture of the arm when returning to a supposed miss-fire.

John Rafferty, employed as "powder-monkey" at the Mount Lyell M. & R. Co.'s mine, was forcing a charge of rackarock into a rugged hole, when the charge exploded. He received burns on the hand; not serious.

At the Mount Bischoff Tin Mine, — Palmer waited only 15 minutes before returning to a supposed miss-fire, an explosion took place, and he was injured. A telegram received from the general manager of the mine four days after the accident occurred reads: "Palmer very low yesterday, but much better to-day. Doctor now hopes to pull him through." The information received in connection with the accident is meagre. Nature of injuries not given. Palmer's Christian name not given.

J. Simons, hammer and drill man at the Anchor Tin Mine, jumped a deep hole in the rock and bulled it out in the usual way with a plug of gelignite, but as the space thus produced was not large enough for the powder charge, he primed another plug of gelignite, and was about to drop this down the hole on to a couple of handfuls of powder, when a spark from the lighted fuse must have exploded the powder. Simons had his face badly burned.

T. Mitchell, Mount Lyell, was charging a hole, when an explosion occurred, resulting in a serious scalp wound.

G. Hudson, Silver Queen Mine, returned to a supposed miss-fire, when charge exploded. He received severe scalp wound and lost the sight of both eyes.

Boiler Explosion.—Two men killed, three seriously injured, at New Mount Zeehan Silver Mining Co.

Mathew Hoskins, aged 34, manager, married, and Edward Bowden, aged 42, widower, scalded to death. Thomas Grubb, A. Stokell, and William Richardson, badly scalded. It appears the manager and engine-driver attempted to adjust the pin of the safety-valve, which in some way got out of place, and called the other three men to assist. There was something like 40 lb. steam pressure on at the time. A bar was applied to get leverage on to the pin, and this slipping from its fulcrum—probably forced off by the sudden stoppage of the escaping steam—the valve was blown out, and the five men at once enveloped in scalding steam, with the result already stated.

Breaking of a chain.—John Ritz and Jas. Conole were engaged getting some machinery up the Hercules tramway, when a link of the chain broke. Ritz had his lip cut, and Conole received severe cuts about the head.

Entering a cage in motion.—At Western Silver Mine, Thomas James Phelan got off a cage, and in attempting to get on again was thrown into the shaft and instantly killed. From evidence at the inquest it appears that Phelan got off at the wrong level, and on finding his mistake attempted to re-enter the cage, which, the platman says, had started to go down. The platman prevented him, and knocked 1 to stop the cage. Phelan then attempted to get in, but the cage immediately rose and he was caught against the cap of the opening-set and fell down the shaft. The engine-driver stated that the cage was at rest when he received the signal of 1 knock, which he interpreted to mean "Hoist empty cage." The jury were of the opinion that the signalling code should be amended.

Machinery in motion.—Two men seriously injured, and one not seriously.

Allen Bird, aged 24, married, employed at the Tasmanian Gold Mining Company's battery, lost an arm through being caught in a belt used for driving a grindstone. The belt was twisted round the countershaft of the rock-breaker, and the injured man, whose duty it was to oil the shaft, had been warned against going near it until the breaker was stopped.

Wm. Godwin had his thumb completely severed by being caught between the frame and driving-wheel of the battery at the Australian Tin Mine (Lottah) while cleaning the machinery in motion. He was not required to do this work, and had only himself to blame for the accident.

William M'Neice, aged 13, employed at the Western Mine, Zeehan, came in contact with a belt in the mill, and received a cut on the head.

Miscellaneous.—John Fletcher, South Lyell Company, had his arm broken through a drill falling down the shaft.

G. Grubb, Silver Crown Mine, had his leg broken through a fall from a wood-truck.

Percy Williams, Mount Lyell Mine, received fatal injuries through being run over by a wagon in open cut.

The majority of the foregoing accidents were caused through carelessness or want of caution on the part of the person injured; some few were unavoidable. One unfortunate accident, causing the death of Thomas J. Phelan, appears to have been caused through confusion of signals. Following a recommendation of the jury in this case, several members of the Mining Managers' Association, as well as the President and Secretary of the Australian Miners' Association, and Mr. J. Harrison, Inspector of Mines, joined in framing an entirely new code of signals, which it is sought to have made universal for the whole Colony. Copies of this new code have been distributed amongst the mining managers of the northern and eastern districts, who, however, do not appear willing to adopt it, as it is considered to be too complicated to be applied to most mines. It is therefore not likely to come into general use in the mines of the Colony. There can be no doubt as to the desirableness of a complete code of signals being made universal for the mines of the Colony if such a thing can be accomplished without, as it were, compelling owners or managers to use a code, however perfect it may appear to be, that they protest against it as being unsuited to their respective mines.

The Regulations and General Rules, as per Part IV. of the Mining Act of 1893, have on the whole been fairly well complied with. There is less fault to be found with the methods of working, and explosives are being handled and stored with more care than hitherto. There is, however, one thing that demands serious consideration, as affecting the health, and, in many cases with serious consequences, the lives of the men employed in these mines: that is ventilation. The majority of the mines in these northern and eastern districts are ventilated by natural means, which is fairly satisfactory in the case of mines worked by adit levels, but not so in the shaft mines, where there is, perhaps, no second shaft to be used as an "upcast," and give better circulation. Natural ventilation at best has its drawbacks, being so easily affected by atmospheric influences. In cold weather the circulation is, perhaps, all that can be desired, but in hot, muggy, summer weather it is the reverse. Artificial ventilation is produced in the coal mines of Mount Nicholas by means of furnace "upcast" shafts, using the main working tunnel at each mine for "downcast," or inlet of cold air. This is a satisfactory way of ventilating, if only reasonable attention be given to bratticing, regulating doors, and furnace. In several of the deep quartz mines compressed air is used to assist circulation, but as this generally comes from the exhaust of the rock drill machine its good effects are only felt locally, the noxious gases being driven out of one place to settle in another, probably—if it be a heavy gas such as carbonic acid—to settle in another along the working roads or levels. The best known mechanical contrivance for the ventilation of deep mines is the blower or fan, which, when used as an exhaust at the "upcast" shaft, is found to work well and give good results. Of course, the introduction of a ventilating machine means increased expenditure in the equipment of a mine, and owners and managers, as a rule, try to do without this extra cost; but as good ventilation in a mine means a far greater amount of labour being performed by the men employed in a given time, not to speak of the losses of having the working of certain levels and stopes stopped altogether at different times owing to some sudden change of the atmosphere, and also the delays caused through waiting for the smoke to clear off after shots are fired, it is, after all, doubtful economy for owners to work their mines without being properly ventilated. Section 102, Sub-section 1., under "General Rules," in our Mining Act, says:—"An adequate amount of ventilation shall be constantly produced in every mine to such an extent that the shafts, winzes, sumps, levels, stables, &c., shall be in a sufficient state of ventilation for working and passing therein." In very many of our mines the requirements of this Section of the Act are not complied with, not but that managers are always, or nearly always, willing to remedy—so far as lies in their power—any defect complained of by the inspector; but if owners will not provide the necessary means to thoroughly equip their respective mines, the manager is powerless to do what is required. The authority of the inspector is often required to assist managers in cases of this kind. There can be no doubt of the urgent necessity for improved ventilation in very many of our mines, especially at Lefroy and Beaconsfield, where many of the lodes give off large quantities of carbonic acid gas in addition to that produced by respiration and the burning of lights, thus endangering the health and lives of the men required to work in such places. The baneful effects of insufficient ventilation for the miners of the Colony is only too apparent. I therefore respectfully recommend that the "adequate amount of ventilation" required by the Act be insisted upon, irrespective of what the cost of producing such may be to any mineowner.

Complaints.—Only one complaint was received, and as this was not of a serious nature, it was easily disposed of. As a rule, the men employed at the different mines show an inclination to avoid anything in the way of a complaint to the inspector.

Ropes, cages, and safety appliances have been practically tested at regular intervals, and one of the former condemned. Safety appliances were found to act well.

I am glad to report a more prosperous and progressive state of things in connection with the tin-mining industry in this part of the Colony. The great rise in the price of this metal which has taken place within the past year has enabled the owners of many old mines that have been barely able to keep going through the time of depression, to work at a profit, and also give employment to a greater number of men. Very many old claims that had been idle for years have been reopened, and portions of same considered not payable in the past are now worked at a profit. Of the big mines working, the Briseis is perhaps the largest producer at present, and the rich and apparently extensive deposit of drift and gravel now being operated on should gladden the hearts of shareholders.

At the Anchor mine the work of development has been prosecuted with energy. Just a year ago this mine, which cost so many thousands of pounds to equip with the most modern tin-dressing machinery, was shut down, marked not payable. Some two months later it was reopened, the management this time being in the hands of Mr. R. Mitchell, than whom no better tin ore-dresser is to be found in these colonies. No. 2 50-head battery—erected but not worked by the previous manager—has been overhauled, readjusted, and set going, thus completing the whole plant of 100 heads. The rock has been tested by boring with diamond drill at different places, and although the prospects obtained were not any better than the average from the working face, still sufficient has been done to prove the existence of a great extent of the tin-bearing quartz porphyry. In addition to this, an adit has been driven in rock from the battery tramway level, about 25 feet below the floor of the main face. The stone obtained from this is richer in tin than that of the

main working. The quantity of tin ore obtained from each ton of stone crushed is 9 lbs., equal to four-tenths ($\frac{4}{10}$) of one per cent., which—low average though it be—is sufficient at the present high price of the metal, combined with the small cost of treating the stuff, to give handsome returns. Not more than 75 heads of stampers have been in work up to the present. Each of those is capable of crushing three tons of stone in the 24 hours. The stone is crushed, and the disintegrated stuff passed over classifiers, jiggers, and frue vanners, and tin ore dressed up to 70 per cent. obtained without re-handling from the time it goes into the battery hopper.

Another trial is being given the Liberator Mine; and it is now hoped, with the enhanced price of tin, that this mine will be made to pay.

The Cambria, a couple of miles further west, is being opened up, and a tramway about 4 miles in length is being constructed to connect the mine with the Liberator battery.

Mr. Alfred Deedes, chairman of the Anchor board of directors, is responsible for the opening up of these outside mines; and, if we may judge from the enterprise and pluck shown by this gentleman and his co-directors in sticking to the Anchor Mine when it was thought to be a failure, it is only fair to assume that the other mines of which they are the owners are at all events reasonably good shows, and that capital for their development will be provided and judiciously expended. The Anchor Company are now about to commence the construction of a water-race to bring water from the Columbia Falls, George's River, on to their mine. The erection of tin-smelting works by this Company is also under consideration.

The Australian Tin Mine battery has been crushing stone from the Don section for the past four months. The stone is being hauled to the battery over an inclined tram 30 chains in length, the ascent from mine to mill being about 100 feet. The stone being treated is said to go one per cent. of tin.

A new discovery of alluvial tin has been made on the shore of George's Bay, about 4 miles south-east by road from St. Helen's. Not much in the way of development has been done so far.

Coal Mines.—New works have been opened up at both collieries during the past year, and at present the Cornwall Mine is working on a good six-ft. seam, in which several down-throw faults had to be passed at the opening up. The seam is now worked in more settled country. A second seam—probably a continuation of the old 4-ft. seam further east—is being opened immediately above the 6-ft. already referred to. The whole of the works at this mine are in a satisfactory condition.

At the Mt. Nicholas Mine the upper 6-ft. seam, worked many years ago, is being reopened at a point east of the old workings. I understand from the manager that the intention is to develop, and then carry on the whole of the workings on this seam. The old workings are in a very bad state of repair, and it is only by frequent warnings and threats of penalties that the Inspector is enabled to get the proper timbering to secure the mine put in. Indifferent ventilation is another cause of complaint. Altogether the working of this mine is most unsatisfactory from an Inspector's point of view.

Ben Lomond.—The Rex Hill Tin Mine commenced crushing at their 10-head battery a short time ago. The stone is obtained from the flow and partly from the sides of the old chamber. The works are being carried on with due regard to the safety of the men employed.

At Mangana a fresh start has been made at the Mangana Gold Reef (late Sovereign) Mine. New poppet-heads are erected, and the old shaft is to be sunk to a further depth of 200 feet, where it is hoped to again pick up the shoot of gold met with in the upper adit levels.

Salmon Gold Syndicate's Mine (Miami).—Good progress is being made here with opening up of the mine. The shaft is down 400 feet, or 200 feet below No. 1 adit level. The lode east of No. 3 level has opened out to width of seven feet a solid body of stone. Found the works in good order, regulations being well complied with.

Mathinna.—Very little is being done at this place outside the New Golden Gate Mine; the workings of this latter is satisfactory. In the early part of the year the stopes at this mine were being filled with sand from the cyanide vats, which had the effect of vitiating the ventilation of the mine to a certain extent. Complaints were received in an indirect way, but the men, when questioned directly, declined to say that the bad ventilation was caused by the filling in of the cyanide sand. Eventually, however, when an appeal was made to the manager, the filling of the stopes with cyanide sand was discontinued forthwith.

Duirng the year the new cyanide plant, comprising four 100-ton vats, has been completed, and is now operating on a large heap of tailings, estimated to contain 100,000 tons, which gives an assay of 2 dwts. 15 grs. of gold to the ton. About 80 per cent. of the gold contents are recovered by the cyaniding process. The cost of treatment by the old plant, which is still in use treating the slimes from the battery, or, more properly, from the vanner concentrating plant, was 2*s.* 3½*d.* per ton, which included cyanide, zinc, labour, acids, mint charges, coke, &c. The assay value of the sand before treatment was 8*s.* 6*d.* per ton; after treatment, 1*s.* 5*d.*; extraction value, 7*s.* 1*d.*; thus leaving a profit of 4*s.* 9½*d.* per ton. A Rand Drill Co.'s air compressor plant, equal to 12 drills, has been added to the equipment of the mine, at a cost of £1000.

Messrs. Doyle and Bairstow, late of Charters Towers, Queensland, have erected a cyanide plant equal to treating 100 tons of sand per week, and are treating the sand from the old City of Hobart battery. They appear to be very well satisfied with results so far.

Marshall and Terry's Gold Sections on the head waters of the Scamander River, about 12 miles N.E. of Mathinna. There are several lodes traversing these sections, all of which are said to be rich in gold. A good deal of prospecting has been done, and a battery (10 heads) is being erected.

Several mines—the October, Mabel, and Record, north of Mathinna, all in full swing a year ago—are now shut down. Hickson's Gold Mine is still working, and their chances of success are good if they once get a plant equal to coping with the water, which is very heavy.

Mount Victoria.—The Ringarooma Gold Mining Company has been doing a good deal of preparatory work during the year. A 12-head battery has been erected at the New River freehold property, also six heads of stamps added to the Ringarooma battery. Preparations are being made at this latter place for the erection of a powerful electric plant, to be used for the purpose of pumping and winding, in the mine a

little way off. The electric power is to be transmitted by cable from the dynamo to a large chamber underground about 1100 feet from the entrance to the main adit. In this chamber, which is 48 feet in length by a width of 19 feet, height from 11 feet at lowest part to 24 feet at end where shaft is being sunk, the winding and pumping machinery will be placed. When this plant is finished it will afford a means of sinking on the Gumsucker lode, from which such good results have already been obtained. The Pennefather P.A. Mine has been refloated under the name of the Central Ringarooma. Prospecting is being carried on under the supervision of Mr. Wm. Brown, manager of the Ringarooma Mine. Of the outside shows at Alberton I cannot say much, as I have but few opportunities of judging of their system of working. They are generally about to commence work, or have just ceased operations, when I visit the locality.

Warrentinna.—Mining at this place is at a very low ebb. The East Volunteer has been shut down for several months past. The Coronella Extended, now known as Bayley's Lease, are debarred from getting capital to develop their mine through pending litigation. The Derby Mine still keeps a few men on, but results are not satisfactory.

REPORTS OF THE COMMISSIONERS.

Mr. Commissioner GLOVER reports :—

Though the experiences of the past year do not disclose any final result in mining operations on the Northern Goldfields, they present circumstances which justify expectations of such results, of a highly satisfactory nature, in the near future. In my last annual report I mentioned as a hopeful circumstance that efforts were then in progress in England to induce the investment of capital in developing the sections on the S.E. and N.W. of the Tasmania Company's ground at Beaconsfield, as, without the aid of outside capital, effective development of mines on these fields was an utter impossibility. I also alluded to the somewhat remarkable circumstance that, although the great extent, depth, and continual productiveness of the Tasmania Mine had been positively proved, capitalists had never been tempted into the enterprise of locating the same lodes outside that Company's boundaries. I have now the satisfaction to report that both of these desiderata are about to be realised. Although the negotiations for capital then pending in England fell through, Victorian aid has recently been secured for the effectual development of eight sections on the western side of the great mine. A strong association has been formed in Victoria to intercept the western continuation of the Tasmania reef. This event is no longer in the realm of uncertainty, mining operations being in full activity, and machinery to cope with the inevitable water has arrived from Melbourne. Fair grounds are thus afforded for the hope that the mysterious and erratic reef, which has for some 20 years baffled the many futile attempts for its discovery, will at length become the scene of mining industry, outside the Tasmania Company's boundaries. Another subject for congratulation consists in a further acquisition of Victorian aid in an entirely new branch of mining enterprise, namely, the utilisation of the extensive deposits of asbestos in the vicinity of Beaconsfield. A strong company has been formed in Victoria for the said purpose, called the "Australasian Asbestos Company." The quality of the mineral to be operated upon has been pronounced by recognised experts in that class of industry to be superior to that of most of what is already known and utilised in other parts of the world. Considering the many and important uses for which, within only the last few years, asbestos has been found to be adapted, there can be little doubt of the importance of the enterprise. The celebrated Tasmania Mine continues to maintain its great contribution to the mineral yield of the country. There are eight other mining operations in more or less activity, but they are still in the prospecting stage, at various depths from the surface, within that of 400 feet. The quantity of gold produced from Beaconsfield for the past twelve months was 28,835 ounces, value £108,371. The average number of men employed in mining work at present is 616.

All hopes and expectations for the future of Lefroy are now centred in the efforts of two mines, the Volunteer and the New Pinafore, whose deep-sinking operations more than 12 months ago had reached depths of 1300 feet and 1250 feet respectively, but the work of which has since been devoted to prospecting at those levels in the hope of finding sufficient gold to supplement the contributions of shareholders, upon which alone the former depends for the continued prosecution of its enterprise, the working expenses being £500 per month. The expenditure of the latter is aided to some extent by the gold extracted by the cyanide process from the "tailings" accumulated for many years. Should the operations of these two mines succeed in revealing gold at greater depths in payable quantity, as expected by analogy of similar localities in Australia, it would inevitably cause work to be resumed in the six other mines at Lefroy, which were once so prolific to a depth of about 400 feet, when the yield ceased, as it did also in the case of the two mines in question. These two mines alone, when in their productive state, yielded, for the year 1894, 24,518 ounces of gold, value £96,488. It is much to be regretted that a goldfield with the possibilities of Lefroy should remain unproductive for the want of pecuniary means for its development. Within the last few days a promising report has been made by a prospecting company between the "Pinafore" and "Chums" reefs ; a crushing of 42 tons at their claim yielded 98 ounces of gold. There are at present 133 men employed in mining work on this field.

The worked-out surface alluvial goldfield of Lisle still holds out sufficient inducement to some 40 or 50 men, being principally persons who have settled on small agricultural holdings in the vicinity, and supplement their means by gold-digging on spots formerly imperfectly worked and abandoned. But the new departure in mining operations, recently introduced from New Zealand, by dredging, not only rivers, but on suitably humid localities on land, is engaging the attention of several persons, and at present applications have

been made for over 100 acres for that purpose at Lisle. At Golconda, Denison, &c., prospecting work is actively proceeding, but nothing has transpired worth reporting.

At Middlesex Plains, including Bell Mount, Forth, &c., many prospectors are engaged in exploring the region. There are at present only four settled mining operations, but the only one of these demanding special notice is that known as "Shepherd and Murphy's" claim. Although the mine contains several associated metals, its present principal yield is tin and bismuth. Some 5000 tons of ore are estimated to be in sight, and 600 tons of ore have been mined, and ready to be dealt with; and about 300 tons have been sent away by means of pack horses. But little or no progress can be made until the great difficulties of transit can be overcome by means of a road.

Mr. Commissioner O'Reilly reports :—

I have the honour to submit my Report for the year ending 30th June, 1899, upon the state of mining in the North-Eastern Mining District.

Gold.—At Mount Victoria, during the past year, mining operations have been carried on in a steady and satisfactory manner on several of the claims.

A considerable amount of enterprise has been shown by the Ringarooma Gold Mining Company in providing the most modern appliances and requisites for working their mine in a comprehensive and effective manner. Extensive and costly works are now in progress, with the view of thoroughly opening out the mine, so that it can be worked with economy and successfully. Electrical pumping and winding plant are about being erected for this purpose. There will be a fifteen-head battery (water-power) in this claim completed in a short time. This company also holds at New River, a few miles distant from the above claim, three hundred acres of freehold land, upon which gold reefs of a very promising character have been found, and, so far as tested, have proved payable. A ten-head battery is now being erected on this claim, and the prospects of this mine are considered very favourable. The capital of this company appears to be economically and judiciously expended, under careful and able management, on the works of their mines.

Several other claims in this locality are making satisfactory progress, and, on the whole, the prospects appear very bright.

Alluvial gold is found in payable quantities on private property at New River, four men being employed.

At Warrentinna, mining operations have been very limited, and do not appear to have been carried out in a skilful or satisfactory manner, resulting in disappointment and loss of a considerable amount of capital. A moderate amount of capital, expended under capable and judicious management, in testing the reefs by deep-sinking, would, it is generally believed, prove highly remunerative. Until a radical change in the present system of mining is brought about I cannot look hopefully for any improvement from the present depressed state this mining field now labours under.

Nothing has been done at Waterhouse or Lyndhurst during the past year in the way of mining operations. Several sections have been applied for under lease, and it is to be hoped that mining operations will be commenced during the coming year. I have no doubt that a moderate amount of capital expended judiciously here would result satisfactorily.

The Portland Company's Mine, situate near Gladstone, has been closed down for some time through want of capital to develop it. Although the lodes on this claim are narrow, they have been proved to be highly payable if sufficient capital were provided to mine and treat them. There is a considerable area of auriferous land in this locality, which would warrant expenditure of capital in prospecting it.

On the whole, notwithstanding the drawbacks referred to, I look forward to substantial progress being made in the state of gold-mining in this district during the coming year, especially at Mount Victoria, where the yields from the claims there will be largely increased.

Alluvial gold is found mixed in small quantities with alluvial tin ore on several of the tin claims, and forms an important factor in producing profitable returns, but it is difficult to estimate the quantity thus won.

Quartz crushed	2397 tons
Gold won	2273 ounces
Average number of men employed.....	90

Tin.—In the Ringarooma locality, tin-mining has during the past year been carried on to a very limited extent, and the returns of yields but small.

Considerable enterprise has been shown in opening up some claims at Mount Maurice, but so far the returns have not proved satisfactory.

At Branxholm much mining activity is shown, a large number of claims being at work in the locality of Ruby Flat, and the yields are considered very satisfactory. The Arba Tin Mining Company—now incorporated with the late Ormuz Tin Mining Company—whose claim, situate on private property, adjoins that of the former company, are now taking vigorous measures to properly equip their mine, and place in good repair, at considerable cost, their water-races. I understand that it is proposed to work this mine upon a large scale, and this will infuse new life into the mining industry in this locality.

At Derby and Brothers' Home, the principal claims there have been continuously worked, the average number of men being employed, and prospects are considered to indicate increased outputs during the coming year. The carrying out of large and costly waterworks from the Upper Ringarooma River is under consideration by the Briseis, and also the New Brothers' Home No. 1 Company (surveys being made), to provide an adequate supply of water for mining their claims on much more extensive scales than heretofore. The latter company is now engaged in removing the heavy overlay of basalt from over the rich tin deposit, and consequently do not raise much tin. The Briseis Company's claim looks exceedingly well, and is under careful and able management. Last month's yield of tin ore amounted to 30 tons, and present prospects indicate a continuance. The face, where now mined, appears very rich in tin ore, and the deposit or wash has not yet been bottomed there. I understand that a Melbourne syndicate have the

option of floating this mine, under certain conditions, in London, the terms being £150,000 to the shareholders in the company, and £40,000 to be paid to the working capital of the mine, the present shareholders retaining one-fourth interest in the mine. The yields from the Krushka Brothers' Mine continue satisfactory, as also from the Brothers' Home Extended claim, which latter is mined very successfully by a co-operative party of miners.

The prospects of the Moorina locality have very materially improved of late. The local claims are in full work, and yielding fair returns. New claims are being taken up, and capital proposed to be invested, which will tend to remove the depression experienced in this place of late years.

The Pioneer Tin Mining Company's claim at Bradshaw's Creek has been practically shut down for a considerable time. This is caused, I understand, through defective supply of water. A large outlay is required to provide an adequate supply, of necessity, from a considerable distance. The tin deposit in the workings of this mine have not yet been bottomed, and prospecting operations by boring-rods are now being carried on to test the value of deep deposits. This mine should yield very profitable returns if sufficient capital were supplied to carry out mining operations on an extensive and economical scale, even at the present levels of previous mining.

At Wyniford River and South Mount Cameron a large number of small claims are being mined, principally under miners' rights.

The Gladstone and Mount Cameron localities have largely felt the depression and dry seasons of the last few years. Many miners from here removed to the West Coast and other mining districts to obtain more remunerative employment. This depression has not yet been removed, notwithstanding the enhanced value of tin. I fear it will take some time yet before an increased mining population becomes settled here. There is a considerable extent of mineral-bearing land, but the absence of water supply, beyond that obtained from the Government water-race, and also from conservation dams, renders it impossible to mine the high-level lands on the western side of the Ringarooma River. There are here also considerable areas of river and swamp stanniferous flats well worth the attention of capitalists for dredging purposes.

Tin lodes have been found in the Gladstone locality, on the former Esk claim, also on the Cascade Range and near Moorina, the prospects of which are considered very good.

The success attending mining operations by dredging in New Zealand and Victoria of late years has caused much attention to be given to this mode of mining river-beds and flats in this district by this process for tin ore profitably.

The Tasmanian Tin Dredging Company hold several river-bed sections under lease on the Ringarooma River at Derby, and have there constructed a powerful and well-equipped dredge. Dredging operations will be commenced in a short time in the river, near the outlet of the tail-races of the principal mines there. It is considered that there is a large quantity of tin deposited in the river-bed from the mines, and should the appliances on the dredge prove suitable for saving it, the enterprise of this company will, I have no doubt, prove remunerative, and lead to a very large extent of the bed of this river being leased for dredging purposes.

At Corduroy Creek, the Ringarooma Dredging Company holds a maximum area of land under a prospector's licence, and, having thoroughly prospected the ground by boring operations—some eighteen holes having been put down under the supervision of Mr. Joseph Will—have proved the land to be payable, all the bores showing tin ore mixed with a small quantity of gold. These satisfactory prospects have led the company to order from Messrs. Bogle & Clarke, of Launceston, a steam dredge, at a cost of £2500, which is expected to be completed, and at work on the claim, in the course of four months. Mr. Henry Carlin, late manager of the Esk claim at Gladstone, has been appointed manager, and I have no doubt that under his careful and able management this enterprise will succeed. All the conditions of the place are considered very favourable for carrying on this particular class of mining. The success of this enterprise will have a very beneficial effect upon the future of this district.

In the aggregate a considerable area of ground is held under extended prospecting claims for deep leads, principally upon river flats and swamps. This latter description of land can only be profitably mined by a cheap system, such as is provided by the use of dredging plant, and the greater part of the land thus held will, if proved payable, be mined by this mode. These prospecting claims for dredging purposes are necessarily large, as capitalists who invest in mining undertakings require a considerable area of ground to operate upon, and unless this can be secured they will not invest. There is not any likelihood of such land being mined in small areas, as the cost of providing a dredge at £2500 would generally be beyond the means of those who mine small claims. For this latter reason also, the granting of extended areas has not in any way interfered with the mining requirements of the small claim-holders, and no complaints have been made to me by any of them as regards their being deprived of land required by them for mining purposes by the granting of these claims. On the whole, I look forward with confidence to the introduction of a considerable amount of capital into this mining district for the development of dredging claims on river flats and swamps, through the granting of these extended areas, that would not, most likely, be so invested if these areas had not been granted and prospected. I regret to say there is not sufficient local capital for this purpose, and the advancement of the place, in the way of mining, depends very largely on the introduction of outside or foreign capital. So far, very satisfactory prospects have been obtained on several of such claims, and I look forward to a large extent of the lands on these areas being applied for under lease in the course of a few months.

About forty leasehold claims, and seventy miners' rights claims have been mined during the past year, the average number of men employed being 183 Europeons and 195 Chinese.

The total output of tin ore from this district for the year ending 30 June, 1899, amounts to 887 tons, being an increase of 118 tons 5 cwts. over the previous year's yield.

Taking all the adverse circumstances connected with carrying on mining, shortness of water supply, &c., into consideration, this yield is very satisfactory.

On the whole, the future outlook for tin-mining in this district appears very promising and encouraging, and is likely to be profitably carried on for many years to come.

Mr. Commissioner DAWSON reports :—

I have the honour to forward you my Report of the Mining Industry of the Eastern District for the twelve months ending June, 1899 :—

In my last Annual Report I alluded to the long drought, which, I am glad to say, has now quite subsided.

The Anchor, Australian, Cambria, and Liberator mines are now in full work, with plenty of water to drive their extensive machinery.

The output of tin ore from the Anchor, Liberator, and Australian mines is considered satisfactory.

The men working under their miners' rights have a good supply of water, and are now doing fairly well.

Arrangements are now being made to introduce dredging on the south side of George's Bay. So far the prospects are considered very satisfactory.

I venture to assert that a general improvement has now taken place all through the Eastern District. All the men are fully employed at a fair rate of wages.

A large area of the poorer ground will now pay for working, consequent upon the great rise in the price of tin.

Mathinna is practically the only goldfield that is paying dividends in this district. The Golden Gate still maintains its uniform yield of gold, and the mine, I am credibly informed, looks as well as ever.

A considerable amount of prospecting is going on in the vicinity of Mathinna and surrounding district.

At Mangana I have nothing special to report. A considerable amount of prospecting is going on in the vicinity of the township, but with no decided results up to date.

The Salmond Company are actively prospecting their ground about midway between Fingal and Mathinna. The manager's last report is very favourable, as they have come upon good stone at a depth of 400 feet. Several other claims are being prospected adjoining this company's ground.

The coal industry is going along steadily, both mines being fully employed. The demand for the coal is steady, and the quality of the coal is good.

At the Scamander River the company's works are suspended for the present. I have granted this company protection, because they have expended a large amount of capital in developing their ground.

They deserve every success, and I hope they will soon be able to again commence operations.

I am informed that a new company is formed with sufficient capital to properly develop the mine.

Mining matters are looking better just now than they have done for the last five years throughout the whole of the Eastern District.

Mr. Commissioner HALL reports :—

Owing to the operations of the Tasmanian Smelting Company, an impetus has been given to mining in the northern portion of the Western Mining Division, resulting in an increased production of silver-lead ore for the past twelve months, as compared with the previous term.

For the year ending June 30th, 1898, 15,058 tons of silver-lead ore was sent away from the Zeehan Railway Station, value approximately at £177,079, while for the year ending 30th June, 1899, 23,387 tons, valued approximately £207,026, have left the Railway Station. Of this quantity 11,524 tons, value £174,974, have been sent to Strahan, for shipment to foreign smelting works, and the balance, 11,863 tons, value approximately £32,060, has gone to the Tasmanian Smelting Company.

The mines which have been the principal producers are :—Western, 4579 tons, value £62,611 ; Montana, 3470 tons, value £48,986 ; Oonah, 1980 tons, value £24,708 ; Zeehan (Tasmania), 1314 tons, value £16,798 ; Silver Queen, 2349 tons, value £15,280 ; and Smith's Section, 3455½ tons, value £15,171.

Other mines which have contributed smaller quantities are :—Comet, New Mount Zeehan, Western Extended, Silver Bell, Oceana, Block 291, Curtin-Davis, South West Curtin-Davis, West Comet, Rich P.A., Tasmanian Crown, Kozminsky, No. 1 Curtin-Davis, Sylvester, Silver Queen Extended, and Mount Reid.

The increase in the production for the past year may be taken as an earnest of what will happen in the ensuing year. A large quantity of ore has been delivered to the Tasmanian Smelting Company, who have been receiving and stacking it pending the completion of their works. The roasting furnaces began roasting less than four months ago, and the first blast furnace was only blown in in June last. A second will probably be ready towards the end of this month. Many of the mineowners have evidently been waiting for the smelter to get into full swing before exerting themselves to put out ore. As soon as the furnaces are running regularly the deliveries of ore will quickly increase. A first shipment of bullion, about 60 tons, will be made in the first week in July.

The Western Mine still retains premier place, both as regards ore production and depth of workings. The main shaft is down 691 feet. The lowest level is 600 feet, and in it a formation has been cut carrying ore, but not payable. No payable ore has been met with below the No. 5 level, 300 feet. On 22nd May, the breaking of the spur wheel driving the pumping plant caused the mine to be flooded up to the No. 3 level, 170 feet. The damage was repaired by 22nd June, but it will be a month or more before the water is out. A new compound Corliss engine is being built by Messrs. Fraser and Chalmers, of Chicago, to drive the pumps, and is expected to arrive in about two months. It is anticipated that this will enable the shaft to be sunk to a depth of 1200 to 1500 feet.

At the Montana Mine the shaft has been sunk to 329 feet 6 inches. Payable ore has been cut in the No. 3 level, 300 feet, and taking into consideration that this mine adjoins the Western, and the collar of

the shaft is 100 feet lower than in the Western, payable ore has been found 100 feet lower than in the Western Mine. During the year the mine has been equipped with new assay office and plant, an air compressor and five rock drills, an electric light plant and 140 lights, general workshops, engine, lathe and fittings, and blacksmiths' shops with two forges. In March last the company obtained the Tasmanian Crown property, and are now carrying on mining there. 33 chains of tramway have been laid, connecting the Old Despatch Mine with the Montana main workings, and operations there will be commenced in another month.

At the Oonah Mine a contract is being let to sink the main shaft another 100 feet, which will give a total depth of 425 feet.

The Silver Queen Company have confined their operations chiefly to the No. 4 and No. 5 mines. The greatest depth reached is 310 feet. About 80 men on an average are employed by the company. Tributing is carried on on nearly all the company's sections, an average of about 55 men being thus employed.

The Mount Zeehan Tasmania Mine has reached the dividend-paying stage. A dividend of 1*s.* per share on its preferential shares was paid in December last, equal to £2150. The company employs about 56 men, and another 50 are tributing on its various sections.

On the Comstock Mine there is a large ore formation, some 26 feet wide, carrying bands of zinc blende, assaying 46 per cent. of zinc. A market for this has been found with the Tasmania Smelting Company, who purchase it for export.

The Colonel North Company has acquired the Grubb's Mine, buildings, and tramway. The tramway is being taken up and relaid to a 2-ft. gauge.

Work has ceased at the Oceana Mine. A subsidence occurred of the ground round the main shaft, rendering it unsafe. It is doubtful when operations will be resumed.

With the exception of the Comet, not much is being done in the vicinity of Dundas. That company is delivering about 250 tons of ore per month to the smelter.

The Great South Comet Mine is being worked by tribute, and a tram is being put in, to connect with the Adelaide Company's tram.

The self-acting tramway from the Hercules Mine to Deep Lead has been completed, and bins, with a capacity of 250 to 300 tons, are now being erected, to receive the ore and load it on to the North-East Dundas Tramway's trucks. Developmental work is going on vigorously at the mine, revealing large payable bodies of ore. Exploration seems to show that the deeper the ore bodies are followed the freer they become from zinc.

The Mount Reid Mine has completed connection with the Hercules Tramway, and has sent away 122 tons of ore for experimental treatment: 5 tons to the local smelter, and 117 tons to England, to be treated by the Ellerhausen process. A rock-drilling plant is soon to be erected. Contracts have been made with the Tasmanian Smelting Company to deliver to the smelter 30,000 tons of ore, of which 5000 tons are to be delivered before end of December next.

There are about 40 men employed in the Rosebery district. The Mount Black Proprietary, Mount Black Extended, Mount Black No. 1, North Tasmania Copper, and Berry Consols are the only mines now at work. The Mount Black Proprietary Company has sent away 21 tons of ore for experimental treatment: 5 tons each to Wallaroo, Dapto, and Dry Creek, and 6 tons to Tasmanian Smelting Company. The company intend shortly to erect concentrators, and excavations are now being made for that purpose. The machinery will be driven by compressed air, obtained by water-power. Ample water can be obtained from the Stitt River, so the cost of concentration should be very low.

All the mines above-named are carrying on work vigorously, and in addition there are many others which are rapidly pushing on prospecting and developmental work, and should become large ore-producers in the ensuing year.

About 40 ounces of gold have been won during the year from alluvial workings. There are very few miners working for it at present.

Tin-mining showed signs, three or four months ago, of increasing in importance, but up to the present very little work has been done. Some half-a-dozen miners are working the alluvial deposits about Mount Heemskirk.

A seam of bituminous coal has been recently found near Eden. There has been as yet no time to test its value or quantity. The seam is a foot in thickness on the surface, and the coal is said to burn well and throw out a good heat.

Mr. Commissioner Fowell reports:—

The mines that have come immediately under my notice, as having been actively engaged in work during the past year, are:—

First and foremost, the *Mount Lyell Mining and Railway Company*.—This company have during the last year mined and smelted 210,550 tons of ore.

The average number of men employed during that period has been—

At the reduction works, in all branches	1400
At the mine	422
	1822

During the past year the extension of the company's railway from Teepookana to Strahan has been commenced, and it is expected that train service will be established between Strahan and Queenstown by the end of the year.

An aerial ropeway has been constructed between the mine and the reduction works, and is working very satisfactorily.

Further prospecting at a depth has also been carried on, and by so doing it has been undoubtedly proved that with depth the richness of the deposit increases.

This mine has undoubtedly a great future before it.

Prince Lyell Mining Company.—Since this lease was taken up a considerable amount of work has been done. A tunnel has been driven 700 feet. Length of other drives, 220 feet. Cross-cut, 30 feet. Depth of shaft, 70 feet.

Average number of men employed, 6.

A lode has been found to exist on this property, which varies very greatly in extent and metallic contents, at times large and well-defined, carrying copper pyrites assaying up to 33 per cent.; whilst in others it pinches out into mere veins. The flow of water is too great to permit of sinking to a depth, but there is every reason to believe that a more solid and better defined body of mineral would be found if pumping machinery were employed.

Lyell Tharsis Mine.—The principal work on this mine during the past year has been the erection of the aerial ropeway connecting the mine with the Mount Lyell Company's reduction works.

This was completed about the end of March last, and since then has run continually, delivering 100 tons of ore per day to the smelters.

A start has also been made taking out the open cut on the mine, and work has been carried out continuously.

Mount Lyel Blocks.—The work done by this company is on Lease 12-92, driving and sinking 845 feet.

On the 30th of June the number of men employed was 40.

During the twelve months preceding 30th June about £2000 has been spent in development. A body of ore 40 feet broad and 60 feet high has been found, and the rise is still in ore.

The assays give 10 per cent. copper, with a small quantity of gold and silver.

The value of ore at grass is set down at £2000. Ore consists of bornite, glance, and copper pyrites.

The main tunnel is now 1170 feet long, and is being driven about north so as to eventually go under the Lyell Peaks at a depth of over 800 feet.

South Tharsis.—This company is actively at work erecting a concentrating plant to treat their ore, which is of a low grade, and I trust their efforts will prove successful, as the treatment of these ores will much benefit the whole field.

North Lyell.—Work has been proceeding steadily on this mine, both in underground prospecting and preparing to take out ore, on the open cut system.

The railway which is in course of construction from Kelly's Basin, Macquarie Harbour, is progressing. The contractors have met with difficulties in the shape of heavy slips, but there seems every prospect of its completion by the end of the present year.

Tharsis Consols Mining Company.—Prospecting has been carried on during the year with from two to six men.

Two promising lode formations have been discovered.

Work done during the twelve months:—Driven 262 feet, besides surface trenching and stripping overburden.

The ore body has been proved 72 feet wide, fair grade, and good concentrating ore.

Western Tharsis Mining Company.—A considerable amount of prospecting, both on the surface and underground, has been done, and there is good reason to suppose this will be a payable mine.

This will be another mine for concentrators.

Crown Lyell Copper Mining Company.—A large amount of work has been done, consisting of driving tunnels and shaft-sinking, the number of feet driven being about 650.

A main engine-shaft has been sunk 221 feet, and in the main tunnel a winze, some 80 feet, poppet-heads, and winding-plant have been erected.

Average number of men employed, 20.

North Crown Lyell.—The work done on this lease has been driving tunnels, open-cuts, and sinking a winze. Total amount of driving, 505 feet.

Two distinct ore bodies have been passed through, one 20 feet wide, the other 7 feet wide, and it is anticipated to put in a low-level tunnel to prove the ore bodies at a greater depth.

King Lyell Mine.—The work done on this mine during the past year has been chiefly confined to hydraulic sluicing. The stuff being treated is copper-bearing clay, the copper being in the form of native or malleable copper. The clay deposit averages 0·5 per cent. This is concentrated up to 30 per cent.

Glen Lyell Mining Company.—During the past year a considerable amount of work has been done, both of a prospecting and developing character.

766 feet have been driven. An ore body has been cut from 15 to 18 feet wide. Assays have given from 2½ to 14 per cent. copper, 1 to 2 ozs. silver, 16 grs. to 1½ dwts. gold. It is intended to cut this body at a low level.

On an average, 13 men have been employed.

South Mount Lyell.—The principal work done has been sinking the main shaft, which is now down to a depth of 500 feet, and it is intended to sink to a further depth of 50 feet, making a total of 550 feet, when levels will be opened up N.E. and S.W., with the expectation of picking up a substantial copper ore deposit.

The average number of men employed, 30.

Besides the abovementioned properties, work, more or less, has been carried on—Mount Lyell Proprietary, West Mount Lyell, Mount Lyell Consols, Mount Lyell Extended, North Mount Lyell Consolidated, Mount Lyell Comstock, Mount Lyell Reserve, Royal Tharsis, West Lyell Extended, and North Prince Lyell.

A large area has been applied for in the neighbourhood of Mounts Jukes and Darwin.

At Mount Jukes, on the section known as *Harris' Reward*, work has been resumed, but much cannot be done until a good pumping plant is obtained and the country is tried at a depth.

Mount Jukes Proprietary.—Progress is much hindered on this and others in the neighbourhood by the want of a track. The cost of packing provisions is £1 for 50 lbs.

10 men have been continuously at work prospecting on the three sections held by this company.

North Jukes.—Prospecting work done for the last 10 months.

Queen Jukes.—Ditto.

South Jukes.—Work is carried on by a syndicate, and the property is under flotation into a company

3526-93M, Hy. Turner.—Being prospected.

Bean and Allen's.—Intermittent prospecting done, and very rich ore discovered, assaying up to 60 per cent. copper.

At Mount Darwin—the *Prince Darwin*—work has been carried on continuously during the last six months.

On the Darwin Proprietary, and what is known as Dillon's Show, work has been started.

The whole of this country is metalliferous, but the present holders have not enough money to do more than surface prospecting, except in one or two instances.

When the North Lyell Railway is completed this country will be opened up, and there is every prospect of its supporting a large population.

At Mount Huxley one or two men are still making good wages fossicking for gold, and the present holders of gold leases there should take immediate measures to prove their properties. It will require capital to do so, but the indications would certainly warrant it.

I regret to have still to report very little progress made on the gold leases in the neighbourhood of Woody Hill.

The Messrs. Murray Bros. have steadily gone on working, and have altogether crushed about 175 tons of quartz, which yielded 11 dwts. to the ton.

This yield ought to be a sufficient inducement to lead the holders of properties in the neighbourhood to try what they are worth.

There has been very little alluvial mining done. The reason, I believe, is that work has been plentiful, and miners prefer it to fossicking for gold.

I have endeavoured to give you as full an account as possible of the work actually going on at the present time.

Mr. Registrar FIDLER reports:—

I beg leave to report on the mining industry in the Waratah division for the past year. The Mount Bischoff Company has, as usual, maintained its regular output, and is likely to do so for many years to come. Tin has been known to exist at Whyte River for years, and is now being sought after by prospectors. Having myself seen a deal of tin-mining on the North-East Coast, I feel confident that the ground at Whyte River would pay small parties well, after spending a month or two to get the water on. There is nothing there to warrant a company being floated, so far as known at present. In silver ore, I may mention that the Silver Cliff, near Waratah, is shut down, and has been so for some few months.

The Magnet Mine, about 10 miles from Waratah by road, now employs about 50 hands, and the mine looks really splendid; and, no doubt, with proper appliances on the mine for treating the ore, it would pay handsome dividends.

Several sections are held for silver in the vicinity of the Whyte and Heazlewood rivers, but no work is being done on most of them. I have lately seen some specimens of copper ore from a find near the Heazlewood River. It appears to be of good quality, and reported to carry a good percentage of gold. It is known locally as "Binks' Show," and is highly spoken of by those who have seen it.

There is no work being done on the Long Plains at present. At the Specimen Reef they have been doing a little prospecting for some time. The Rocky River Mine has been rather unsettled of late, having changed its mining manager, but is settling down again. The Rio Tinto appears to be hung up, nothing doing there.

On the whole, the mining industry in the district is in a healthy condition, and there appears to be plenty of employment for everyone. There are several good shows, only requiring a little capital and good management to make them pay.

THE MOUNT LYELL MINING AND RAILWAY COMPANY, LIMITED.

Reduction Works, Queenstown, Tasmania,
July 16th, 1899.

DEAR SIR,

I AM just in receipt of your wire respecting the information of our output for the year ending June 30th, 1899.

The work done at the mine is as follows :—

Ore despatched to Reduction Works—	
Excavated in open cut	197,617 tons
Won underground	19,719 ,,
TOTAL	217,336 tons
Number of feet driven	3013 feet
,, ,, sunk	153 ,,
,, ,, risen	24 ,,
TOTAL	3190 feet
Quantity of overburden removed	288,058 tons
Average number of men employed during the year...	422

The work done at the Reduction Works is as follows :—

Quantity smelted during the year (total ore)	201,550 tons

N.B.—The difference between this and the quantity above reported as produced by the mine, is the amount on hand in bins, unsmelted.

Output in blister copper	6105 tons
Containing copper	6029 ,,
,, silver	714,578 ozs.
,, gold	24,726 ,,

N.B.—This production of metals does not take into consideration the quantities contained in middle products in stock, and not worked up at the end of the year.

The last furnace, No. 11, of the entire plant, was blown in on June 29th, 1899.

Average number of men employed at the Reduction Works in all branches 1400

The above figures, of course, relate to the year from July 1st, 1898, to July 1st, 1899.

The figures for the Reduction Works since the inception of smelting operations, in June, 1896, up to July, 1899, are as follows :—

Total ore smelted	406,586 tons
Total production of metals—	
Blister copper	13,119 ,,
Containing copper	12,961 ,,
,, silver	1,363,874 ozs.
,, gold	57,467 ,,

I trust that the above information is what you wanted. If anything else is required, please advise me.

Yours truly,

ROBT. STICHT, *General Manager.*

The Secretary for Mines, Hobart.

TASMANIAN SMELTING COMPANY, LIMITED, ZEEHAN, TASMANIA.

Zeehan, 31st July, 1899.

DEAR SIR,

IN response to the inquiries for information, we respectively submit the following sum of money expended—over £100,000 :—

Cost of construction over £57,000.

Ore purchases over £30,000

Balance went into fluxes and supplies.

The roasters have had a fair trial, and with very good success.

The yield of two and (or) three roasters being 2250 tons calcined.

The furnace puts through approximately a tonnage of ore of from 70 to 90 tons per day, and produces, on an average, 15 tons of bullion per day.

All the machinery works in splendid order.

The electric light is installed, and furnishes light to all the different departments and dwellings.

The water station also does splendid work, furnishing water through the pipes all over the works.

The railway and haulage lines are completed, and give good satisfaction.

The wood tram connecting the firewood reserve with the works is still in course of completion.

The construction of these works called for a removal of over 50,000 cubic yards of dirt and rock.

Over 1¼ million ordinary bricks, manufactured locally, and some 75,000 fire-bricks, which were imported, were used.

There were also 12,000 bushels of burnt lime used, burnt on the premises, and all sand required for mortar was found on the site.

The foundations for different machines and engines required 800 casks of cement, and half a million feet super. of hardwood went into the erection of sheds.

All the buildings are iron-covered, for which purpose over 50 tons of galvanised corrugated iron were used.

All the buildings are painted with an acid-proof paint, to prevent corrugation by the sulphur fumes from the roasting furnaces.

The total length of small railways in the works is about 1 mile of tracks to facilitate the handling of material.

From the present experience the water supply obtained from Manganese Creek will be sufficient, even in the dry season, as all the waste waters return to the creek above the pumping station to be reused.

It gives us great pleasure to add that the whole appointments of the works have proved themselves efficient to a high degree.

The product obtained out of mostly low-grade ores will be silver-lead bullion of a gross value of, approximately, £35 per ton.

Outside of the men employed at the lime quarry and the wood carters, we give employment now to 150 men.

Yours truly,

MAX. HEBERLEIN, *General Manager.*

The Secretary for Mines, Hobart.

REPORT ON THE PROGRESS OF THE MAGNET SILVER MINE.

Supplied by Mr. G. L. Meredith, Legal Manager, Launceston.

The Magnet Silver Mine is situated about four miles in a westerly direction from Mount Bischoff, on a southern spur of the Magnet Range. It may be reached from Waratah by the macadamised Waratah-Corinna road, which has been constructed by the Government at great expense, and when the work now in hand is completed, should be all that can be desired for extensive waggon traffic, and will doubtless meet all the requirements of the Magnet Mine and others in its vicinity. At the seven-mile peg, on above road, the 2-ft. gauge steel tramway of the Magnet Company infringes on the road, so that, taken altogether, the mine is of easy accessibility from the Waratah terminus of the Emu Bay Railway. The geological features of the vicinity of the Magnet Range, where the mine is located, are Silurian altered slates, in which occur associated igneous rocks of an almost unique character, so far as this island is concerned. The lode itself shows a bold outcrop of hard ferro-manganese gossan near a small stream, which is a tributary of the Arthur River. This material is often in huge blocks, and commonly assays high in silver. The immediate locality is heavily timbered; and the spreading natural branches of the horizontal scrub mark the lode's outcrop to a large extent.

The mine offers remarkable facilities for cheap practical working, by adits driven from an easterly aspect, thus completely obviating the necessity of expensive pumping and hauling machinery. Two permanent water-falls are within easy access of the workings of the mine, and offer remarkable natural facilities for obtaining requisite power for driving ore-dressing machinery, as well as for electrical purposes.

Heavy timber is a common feature in the district, and much of this is well adapted, both for mining and building purposes. Four levels have been driven into the hill, all of which have intersected rich ore bodies of enormous size, and a fifth is now being driven, which will intersect the lode at a still greater depth than has yet been obtained. In all, when this work is completed, there will be not less than 360 feet of ground overhead; and as the continuity of the lode has been proved to extend for considerably over a mile in length, it requires no stretch of imagination to grasp the possibilities of the mine. These facts, coupled with the peculiar intrinsic value of the ore, stamp it as one of the most promising mines among many that this Colony possesses.

The main workings have been carried out in what is known as No. 2 level, which intersects the lode at a depth of over 100 feet. Here, as in the workings above, the greater portion of the argentiferous ore is extensively decomposed, but is always rich in silver and lead. The total width of the actual silver-bearing portion is proved, by the crosscuts and drives, to be over 90 feet, mainly composed of two bodies, 20 and 25 feet respectively, the intermediate space being taken up with decomposed country rock, carrying a fair amount of silver.

The average metalliferous value of the whole mass is over 30 ozs. silver, about 12 per cent. lead, and a small quantity of gold. The company is breaking out the richer portion of the ore, which consists of bands of associated oxidised and sulphide ores of great richness, often assaying as high as 260 ozs. silver, 70 per cent. lead, and 7 to 8 dwts. gold,—the average value of the ore sent to market being about 120 ozs. silver, 35 per cent lead, and a few dwts. of gold. This ore, as bagged for sending away, contains 27 per cent. of iron oxide, with a small portion of lime, so that it is remarkably adapted for sweetening the zinciferous ores so abundantly produced and sold to the smelting companies in Australia; and for this reason very strong competition for the output of the mine prevails, and the company is therefore able to make extremely advantageous terms for the sale of the ore. At present the company has a contract with

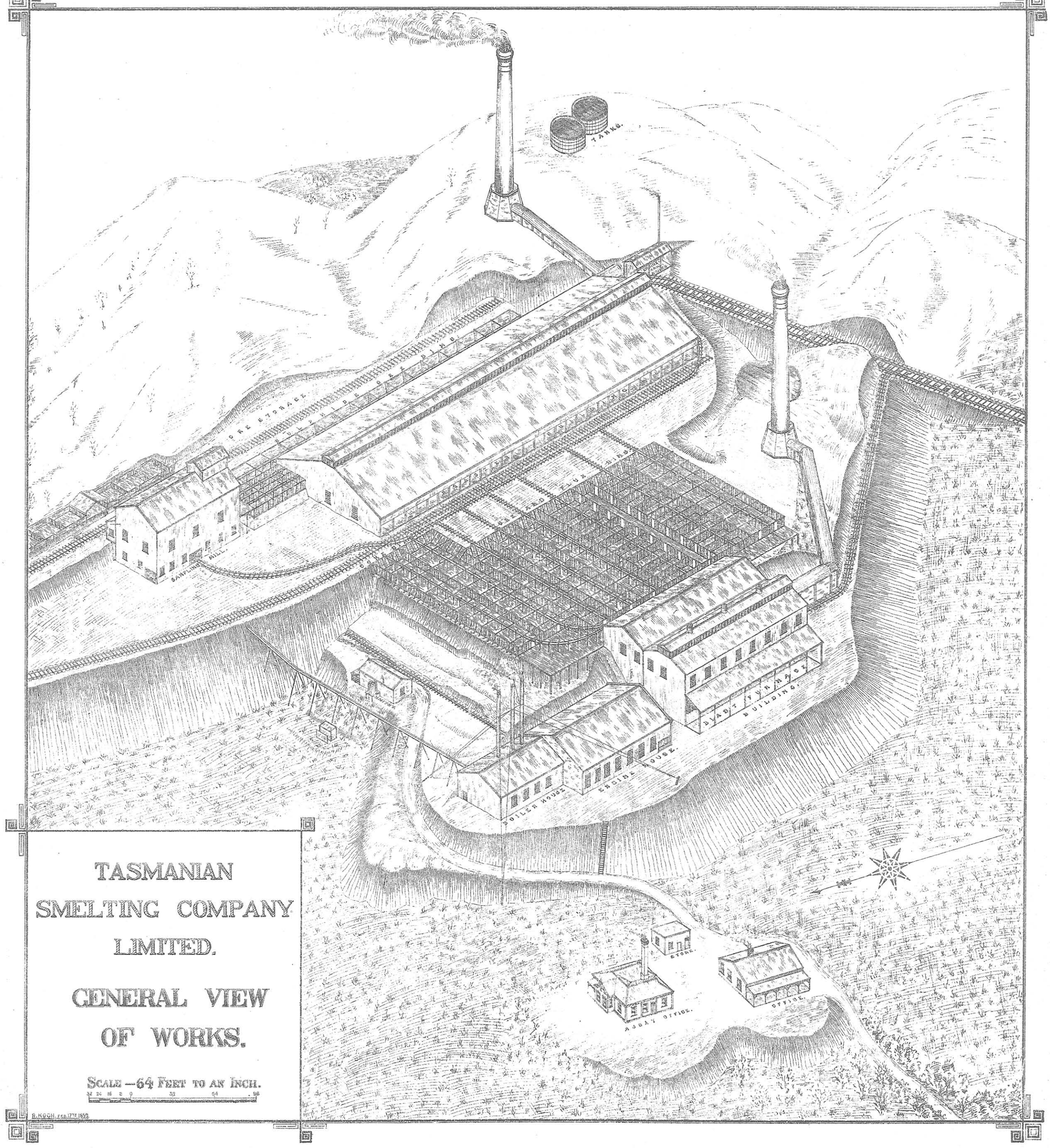
TASMANIAN SMELTING COMPANY LIMITED.

GENERAL VIEW OF WORKS.

SCALE —64 FEET TO AN INCH.

32 24 16 8 0 32 64 96

B. KOCH. FEB. 17TH 1892



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the Smelting Company of Australia, and a gradually increasing output is being maintained. The production is somewhat in excess of the facilities at present existing of conveying from the terminus of the company's tramway to the Railway Station at Waratah.

The last shipment, which was made on June 6th, consisted of 1183 bags, weighing 43 tons. The total quantity of ore sold up to date is as follows:—16,555 bags, weighing 581 tons 9 cwt. 3 qrs. 25 lbs., returning a rich value of £7461 16*s.* 6*d.*

The average price realised has been about £15 per ton, gross. The system adopted has been to grade the ore by mixing on the floors to this value. There is an accumulation of about 4000 tons of second-class material in the ore paddocks for future disposal. It is fully expected that within a few months the mine will be able to sustain an output of 200 tons of first-class ore per month. Needless to say, when this desirable end is attained the shareholders will be greeted with substantial dividends.

The policy of the board of directors is to build up a good reserve fund, so that in the future the mine may be provided with first-class ore concentrators, and, if need be, a smelting plant. As regards the latter, the ore in the mine is an easy proposition, as it carries its own flux without any deleterious matter.

As is shown by the lamination of the ore bodies, the lode is a contact fissure, and, as such, its living to impenetrable depth is substantially assured. The gangue generally is carbonate of iron, with calcite. In this material the undecomposed portion of the mass shows regular seams of ore of varying width and remarkable regularity and striking beauty. This is a persistent feature throughout the whole of the workings of the mine. The primary minerals being mainly galena, and the lesser quantity jamesonite, stibnite, and antimonide of silver. The secondary minerals being crocoisite, vanadianite, with massicot, carbonate, and sulphate of lead, and the mixed oxides of antimony and lead, the latter always predominating. Occasionally filiments of native silver occur in aborescent patches, especially on the footwall side of the lode. The adjacent rocks immediately connected with the lode itself are, on the footwall, a dolomatized websterite which, close to the ore-body, becomes beautifully concretionary, and often contains rings and bands of sulphide ore, with occasional native silver. The hanging wall is composed of an igneous rock, usually dark mottled coloration and nodular structure. It is what is known to patrologists as diabase porphyrite, but has no vernacular term, excepting that the miners erroneously term it, among many other sorts of rock, "diorite."

In the last half-yearly report, issued on 30th March, the directors estimate that there is not less than half-a-million pounds' worth of ore in sight. Since then, the work carried out is of such a nature that this value has been considerably extended; and other developments are proceeding apace, and revealing still further available ore-bodies. In No. 2 level a persistent ore-shoot has been driven upon nearly 400 feet, and still continues, both north and south. In No. 4, which will eventually be the main working level, the ore is of extremely high value. Here extensive ore-sheds are in course of construction, and the tramway laid down to same. No ore has as yet been sent away from this portion of the mine; but there is an extensive area ready for stoping.

REPORT ON THE BELL MOUNT AND MIDDLESEX MINERAL FIELDS.

Government Geologist's Office,
Launceston, 6th September, 1898.

SIR,

IN accordance with your instructions I have lately made a second examination of the Shepherd and Murphy Mine, Bell Mount, and while in the neighbourhood visited one or two other sections where a little work was going on. From Bell Mount I went to the Devon Mine on the Dove River, and returned to Sheffield by the old Middlesex Road, crossing the River Forth at the Lorinna Bridge. On my way I visited the Glynn and Golden Hill Mines on the Five-mile Rise, and the old workings at Mount Claude, and have now the honour to present the following Report :—

Shepherd and Murphy Mine.—Since my previous visit to this mine on June 5th, 1897, a considerable amount of work has been done on the lines suggested in my Report, two adits having been driven in a southerly direction, and a total distance of over 1000 feet of driving and 170 feet of sinking done, with satisfactory results. No. 1 adit starts between the outcrops of Nos. 5 and 6 lodes, and the former was cut at about 170 feet from the entrance. 12 feet beyond this another quartz vein was cut, not seen on the surface, and this has been called No. 5A. Both of these lodes are very small, and no work has yet been done on them. No. 4 lode was cut at 267 feet, and has been driven on on either side of the cross-cut, a total distance of 115 feet. Its course is almost due E. and W., with little or no underlay, and its width is from 18 inches to 2 feet, the lode-matter being principally crystalline quartz, containing a good deal of cassiterite and wolfram with occasional bunches of bismuthinite (sulphide of bismuth). In the east drive the lode has been left standing for a length of about 40 feet to avoid double handling, the bin at the entrance to the adit being full of ore. Connection has been made with the surface by a shaft 66 feet deep, sunk on the lode, which increases in size from the surface downwards, and is said to carry good ore all the way down. The old tunnel on this lode from the eastern fall of the hill mentioned in my former Report is about 25 feet above this level, but no further work has been done there. No. 3 lode was cut 93 feet from No. 4, but is small and broken, and does not seem worth driving on at this level. 50 feet further in No. 2 lode was cut, and connected with the surface by a shaft 86 feet deep. Only about 25 feet have been driven on this lode, which averages about 15 inches wide, and contains some good bunches of clean sulphide of bismuth, besides a fair percentage of tin ore, associated with wolfram. The adit has been extended 120 feet beyond No. 2 lode, and if continued should soon intersect No. 1 lode, which at the surface is about 6 inches wide. The country rock passed through is chiefly sandstone with bands of slate, but in the end it is hard quartzite.

From the bottom of the ore-bin, at the mouth of the adit, the track has been cleared and partly graded for a self-acting tramway, about 17 chains long, to the dressing-sheds, nearly 300 feet below, passing by the mouth of No. 2 adit. In this adit, which is 140 feet vertically below No. 1, No. 6 lode was cut at about 50 feet from the entrance, and has been driven on 320 feet. In the east drive it is about 15 inches wide, and in the west 18 inches to 2 feet in two branches, the general strike being about the same as the other lodes, *i.e.* approximately E. and W. The lode carries very good tin ore, in large crystals, and a good deal of wolfram ; occasionally a little sulphideof bismuth occurs associated with iron and copper pyrites, but this lode is not so rich in bismuth as Nos. 2 and 4. A little molybdenite has also been obtained. The gangue is principally quartz, but in places there is a good deal of fluor spar and chlorite, and sometimes kaolinised felspar, which on exposure to the weather crumbles and releases the crystals of tin ore. Where the lode was cut it is only about 35 feet below the surface, and going west along its course the ground is fairly level for about 150 feet, after which it gradually falls, and a shaft about 10 feet from the end of the drive connects with it in about 18 feet. A good pile of crushing-dirt, estimated to contain about 250 tons, has been obtained from this drive, and should give a very good yield of black tin. The adit will have to be driven several hundred feet before cutting No. 5 lode, but it is probable that another lode will be cut between these two. The three lodes which have so far been driven on have increased in width from the surface downwards, but it cannot be expected that they will continue to increase much more, and, as they are still small, it will be very necessary, when crushing is started, to keep the development work well ahead. It is probable that the lodes will eventually enter the granite below,

but at a depth which will not be reached for many years, if ever, though it is likely that the country rock will gradually become harder.

On the tramway track below No. 2 adit, a heavy brownish crystalline rock is seen, consisting almost entirely either of garnet or vesuvianite (probably the latter) this is evidently a product of contact metamorphism due to the intrusion of the granite, with which the lodes are undoubtedly connected. It may have been originally a limestone, which rock Mr. Montgomery, in his report on the district in November 1893, mentions as occurring further east at the Iris crossing. I noticed several small veins of felspar running through it, and in places it contains a good deal of magnetite. One interesting feature about this rock is that it contains a little sulphide of bismuth disseminated through it, and though I do not think that this is present in payable quantities it would be worth while, when the battery is running, to open out a face and make a trial crushing of 20 or 30 tons. If a lower adit is put in it will pass through this rock, and it is quite possible that another lode will be cut, which would probably be rich in bismuth.

The building for the concentrating plant has been erected, and has been made large enough for 20 heads of stamps, with jigs, Frue vanners, and buddles, but it is intended to erect only 10 head at first. Much of the tin ore is in coarse crystals, and a good deal could probably be saved by a roughing-jig, the dirt being first crushed with a stone-breaker or coarse rolls and passed through a revolving trommel before going to the battery. It will not be possible to separate the three minerals cassiterite, bismuthinite, and wolfram mechanically, but as a much better price is obtained for the metallic contents of each ore by itself than when all mixed together, it will probably be found that hand-picking can be advantageously carried on to a considerable extent and, for the same reason it would be advisable to treat the ore from No. 6 lode as far as possible by itself. The stamps and the vanners are to be driven independently by two Pelton wheels, and a dam has been constructed over 500 feet above the machinery site, estimated to contain between two and three million gallons. In dry weather there is very little water running into this, but a water-right of 10 sluice-heads has been taken up on the Weaning Paddock Creek, and it is proposed to bring this in, but the survey for the race has not yet been made.

From the dressing-sheds a sledge track about half a mile long has been made, connecting with the pack-track from Bell Mount. The first part of this is very steep, and a better grade could probably be obtained by a sidling track to junction with Hall's Track close to the five-mile peg. At present it is quite impossible to bring in any heavy machinery. On the Sheffield side, from the end of the formed road, the track has been cleared 20 feet wide to the foot of Bell Mount, a distance of about 3 miles. This is nearly all through good agricultural land, densely wooded, and would soon cut up with heavy traffic, unless corded or metalled. Round Bell Mount there is a hard bottom, and a good grade can be obtained, but a good deal of cutting will be necessary on account of the steep slope of the hill. Some two miles further on basalt country is again met with, and the present pack-track is in a very bad state. All underground work has been temporarily suspended pending the completion of the road and the subsequent erection of the machinery, but 8 men were employed at the time of my visit ground-sluicing the alluvial to the east of the Western Creek alluded to in my previous Report. The "wash," consisting chiefly of angular and sub-angular fragments of quartzite and sandstone mixed with decomposed basalt, is about 10 feet deep, and contains a little tin ore, wolfram, and carbonate and sulphide of bismuth all through it, the average yield at present being a little more than a bag of mixed ore per man per week, which more than covers working expenses. The ground was very heavily timbered, and work is a good deal hampered by the stumps and logs. In the wash occasional boulders carrying tin ore occur, the source of which is as yet quite uncertain. These boulders, some of which have to be broken up with dynamite, consist of glassy quartz crystals (often broken) and fragments of sandstone and quartzite (occasionally waterworn) cemented together with a siliceous paste. They have apparently come from an older cemented drift, but the crystals of cassiterite which are irregularly distributed through them are, as far as can be seen, quite sharp, and the boulders themselves are very little waterworn. To the south and west the country is covered with basalt, and there is good reason to hope that other lodes exist below this, and probably a deep lead, but these are questions which can well be left to a future time when the mine is better opened up.

A little ground-sluicing has also been done on Section 1963-93M, 80 acres, which is now held by the Shepherd and Murphy Company. The wash in the face is about 4 feet deep, consisting of angular fragments of sandstone, and gives very fair prospects of ruby and black tin. With a good supply of water this would probably pay to work, but owing to its elevation this would be difficult to secure. A small race has been brought in through a gap in the divide from the head of the Narrawa Creek, which is on the other watershed running into the Forth, but there is very little water, except in very wet weather. Water could probably be brought in from the Company's dam, but this is not justified at present, as the extent of the wash is unknown, and it is hard to prospect on account of the thick horizontal scrub.

Since my last visit several small lots of hand-picked bismuth ore and concentrates have been shipped to England and sold, and I am indebted to the kindness of the Manager, Mr. Sheargold, for copies of the account sales.

One lot of hand-picked ore, weighing 6 cwt., assayed 63·6 per cent. bismuth, the metal being paid for at the rate of 4*s.* per pound. A second lot, weighing 5 cwt. 2 qrs. 6 lbs., assayed 70 per cent. bismuth, which was paid for at the rate of 3*s.* 10*d.* per pound. The gross value of the two lots was £168 16*s.* 10*d.*, and the net proceeds received by the Company, £152 15*s.* 3*d.*, equal to £264 8*s.* 10*d.* per ton.

The following are copies of the account sales of the concentrates:—

103 bags (sold in Germany) weighing 5 tons net; assay value, 11·5 per cent. bismuth, 39·6 per cent. tin.

	£	s.	d.
Bismuth contents, 11¼ cwts. at £19 18*s.* per cwt.	228	17	0
Tin contents, 1·98 tons, at £32 per ton	63	7	2
	292	4	2

Charges.

	£	s.	d.			
Smelting, at £6 10*s.* per ton	32	10	0			
Assaying, grinding, sampling, &c.	11	2	0			
Brokerage, commission, &c.	13	10	0			
Freight to Hamburg, dock charges, &c.	14	2	11	71	4	11
Net value received				£220	19	3

13 bags, weighing 13 cwts. 0 qrs. 26 lbs. net; assay value, 14·25 per cent. bismuth, 47·2 per cent. tin.

51 bags, weighing 2 tons 10 cwts. 3 qrs. 5 lbs.; assay value, 15·59 per cent. bismuth, 46·21 per cent. tin.

	£	s.	d.
Bismuth contents (2 lots), 9 cwts. 3 qrs. 6 lbs., at £19 18*s.* per cwt.	195	1	10
Tin contents (2 lots), 1 ton 9 cwts. 2 qrs. 23 lbs., at £38 5*s.* per ton	56	16	2
	251	18	0

Charges.

	£	s.	d.			
Smelting, at £7 10*s.* per ton	24	0	2			
Assays	3	3	0			
Brokerage and commission	11	18	0			
Dock charges, rent, &c.	2	2	4	41	3	6
Net value received				£210	14	6

No mention is made of the tungsten contents, but the price paid for the tin is probably regulated by the percentage of wolfram in the ore. The Manager is now hand-picking more closely, and dividing the concentrates into two classes, coarse and fine. I took samples from the concentrates on hand, which Mr. Ward, Government Analyst, has assayed with the following results :— No. 1. Coarse Concentrates—20 per cent. tin, 33 per cent. bismuth, 9·6 per cent. tungstic acid. No. 2. Fine Concentrates—34 per cent. tin, 6 per cent. bismuth, 14·2 per cent. tungstic acid.

The principal producers of bismuth in England are the firm of Johnson, Matthey and Co., of London, who treat most of the Australian and Bolivian ores, but their process is a secret. The usual method of separating the bismuth from the tin is to carefully roast the finely-crushed ore, so as to convert the sulphide of bismuth into oxide, and then digest the roasted ore with dilute hydrochloric acid. The oxide of bismuth dissolves, and the solution is then drawn off and diluted with large quantities of water, which precipitates the bismuth as oxychloride. Owing to the presence of iron and other impurities, it is generally necessary to dissolve and reprecipitate this once or twice, and it is then reduced to metal by smelting in graphite or iron pots with lime and charcoal. The wolfram remains undissolved in the original residue, together with the tin ore, silica, &c.: on smelting, part of it goes into the tin and makes it hard and less fusible; the rest goes into the slag, making it less liquid, and causing greater loss in tin, through the inclusion of prills. To separate it, the ore is subjected to a preliminary smelting in special reverberatory furnaces, with soda, salt or sulphate of soda, and the tungstate of soda which is formed is leached out with water. Considerable loss of tin is caused by the formation of sodium stannate; and it is said that this loss is not covered by the value of the tungstate obtained, so it does not seem likely that the hopes of being paid for the wolfram will be realised. Probably, however, when regular shipments of concentrates are made, the charges for smelting, assaying, &c., and other incidental expenses will be considerably reduced.

The company has now spent a considerable sum of money, and done a large amount of work, in opening up the mine, clearing, cutting tracks, &c. As before mentioned, the lodes are small; but, in my opinion, the developments are quite sufficient to warrant the erection of concentrating machinery, and I should advise the road being made as soon as the dry weather sets in.

Section 1815-93M, 78 acres.—The Shepherd and Murphy, No. 4 lode, has been traced into this section; and near the north-western corner a deep trench has been cut along its course, and the lode exposed for a length of about 150 feet. It is a well-defined lode, 15 to 18 inches wide, striking E. and W.,—the enclosing country rock being sandstone, striking about E.N.E. The lode-filling is chiefly quartz, affording fine specimens of smoky quartz crystals. It carries a good

deal of wolfram, and in places a little tin ore and native bismuth. So far as proved, it is nothing like payable, and no work is going on here at present, but it is worth further prospecting.

About three-quarters of a mile N.E. of this several sections have been taken up for gold, and a lot of trenching has been done, and several small shafts sunk, which are now all full of water, on a belt of gold-bearing sandstone, running about W.N.W.

On Section 970-93G, known as Packett's Reward, one man was at work dollying the surface-stone, which shows a little fine gold for a width of about 10 feet. There is little to distinguish the gold-bearing stone from the ordinary country rock, which is a friable sandstone containing small stringers of quartz; and in one trench a small quartz vein is seen carrying wolfram. A sample which I took from the bottom of the trench, across a width of about 6 feet, yielded 6 dwts. 12 grs. gold per ton. The stone is very soft, and this would probably pay to crush, if there were any large extent of it; but the experience obtained in a shaft sunk on the "formation" is against the probability of this. This shaft was sunk 30 feet, when water proved too heavy to cope with without machinery, and sinking had to be discontinued. Mr. Hemmings, one of the holders of the section, informed me that, at a depth of about 14 feet in the shaft, pyrites began to come in in the form of wedge, and at the bottom there was pyrites for the full width of the shaft. I took a sample by chipping from the most solid-looking pieces at the mouth of the shaft, but this assayed only 1 dwt. 15 grs. gold per ton. Doubtless the gold has been concentrated near the surface, owing to the decomposition of the pyrites and it does not seem very likely that free gold will be found below the water-level. Owing to the porous nature of the country, water is likely to be heavy, and the present prospects do not warrant the erection of pumping machinery. Towards the Narrawa Creek, however, the ground falls rapidly, and the "formation" could be tested at a considerable depth without much expense,—the country being very easy for driving.

Narrawa P. A.—This company holds sections 35-93G, 36-93G, 37-93G, and 40-93G, a total of 60 acres, of which 35-93G, 36-93G, 20 acres, lying a short distance north of Packett's, are reward claims for gold. The principal work done is on section 35, on which a tunnel has been driven about 135 feet in a general westerly direction along the course of a formation consisting of sandstone and quartzite heavily impregnated with iron, arsenical and copper pyrites, with, in places, a good proportion of galena. At 80 feet from the entrance a cross-cut has been driven 20 feet to the S., showing more or less sulphide ore all through the country. Above the tunnel the hill rises very steeply, and offers excellent facilities for working by means of tunnels should payable ore be discovered. On the surface the iron-stained capping has been trenched across in several places up the hill, and is said to carry a little free gold for a width of 30 or 40 feet. As far as would be seen it consists of quartz grains cemented together with oxide of iron, probably due to the decomposition of the pyrites, which have released the gold, and I consider the formation to be an impregnation rather than a lode. A sample which I took from some of the ore at grass assayed 2 per cent. copper, 5 oz. 17 dwts. 12 grs. silver per ton. and traces of gold. In driving it is quite likely that good bunches of ore will be found, but frequent assays should be made to determine the value of the ore.

Bell Mount Gold Field.—This field has been practically abandoned, though one or two men still make a living on it. Several good sized nuggets up to 16 ozs. in weight were found some years ago, and altogether a large quantity of gold has been obtained, but the source which shed the gold has not yet been discovered. Much of the country is covered with basalt, and it is probable that auriferous leads lie buried beneath this. Prospecting is also much hindered by the thick scrub, but the fires of last summer have now cleared a good deal of this, and the field deserves further attention from prospectors.

Leaving this district, Hall's track was followed for about two miles in a southerly direction along the basaltic plateau forming the divide between the Forth and Iris Rivers. This track then bears round to the west following the high land, and junctions with the V.D.L. Co's. road not far from their Middlesex Plains block. Another track bears to the east and joins the Middlesex Road close to the old Caledonian Gold Mine. One fair-sized creek, locally known as the Bull Plains Creek, was crossed at an elevation of about 100 feet above the Shepherd and Murphy Camp and might be available as a source of power for that mine, being nearer than the Weaning Paddock Creek, but it is on the Forth watershed and it seems doubtful if the water could be taken across the divide. The track here passes through some well grassed open country, but it lies too high to be of much value, and at the time of my visit was covered with three or four inches of snow.

The Caledonian Mine has been abandoned for some years, and the 15-head battery, which must have cost a great deal to bring to such a spot, has been removed to the Golden Hill Mine near Lorinna.

The Middlesex Road was followed to the top of the Five Mile Rise, which, according to my aneroid readings, is 2000 feet above the bridge over the Forth at Lorinna: we then branched off and followed a blazed line along the ridge overlooking the deep gorge of the Dove River, and finally struck the pack-track made by the Devon S. M. Co. from their mine. For some distance past the Caledonian Mine the country consists of sandstones and grits, which further on are overlain by basalt, and near the Devon track granite is seen, which continues down to the Dove River.

DOVE RIVER DISTRICT.

Devon Mine.—The Devon Silver Mining Company, No Liability, holds Sections 1831-93M, 1938-93M, 1939-93M, and 1940-93M, a total of 160 acres, and this is the only property in the district upon which any work to speak of has been done, progress having been very much hampered by the difficulties of access. The Dove River runs in a southerly direction through the centre of Section 1831-93M, on which the present workings are, the banks on either side being very steep, and in places quite precipitous. The only means of crossing the river is by a rough bridge made of fallen trees; this is often covered with water, the river rising rapidly after heavy rain, and it was partly carried away while I was there.

The principal country rocks are granite and quartz porphyry, with metamorphic slates and sandstones. The normal granite, which is composed of reddish felspar, quartz, and black mica (biotite) is plainly intrusive through the sedimentary strata, which are probably of Upper Silurian age, but it is not at present quite clear whether the quartz porphyry forms a dyke (elvan course) in the granite, or whether it is merely a marginal portion of the granite mass, but I am inclined to think that it is a dyke.

The sedimentary rocks have undergone considerable metamorphism, but the line of contact with the igneous rocks is covered with a thick talus of angular detritus.

About four chains from the northern boundary, and nine chains from the western boundary of Section 1831-93M, a tunnel has been driven 85 feet in a westerly direction about 25 feet above the level of the river. At about 40 feet from the entrance a small vein of gossan carrying a little galena and cerussite was passed through, and at 50 feet a lode was cut carrying about 9 inches of clean galena, but the ore soon cut out when driven on N. and S. In the north drive, which is in 25 feet, the ore made again in about 5 feet, but proved to be only a bunch. In the end it is making again, and there is about 9 inches of good ore in the back of the drive, but in the bottom it is very small; the country rock is quartz porphyry on both walls. Going south the lode was barren for about 12 feet, but near the end, which at the time of my visit was 21 feet from the cross-cut, there is very good ore showing in the back of the drive, cubical and fine-grained galena with a little copper pyrites, the clean ore being in one place about 18 inches wide, but in the bottom of the drive there is only a thread of galena. In the end the vein is split into two branches, each carrying a few inches of clean galena, and for the whole width of the drive there is a little pyrites through the porphyry with small strings of galena. I took a sample of the clean ore from the back of the drive for a length of about 6 feet, which assayed 1 dwt. 15 grs. gold, 87 ozs. 10 dwts. 20 grs. silver per ton, and 73 per cent. lead. The pyrites is also reported to carry gold, and I therefore took a sample across a width of about 4 feet 6 inches which is being saved for seconds, but this only yielded 6 dwts. 12 grs. silver per ton and no gold. The tunnel has been continued 35 feet past the drive in quartz porphyry all the way. Above the tunnel the hill rises at an angle of about 45°, and some high grade galena was obtained from an open cut along the outcrop, the point where the first ore was found, being about 100 feet N. of where it was cut in the tunnel, and about 60 feet above it. A trial parcel of 5 tons 18 cwt. from this cut was sent to the Dapto Works, New South Wales. This parcel assayed 66·6 per cent. lead, 71 ozs. 19 dwts. 19 grs. silver, and 4 dwts. 4 grs. gold per ton, the gross value being £90 19*s.* 3*d.*, and the net value at the works, £64 12*s.*; but the charge for packing the ore to Sheffield was £6 per ton, and freight to Devonport and Sydney had to be paid in addition to this, so that very little profit remained. About 10 tons of first-class ore have been obtained from the tunnel level, which will not be sent away until there is a better track to the mine. The ore in the open cut occurs in the same bunchy way as in the drive. From the frequent "slickensides" that are seen it is evident that there has been a movement of the wall-rocks, and the lode occupies a fault fissure. The section of the original fissure appears to have been a series of short curves, and by the movement of the walls relatively to one another small open spaces were formed which are now filled with ore, while at the same time the wall-rock was more or less shattered. I am of opinion that the lode will be patchy throughout both in strike and dip, the ore occurring in bunches or pockets rather in regular shoots, but it is likely that the bunches will be fairly frequent. In stoping it will be necessary to take out the whole length, as the ore is likely to make a few feet above even where the lode is barren in the back of the drive.

The course of the lode is nearly N. and S. approximately parallel to the hill, so that the steep rise of the latter is not of much advantage unless other parallel lodes be discovered further up. Of this there is some likelihood; and to the S.W. of the tunnel, about 200 feet above it, a vein of manganese gossan about 18 inches wide is seen, striking apparently a little W. of N. and underlaying E., which is worth further attention. Surface prospecting is rendered difficult, owing to the thick accumulation of detritus from the disintegration of the rocks above. No work has been done on the northern sections, and I did not visit them.

Going west from the tunnel workings, the river is again met with in about three-quarters of a mile, having taken a sharp bend, and the intervening ridge is about 900 feet high. Several sections have been applied for on the other side; and I was shown samples containing galena, cerrusite, and zinc blende, said to have come from a formation 11 feet wide, on one of these sections; but unfortunately, owing to the river being flooded, I was unable to get across to see this. The country rocks on the ridge consist of slates, sandstones, and grits, much indurated and altered to hornstone and quartzite, which in places stand out in precipitous cliffs, owing to their superior hardness resisting the influence of weathering. The general strike appears to be nearly E. and W., and the

dip at high angles to the N. There is no direct evidence as to the age of these rocks, but they are certainly as old as Upper Silurian, and may be Lower Silurian.

South of the Devon Mine several sections have been taken up, but no work was going on at the time of my visit, and very little prospecting has yet been done.

From general considerations, it may be said that the district is a likely one for the occurrence of minerals, consisting as it does of the older sedimenatry strata, traversed by intrusive igneous rocks; and, although granite is not generally supposed to be favourable for lead ores, the high-grade ore obtained at the Devon Mine should encourage further prospecting. Probably at a depth the galena will give way to copper pyrites. An effort should be made to trace the lode into the sedimentary rocks, in which it is likely to be more productive. The great bar to prospecting at present is the expense and difficulty of getting supplies. The pack-track made by the Devon Company is far too steep, rising 1500 feet in the first mile and a-half. The level of the Devon Camp is about 300 feet above the Forth Bridge at Lorinna; and, though the country is a good deal furrowed with deep gullies, it is said by those who know the country well that a good track could be obtained from the bridge to the Devon in five or six miles by following the Dove down to its junction with the Forth. A good deal of this would be in rotten granite, which makes an excellent track; and I should advise a rough survey of this being made at once. The present track joins the Middlesex Road on the Five Mile Rise, 1400 feet above the Lorinna Bridge.

FIVE MILE RISE GOLD FIELD.

Glynn Mine, Sections 720-93M, 721-93M, 1010-93M, and 1011-93M, a total of 30 acres.—Until recently this mine was worked by tributors, who at considerable expense erected a small five-head battery and portable engine. The workings are situated on Section 1011 at an elevation of nearly 2000 feet above sea level, and the tributors got out several small crushings from an open cut about 85 feet long along the reef. The last 55 tons crushed, of which 35 tons were classed as seconds, yielded 19 ozs. of gold. The reef runs a little W. of N. with a slight underlay to the W., and the enclosing country rocks are slates and argillaceous sandstones dipping at very low angles to the north, and striking nearly E. and W. To the N.E. the country is covered with basalt, which in places has a vesicular structure, and contains abundant zeolites. From the end of the tributors' workings a winze was sunk 16 feet and connected with a shaft 35 feet deep sunk on the top of the ridge to the west of the line of lode, and the country in the cross-cut between the shaft and the winze is said to have carried a little fine gold throughout; but all these workings are now inaccessible. Above the open cut are several large isolated boulders of conglomerate said to contain a little gold, but I do not consider these of any importance, except as showing that the older rocks from which they were derived were gold-bearing. The company has now resumed work, having bought the tributors out, and a tunnel has been driven west about 25 feet below the old workings, the lowest point available to serve the battery at the present site. At 49 feet the reef was cut about 3 feet wide, and has been driven on N. about 26 feet, but it had pinched a good deal in the end when I saw it. The reef may be called a "mullocky" one, consisting chiefly of crushed country rock with rubbly iron-stained quartz. Very fair prospects of fine gold can be obtained with the dish, but the gold is said to be of very poor quality, being worth only about £2 10*s*. per ounce, owing to the large proportion of silver. Comparatively little stone is available above the present level, but quite sufficient to prove whether it can be treated at a profit, which there seems good reason to hope, as it can be cheaply mined and easily crushed, and a yield of ½ oz. per ton should pay all expenses; doubtless, too, better results will be obtained when the battery, which is now exposed to the weather, is covered in. I consider that the reef is likely to live down, but it is probable that below the water level there will be a considerable percentage of pyrites, and a winze should be sunk to ascertain this. Water for the boiler and for battery purposes is very scarce in summer. A small steam-pump has now been obtained, and it is intended to pump the water from the so-called Big Creek, which runs close to the battery, about 25 feet below it, but I believe there is very little water in this creek in very dry weather. Several chains lower down the creek a little work has been done on a quartz formation carrying a large proportion of iron pyrites which is said to contain silver, but the old prospecting drive was inaccessible, and no opinion could be formed as to the size and probable value of the formation.

Golden Hill Mine, Sections 348-93G, 349-93G, 350-93G, and 351-93G, 10 acres each.—These sections lie a short distance to the west of the River Forth, near the bottom of the Five Mile Rise; and, till recently, were worked privately. A good 15-head battery, which formerly stood at the New Caledonian Mine, has been erected close to the river; and this is connected with the mine by a wooden tramway about half a mile long, having a fall of about 200 feet. The country rocks are very similar to those at the Glynn Mine, consisting of fine-grained sandstones and slates, lying very flat, and striking about E. and W.; but I saw no sign of any fossils which would indicate their age.

The present company is working in a drive started by the former proprietor, who drove a tunnel a total distance of 317 feet, in a general south-westerly direction. At 287 feet a lode formation was cut, which has been driven on about 70 feet to the S.E.,—the strike being about S.E. and N.W., underlaying S.W. The ore consists of iron pyrites and zinc blende, in places very free from gangue, but generally disseminated through a hard siliceous matrix, and on the hanging-wall is a small oxidised vein carrying a little free gold. The lode-channel appears to be a true

fault-fissure, originally partly filled with crushed country rock, which has been silicified by percolating solutions, which at the same time deposited the sulphides. At 165 feet from the entrance a vein of oxidised lode-matter was passed through, which seems worth following; and, since my return, I have been informed that what is probably the continuation of this has been found on the surface, 60 feet above the tunnel. Where cut, it is said to show about 3 feet wide of gossan; and a trial crushing of 12 tons, taken from an open cut, yielded half an ounce of gold per ton. A small creek runs to the N.E. past the mouth of the tunnel; and a short distance up this, W.N.W. from the mouth of the tunnel, a seam of blende and pyrites about 2 feet wide is seen in the face of a cliff, cutting right across the bedding of the country. This is probably a continuation of the lode worked in the tunnel.

At the time of my visit, a trial crushing of 50 tons was being taken out from the tunnel-level, and the battery was crushing with eight heads. I have since heard that the 50 tons yielded 11½ ozs. of gold from the amalgam; but the stone contained a large percentage of pyrites and blende, and the sands have been stacked for future treatment. I took a sample from the launder at the bottom of the plates, which gave, on assay, 8 dwts. 4 grs. gold per ton. Below water-level it is probable that there will be little or no free gold; and the future success of the mine largely depends on the treatment of the sulphides. They could be easily concentrated on a vanner or rotating table; and a fair bulk sample should be taken from the accumulaled sands, and carefully washed and assayed, to ascertain if this would pay.

Alluvial Workings.—A good deal of alluvial gold has been obtained from the Five Mile Rise at various times; but the difficulty of obtaining a permanent supply of water has always been the great drawback.

To the east of the Glynn Mine, Mr. O'Rourke has an alluvial claim, on which he has done a large amount of work. He has a water-right of 2 sluice-heads on Big Creek, and this is brought in by a race about half a mile long into a small dam, from which a line of pipes conveys it to the face; but the pressure is not sufficient for effective hydraulicking, and the supply is very poor in summer. The "wash" consists of angular fragments of sandstone, and in the highest face is about 16 feet deep, with one or two hard bands of ironstone cement. The bottom consists of slate and sandstone, with a very flat dip. The gold is mostly coarse, and very little water-worn; and the appearance of the "wash" shows that it has not travelled far, but no reefs have yet been discovered which could have shed the gold.

A little gold is said to be obtainable nearly everywhere from the surface-gravel formed by the disintegration of the bottom "in situ," and it is probable that this is largely derived from small stringers in the country; but there is still a good chance of discovering a payable quartz reef.

MOUNT CLAUDE.

Very little work has been done here since Mr. Montgomery reported on the district in 1893, and all the ground was afterwards forfeited; but attention is again being directed to the locality, and several sections have been recently taken up again. The long tunnel started by the Mount Claude Silver Lead Mining Co., and continued in turn by the Southern Cross Proprietary Silver Mining Co. and the Kentish Proprietary Silver Mining Co., was extended to 850 feet, and again abandoned. The end is in hard crystalline limestone, and I could see no sign of any lode formation corresponding to the gossan outcrop on the surface. This section, formely 90-87M, is now numbered 2093-93M, having been recently taken up on the old lines in the name of W. D. Tune, and I believe a company has been formed in Sheffield to work this, the intention being to sink a shaft on the line of the gossan outcrop west of the line of the tunnel, but operations had not been started at the time of my visit. The old workings higher up the creek were inaccessible, owing to a flood in the creek. The strata are here seen to be very much crumpled and folded, and it is impossible to see what is the normal strike or dip. All the high peaks are capped with coarse conglomerate, the beds of which are, in places, seen to be also much curved and folded, but it is not quite clear whether they belong to the same age as the sandstones, slates, and limestone seen lower down, or whether they are younger than these, and rest unconformably upon them.

The only work that was going on at the time of my visit was on the north side of the Mount Claude Creek, about 10 chains from the end of the old tramway. A hole has been sunk close to the line, and for a width of seven or eight feet there are several small veins of galena up to 3 inches in in thickness, with a little iron and copper pyrites and zinc blende, and the country rock is all more or less mineralised. The apparent strike of the veins is about S.E. and N.W., with a slight underlay to the N.E. into the hill, but from the nature of the occurrence they are likely to be very irregular both in strike and dip. Below the tram to the S.W. the ground falls rapidly towards the Mount Claude Creek, and a tunnel had just been started which, in about 30 feet of driving, should intersect the veins seen above at a depth of about 25 feet; but it would be advisable to continue the tunnel until clean country is met. In the approach to this tunnel small strings of galena are seen, and there is also a good deal of galena finely disseminated through the country rock, which is a hard metamorphic sandstone or quartzite. Forty feet lower down several small veins of galena and copper pyrites are seen in the joints of the country at the foot of a perpendicular cliff. The country has evidently been shattered and permeated by mineral bearing solutions for a considerable width, and the formation partakes rather of the nature of a stockwork than a

lode, but it is quite possible that at a depth a clean fissure may have been formed, in which case the ore would probably be more concentrated. Several tons of good concentrating ore have been obtained from the cut near the tram, and picked samples are reported to have assayed from 60 to 71 per cent. lead and 42 to 58 ozs. silver per ton, with traces of gold. One sample, described as quartz only, without any visible ore, is said to have yielded 9 per cent. lead, 8 oz. 6 dwt. 4 grs. silver per ton, and 3 dwt. 6 grs. gold per ton.

Further S.E. at the foot of a cliff above the tram a rather promising looking vein of coarse and fine grained galena with a little copper pyrites is seen, and a sample which I took from here assayed 72·6 per cent. lead, 39 ozs. 4 dwts. silver, and 1 dwt. 15 grains gold per ton. A good deal of first-class ore could be picked from the small veins of galena, but no dependence can be placed on the continuance of any individual vein, and the proposition is at present mainly a concentrating one, but one which seems to offer very fair prospects of success. I do not know how much water the Claude Creek carries in summer, but it drains a good deal of country, and judging by the amount of water in it at present, it seems probable that a good supply could be obtained for concentrating purposes. There are good facilities for mining by means of adits, and the ore could be cheaply carted to Railton *viâ* Sheffield, a distance of about 23 miles. There is a good road from Sheffield to the agricultural holdings near the head of the valley of the Dasher River, and from here to the old Mount Claude tramway a good road could be made at small expense. The Lorinna road branches off about a mile and a half from the tramway, and passes over the top of Mount Claude and Oliver's Hill (a continuation of Gad's Hill.) The machinery for the New Caledonian and Glynn batteries was taken over this road, but at very great expense. Going over Mount Claude it is very steep, rising over 1100 feet in about two miles, and from the top of Oliver's Hill down to Lorinna there is a fall of nearly 1800 feet in under four miles. The road has only been formed in places, and the grades are so steep that the water soon wears deep channels, making it quite unfit for wheeled traffic. On the Forth side there is some good agricultural land, densely wooded, but I do not know what extent there is. The level of the Lorinna Bridge is only about 200 feet below that of Sheffield, and it is probable that a much better route for a road could be obtained by keeping as close as possible to the river, but, from the broken and rugged nature of the country, this is likely to be a very expensive undertaking, not justified by the present development of the mines.

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

J. HARCOURT SMITH, B.A.,
Government Geologist.

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

REPORT ON THE PENGUIN AND DIAL RANGE MINERAL FIELDS.

Government Geologist's Office,
Launceston, 20th October, 1898.

SIR,

I HAVE the honour to submit the following Report of a brief examination of the above fields.

The general geology of the district was fully described by the late Government Geologist, Mr. A. Montgomery, M.A., in a Report dated 29th July, 1895, the conglomerates, breccias, and tuffs of the Dial Range formation being provisionally referred to the Devonian System, and very little additional light has since been thrown on the subject. North of the Dial Creek, near the River Leven, a belt of syenite was noticed. I could not ascertain whether this is intrusive or not, but it may represent the root of the volcanoes from which the tuffs were ejected.

I only visited places where work was actually going on, or where something has been done since Mr. Montgomery's visit.

PENGUIN DISTRICT.

Section 2385-93M, formerly 155-87M.—The shaft of the old Penguin Mine is situated on this section just above high water-mark, close to the township of Penguin. It is said to have been sunk nearly 30 years ago, but no work has been done for many years until quite recently, when the shaft was unwatered and the old drives cleaned out by a Melbourne syndicate, on account of the high assays which are reported to have been obtained. The shaft is 6 feet by 8 feet in the clear, timbered with 10-inch by 10-inch frame-sets, and, except near the surface, the timber is still quite sound. Including the well, it is about 70 feet deep, and at 60 feet from the surface a considerable amount of driving has been done both N. and S. of the shaft. The country rock passed through in the drives is chiefly a hard siliceous dolomite more or less impregnated with pyrites. There have evidently been considerable differential movements within the mass, and numerous smooth "heads" have been developed, which are generally faced with calcite and iron pyrites; the latter also occasionally occurs in bunches with a little copper pyrites and tetrahedrite, but, as far as I could see, there is nothing like a regular lode, and the drives appear to have followed the heads in the country.

On the north side of the shaft there is a very roomy chamber from which the drive starts in a north north-westerly direction towards the sea, but gradually bears round to nearly east. About 8 feet from the end is a winze 12 feet deep, which was full of water at the time of my visit; this has since been baled out, and I have been shown samples from the bottom containing a good deal of copper pyrites and tetrahedrite with dolomite. The ore is said to be about 4 feet wide, but it is probably only a bunch. About 40 feet from the end a cross-cut has been driven 50 feet to the east without disclosing anything of value. South of the shaft about 150 feet of driving has been done in various directions, and a winze sunk 20 feet (now full of water), but I could see nothing to encourage further work being done. Although the north drive is all under the sea at high water, there is comparatively little water making, and the workings are kept dry by baling one shift with a whip.

About a chain east of the shaft, a prospecting shaft has been sunk about 20 feet. This is now full of water, but the stuff at the surface shows a good deal of iron pyrites, with a little galena, blende, copper pyrites, &c. in strings through the country, which consists largely of steatite, with bright green chlorite, magnesite, and calcite. At 8 feet down there is said to be about 3 feet of ore, which dipped out of the shaft to the east, but the manager informed me that a sample which he took from there returned only 15 grs. gold, 1 oz. 18 dwts. silver per ton, ½ per cent. copper, and ½ per cent. lead. I took a rough sample from some of the stone lying about the shaft, and sent it to Mr. Ward, the Government Analyst, but it did not contain appreciable quantities of any valuable metal.

Several small holes have been sunk on the beach below high-water mark, and for some distance on either side of the main shaft numerous small veins are seen, carrying oxide of iron and sulphides of iron, copper, lead, and zinc; but none of them, so far as could be seen, are rich enough or large enough to work, and there is no regularity in strike or dip. There is a possibility that at a greater depth they may come together and form a good lode, but at present the prospects do not seem to me to warrant the expense of proving this.

Hematite Deposits.—On the east side of Penguin Creek, between two and three miles from its mouth, some work has been done by a Sydney syndicate, known as the Tasmanian Iron Company, on Mr. Hudson's property, where two quarries have been opened on the hematite

deposit mentioned in Mr. Montgomery's Report. No work was going on at the time of my visit, and I have been unable to obtain particulars as to the quantity and quality of the ore obtained, but several hundred tons were sold as flux to one of the New South Wales Smelting Companies, and I was informed that it averaged over 90 per cent. peroxide of iron. In the face there is from 15 to 20 feet of ore, a large proportion of which is very pure, dense, red hematite, but some parts are rather earthy and impure. Very little stripping is necessary, and, if systematically developed, large quantities of good ore could be very cheaply mined, but at present the costs of transit are too high to allow of much profit. From the quarries a wooden tramway about a mile long has been made down the valley of the Penguin Creek, which stream is crossed five or six times, and from the end of the tram the ore had to be carted over a rough road to Penguin wharf, whence it was taken in lighters to Devonport. The natural outlet is right down the Penguin Creek to its mouth, but the proprietors have been unable to come to terms with the owners of the properties through which the line would pass. The tram is now being extended to meet the Iron Cliffs Road, but the ore will still have to be handled twice, and carted a distance of nearly a mile to the wharf. When the Ulverstone-Burnie Railway is constructed the ore will doubtless be sent to the latter port, and it should be possible to put it on board ship there for about five shillings per ton.

Going south the hematite is seen outcropping in several places, and on Mr. Good's property a small quarry has been opened in which there is about 10 ft. of good ore. This is about 150 ft. higher than the Tasmanian Iron Company's workings, and is probably a separate deposit. The Iron Cliffs Road runs close to the quarry, the distance to Penguin being about 3½ miles, and several small lots of ore were sent away, but, owing to the steep grades on the road, the cost of carting was too high to allow of profitable working. A good grade could be obtained for a tramway down the valley of the Penguin Creek, and, should iron smelting works be established on the mainland, these deposits would be well worth further attention.

Iron Cliffs.—South of Mr. Good's farm, two mineral sections, Nos. 1785-93M, 78 acres, and 1661-93M, 79 acres, have been taken up, through which runs the immense outcrop of brown hematite known as the Iron Cliffs. This is described in Mr. Montgomery's report before alluded to, but, at the time of his visit, no work had been done on it. Shortly afterwards a crosscut tunnel was started, about 25 ft. above M'Bride's Creek, and driven 260 ft., bearing S. 70° E. The country passed through is soft slate and sandstone, much stained with oxide of iron, and, about 40 ft. from the end, a gossan formation was cut striking nearly N. and S. and underlaying to the east. This is about 20 ft. wide, and is succeeded by about 8 ft. of country, after which gossan again appears and continues to the end of the tunnel, the eastern wall not having been reached when work was suspended. It would have proved the lode much better had the tunnel been driven north along its course from where it is cut through by the creek a few chains to the south-east. The gossan is similar to that seen on the surface, consisting largely of compact limonite in botryoidal and stalactitic forms; but there is a good deal of friable porous gossan of rather kindly appearance, and, in places, veins of quartz. I took a sample across the whole width of about 30 ft. exposed in the tunnel, but it contained no appreciable quantity of copper, silver, or gold. Above the tunnel the outcrop of the lode forms a ridge between M'Bride's Creek on the west and a deep blind gully on the east, and the configuration of the country is naturally favourable to the thorough oxidation and leaching of the metallic contents of the lode. Under these circumstances the absence of copper is not surprising, and it frequently happens in copper-bearing lodes that the copper contents have been leached out of the upper parts of the lode and redeposited in a concentrated form at a lower level. The absence, however, of silver and gold in the gossan is distinctly unfavourable, as these metals are generally concentrated in the oxidised portions of the lode; but it is quite possible that richer chutes would be met with in driving along its course.

Further north the lode is cut across by another deep gully, the highest point of the outcrop to the north being over 300 ft. above the bottom of the gully. The outcrop is here very wide, and the ground falls rapidly towards M'Bride's Creek, but further north and to the east basalt comes in, the ground being fairly flat, and it is probable that the lode-matter will not be so thoroughly oxidised as it is further south. From the compact nature of the gossan it seems probable that the greater part of the lode-filling was originally iron pyrites; but the lode is well worth a further trial, and since my visit a company called the Lady Braddon Mining Company has been formed to test it. To prove the value of the lode it is absolutely essential to get below the water-level, and I should advise driving a low-level adit underneath the big outcrop and then sinking a winze as deep as the water will allow.

A road could be easily made to connect with the Iron Cliffs Road in less than a quarter of a mile, so that the property is very easily accessible.

About 10 chains a little south of east from the tunnel is an old prospecting tunnel about 300 feet long, which was driven some years ago, and is now partly fallen in. The country passed through is chiefly soft slate and sandstone, striking nearly north and south, and dipping at high angles to the east. There is a good deal of pyrites through it, the water coming from the tunnel being heavily charged with oxide of iron, and in places the sides of the drive are stained with copper salts, but I could see no sign of any lode. Further north is another small tunnel about 50 feet long through brecciated conglomerate. The sides in places show the characteristic green

copper stainings, and near the entrance is a small vein of rubbly quartz from which fair prospects of native copper can be obtained by panning, but this is too small and ill-defined to be of much value.

DIAL RANGE FIELD.

This field lies between six and seven miles almost due south of Penguin, and occupies a narrow strip between the Dial Range and the River Leven. The ground was originally taken up for silver seven or eight years ago, but very little work was done, and all the sections were soon forfeited. Recently most of the ground has been taken up again with different boundary lines for copper, but the only sections on which any work to speak of has so far been done are those of the Keddie Copper Mining Company and the Dial Range Prospecting Association.

Access.—From Penguin there is a fair road to the agricultural holdings at the foot of Mt. Montgomery. The land passed through is very patchy, rich, chocolate-coloured soil, due to the decomposition of basalt, alternating with barren healthy patches. From the end of the road there is only a rough bridle-track, which has been partly formed in places. Numerous small creeks are crossed, but a good track could be constructed with no great expense.

The field can also be approached from Ulverstone by going up the Leven in a boat to what is known as Hay's Landing, about six miles from Ulverstone, and thence following the river to the Dial Creek, a distance of about three miles. The river is in places very shallow, and a good deal of expense would have to be incurred in dredging and snagging to make it navigable for small steamers.

Keddie Copper Mining Co.—This company holds Section 2638-93M, 80 acres, which includes parts of the old leases 2605-87M, 3469-87M, and 3472-87M. The Dial Creek runs through the centre of the property, and on the south side of this a tunnel is being driven, bearing S. 35° W., to intersect a lode which is seen outcropping near the top of the hill about 160 feet above the tunnel level. The country rock passed through is chiefly breccia, varying a good deal in texture and composition, but consisting principally of angular fragments of slate and sandstone, mixed with volcanic ash. Some parts are extremely soft and porous, while in other parts the rock is much silicified, and it frequently contains iron and copper pyrites, carbonate of iron, &c., irregularly disseminated through it. At 70 feet from the entrance an intensely hard formation was struck, consisting of an intimate mixture of fine-grained iron pyrites and quartz. Near the bottom it is six or seven feet wide, but does not rise to the back of the drive. This may be the continuation of the lode seen in the creek where the track crosses it N.W. from the tunnel, but it has not a very promising appearance. I visited this property twice, and at the time of my second visit on October 18th the tunnel was in 113 feet, the end being in hard breccia, letting out a good deal of water. It is probable that a change will soon come in, as the older Cambro-Silurian strata are seen outcropping a short distance higher up the hill.

About 75 feet above the tunnel is an old shaft 16 feet deep, and the tip shows a little iron and copper pyrites. Just below this, a few shots have been put into an outcrop of quartzite and hornstone, showing specks of copper pyrites and malachite. It resembles more a band of silicified country than a lode; but the tunnel will soon prove if it is of any value.

Two or three chains further south, and 85 feet higher up, is another old shaft said to be 20 feet deep, sunk in gossan of rather kindly appearance. This is the outcrop of the lode for which the tunnel is being driven: its strike is apparently about N. 20° W., and its underlay to the E.N.E. It is probable that the tunnel will strike it well below the zone of oxidation, and will therefore have a good chance of proving its value.

At the top of the spur, close to the southern boundary, is another rather promising-looking gossan outcrop, running apparently N.E. and S.W. A little work was done on it some years ago, but not sufficient to prove its value. Several other outcrops of gossan are seen on this section and on the adjoining section to the west; but they all require to be sunk or driven upon before any opinion can be expressed as to their value.

South-east from the tunnel, on the east side of a small creek running into the Dial Creek, a few shots have been put into a formation consisting of quartz and iron pyrites intimately associated, which, as far as can be seen, is about 10 feet wide, striking N.W. and S.E. To the S.E. the hill rises very rapidly, and the outcrop can be traced for a considerable distance, the pyrites gradually giving place to gossan. I took a sample by chipping from the pyrites exposed, but this yielded, on assay, only 1 dwt. 15 grs. gold per ton, no silver and no copper. It might be worth while driving on the course of this in the hope of meeting richer chutes, and, in the event of good ore being found, a short cross-cut could be driven from Dial Creek, into which the above-mentioned tributary falls, with a drop of about 40 feet, but present appearances are not very favourable.

Dial Range Prospecting Association, Sections 3188-93M, 3189-93M, 3190-93M, and 3191-93M, 80 acres each.—On Section 3191, close to the S.E. angle, which is the centre of the property, a pyrites lode about 7 feet wide, striking nearly N. and S., and underlaying E., is seen in the bed of a small creek. The ore is very free from gangue, consisting principally of crystalline iron pyrites, with bunches of very pure copper pyrites, frequently much tarnished and coated with

black oxide of copper. The bed of the creek has been lowered, and a tunnel bearing N. 20° W. has been driven a distance of about 70 feet. The country-rock is very soft tufaceous breccia, requiring close timbering, and it is difficult to see exactly what has been passed through, but the drive appears to have gone diagonally across the lode. The end is in breccia, with a little pyrites through it, and I should advise cross-cutting E. to try and pick up the lode. It is quite possible, however, that it has dipped under foot to the north, the fissure not extending to the surface in the soft breccia. I took a fair average sample of the lode across a width of about 6 feet near the entrance of the tunnel, which Mr. Ward found to contain 3·2 % copper, traces only of silver and gold; but much better assays are reported to have been obtained.

In several places the sides are stained green from the copper salts leaching out, and the trunk of a tree fern which had been lying for some time at the foot of the seconds tip has become saturated with copper sulphate in solution, so that when any bright piece of iron or steel is thrust into it it is immediately coated with metallic copper.

Much of the ore is very friable, and it is probable that a good deal of the contents has been dissolved out and reprecipitated at a lower level. Unfortunately, going north from the mouth of the tunnel the ground is comparatively flat for a considerable distance, and it is impossible to put in a lower adit. Even as it is, there is a descent of several feet into the tunnel, and the stuff has to be wheeled up an incline and taken some distance for a suitable dump.

The best way to properly test the lode would be to sink on it, and there is a good probability of the copper contents increasing with depth, but water is likely to prove heavy, and, with the present means of access, it would be impossible to bring in any heavy machinery.

About 100 feet south of the tunnel is another small branch creek, in the bed of which some pyrites is showing, but its full width is not seen. South of the creek a second tunnel is being driven bearing S. 10° E., and at the time of my visit this was in about 120 feet. The country rock passed through consists of felsitic tuff and breccia: near the entrance it is much stained with oxide of iron, and for the last 40 feet there has been a good deal of iron pyrites and quartz with vughs containing black oxide of copper, but there is no defined lode. Near the top of the hill, 120 feet above the tunnel, is a strong outcrop of hematite with veins of quartz, probably the capping of a pyrites lode, and the tunnel is now being turned to come under this.

A short distance up the creek, S.W. from the tunnel, the Cambro-Silurian strata are seen, consisting of alternate bands of slate and sandstone, striking about N.W. and S.E., and standing almost vertical. The tuffs and breccias appear to have been laid down on a very uneven bottom, unless, as is probable, they have been brought into their present position by a fault. This is a point of some importance, as the lodes are likely to be better defined and more productive in the older rocks.

As before mentioned, practically no work has been done outside the properties already described, but the indications are sufficient to warrant more thorough prospecting.

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

J. HARCOURT SMITH, B.A.,
Government Geologist.

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

REPORT ON THE DISCOVERY OF GOLD AT PORT CYGNET.

Government Geologist's Office, Launceston,
9th December, 1898.

Sir,

In accordance with your instructions, I have visited Port Cygnet and examined the work that has been done in the locality in search for gold, and have now the honour to submit the following Report :—

Locality and Access.

Port Cygnet is really a branch or arm of the River Huon, about five miles long and from half a mile to two miles broad, running in a general northerly direction, but the name is generally applied to the township of Lovett, which lies at its head, distant by road about 34 miles from Hobart. Lovett is the centre of a large fruit-growing district, and although alluvial gold was discovered over ten years ago near Lymington, it is only quite recently that it has been discovered *in sitû*.

General Geology.

On the eastern shore, going up from Garden Island, flat-bedded sandstones and mudstones are seen, and at Mount Cygnet, about four miles east of Lovett, a coal seam is being worked, which Mr. R. M. Johnston has determined to belong to the upper division of the Lower Coal Measures (*Permo-carboniferous*), corresponding with the Adventure Bay beds.

In the immediate neighbourhood of Lovett argillaceous sandstones and mudstones also occur, but it is difficult to distinguish their bedding-planes ; the discovery of fossils of Spiriferæ and Fenestellæ near the Livingstone Mine and elsewhere proves that they belong to the marine beds of the *Permo-carboniferous* system. The principal rocks of the district, however, are of igneous origin, and, from their great diversity, they offer a most interesting petrological study. They apparently occur both as contemporaneous sheets (lava flows intercalated with the sedimentary strata) and also as intrusive dykes. They are essentially porphyritic in structure, consisting of felspar crystals in a compact ground mass, which in different parts is white, ashen gray, brown, yellow, greenish, and occasionally almost black. The felspar crystals are sometimes small and numerous, evenly distributed throughout the mass, giving the rock at first sight the appearance of a holo-crystalline structure ; occasionally they are few and unevenly distributed, and in some cases the rock is almost entirely made up of large tabular crystals up to 1½ inches long and one inch wide, the edges of which are sometimes rounded and corroded. They are frequently partly kaolinised, but in unweathered pieces glassy crystals of sanidin can be recognised, and from their tabular habit it is probable that many of the larger kaolinised crystals are also sanidin. Hornblende is frequently seen, and occasional crystals of triclinic felspar can be recognised by the fine parallel striations due to repeated twinning. In some parts there is a good deal of pyrites disseminated throughout the mass. Although there is such a diversity in these rocks they all bear a strong family resemblance, and, pending microscopical examination, which is now being undertaken by Messrs. Twelvetrees and Petterd, they may be provisionally classed as Trachytic Porphyries. With few exceptions they do not, as might have been expected, form bold outcrops, and no attempt was made to define their limits, but they are said to extend right through to Oyster Cove.

A short description will now be given of the mining work that has been done.

Livingstone Mine.—This property lies about two miles N.E. of Lovett, and consists of two 20-acre sections adjoining Lot 198 of 500 acres purchased by John Thorp, jun. These sections have recently been granted as reward claims for gold to the original prospectors, Wm. Anderson and J. Thorp, who had previously done a considerable amount of work. A narrow ridge runs through the sections in a N.E. and S.W. direction, and on the western fall of this, near the top, at an elevation of about 630 feet above sea-level, a quartz reef was discovered, on which an underlay shaft has been sunk to a depth of about 60 feet. The reef varies in thickness from about 2 ft. 6 in. to 4 feet, and strikes, as far as can be determined at present, about N. 70° E. Near the surface it is almost vertical, but at the bottom of the shaft has a considerable underlay to the S.S.E. The quartz is in places fairly solid, but generally occurs in small parallel bands separated by thin seams of decomposed porphyry, which give it a somewhat laminated appearance. The country rock on either wall is a brownish, somewhat decomposed porphyry, which has been locally called diorite. The manager kindly showed me the assay certificates of several samples of the quartz sent to Melbourne for assay. Two picked samples assayed 3 ozs. 23 grs. and 1 oz. 12 dwts. 6 grs. gold per ton respectively, and a sample of 48 lbs., treated at Messrs. Parker and Co.'s works as Footscray, yielded at the rate of 10 dwts. 13 grs. free gold per ton. A bulk sample of about one ton yielded at the rate of 5½ dwts. free gold per ton.

Iron and copper pyrites occur irregularly distributed through the quartz, and gold is said to have been seen in the stone in the last few feet of sinking ; but a sample which I took across the reef near the bottom of the shaft and sent to Mr. Ward, Government Analyst, contained no gold. Of course, however, a better idea can be obtained of the true value of the stone from a bulk sample than from a sample of five or six pounds such as I took, as gold is invariably very unevenly distributed through the stone.

The reef cannot be traced on the surface, owing to the covering of angular *débris*. On the western side of the ridge, about 150 feet vertically below the mouth of the shaft, a tunnel has been driven about 350 feet. This starts in a north-westerly direction, but has been turned considerably towards the west, and in the end is running a little west of north. The country passed through consists chiefly of compact mudstone and sandstone with several bands of porphyry, the last one passed through near the end of the tunnel being about 10 feet thick, standing almost vertical and striking approximately north and south. Had the tunnel been kept on its original course the distance driven would probably have intersected the line of the reef, and something definite would have been known as to whether the reef lived or not. I am of opinion that it is a contraction fissure and likely to be confined to the porphyry. The simplest way to prove this would be to drive both ways from the bottom of the shaft, which, however, is far too small for a working shaft. I would strongly advise that a trial lot of at least 20 tons of stone be sent away for a bulk test. With the natural facilities that exist for economic mining, and the easy accessibility to the mine, a yield of half an ounce of gold to the ton should pay all expenses.

Mount Mary Mine.—Gold has also been found south of Lovett on private property, just outside the town boundary, and some prospecting has been done by a local syndicate. The gold-bearing rock is generally fine-grained to compact, but in parts numerous rounded and sub-angular fragments of quartz, slate, &c. can be seen, which leave no doubt as to its fragmental character. The main mass is probably a very fine volcanic ash or tuff. The outcrop of the formation is on a ridge running S.W. from the township of Lovett at an elevation of about 400 feet above sea level. A hole has here been sunk about 9 feet, the formation being about 3 feet wide, striking E.N.E., and dipping to the N.N.W. at an angle of about 55°. A good deal of the rock is stained red from disseminated hematite, and there are numerous fine cracks filled with brown oxide of iron. On breaking some of the stuff thrown out from the hole I found fine specks of gold in several pieces, and a rough sample of some of the most likely looking pieces which I sent to Mr. Ward contained 4 dwts. 2 grs. gold per ton. About 25 feet W.N.W. from this hole a vertical prospecting shaft was sunk, which passed through the formation, and from the bottom, about 60 feet from the surface, a crosscut to the N.W. intersected it in about 16 feet. It is here about 4 feet wide, with about the same strike and dip as at the surface, but it is much broken, the joints being faced with kaolin, probably due to the decomposition of the felspar of the tuff. I took a sample from different parts across the whole width exposed, but this showed, on assay, only traces of gold ; a previous sample from here is said to have assayed 2 dwts. 7 grs. of gold per ton. The country passed through in the shaft and crosscut is mudstone, containing occasionally rounded pebbles. A larger shaft has now been started about 20 feet further west, but had not cut the formation at the time of my visit. Possibly, in driving along the course of the formation richer patches of gold-bearing stone may be met with, but I see no reason for supposing that the average gold contents will increase with depth, and the prospects do not seem to me to be sufficient to warrant spending much more money on it.

Most of the surrounding land is freehold, but a short distance to the S.W. is an 80-acre block of Crown Land, and on this a ten-acre Section, No. 1306-93 G, locally known as Murphy's Section, has been taken up for gold. A little below the track from Port Cygnet, near the northern boundary of the section, at an elevation of about 750 feet above sea level, is a bold outcrop, which, from a distance, resembles the outcrop of a quartz reef, but a closer examination shows it to be a compact whitish rock containing porphyritic crystals of sanidin, with pyrites finely disseminated through the ground mass.

Two or three chains further south a hole has been sunk about 9 feet, now half full of water, from which a little gold is said to have been obtained. The stuff broken out consists of reddish siliceous rock, with blebs of glassy quartz, and occasional crystals of felspar. Some pieces are curiously streaked with fine parallel lines of white and red, and the whole has a somewhat brecciated appearance. It is probably a dyke which has partially fused together fragments of the country through which it burst. In some parts it is traversed by thin veins filled with chalcedony or opal, due to hydrothermal action. A little further S.W. a deep trench has been cut through an outcrop of fine-grained porphyry, containing a little pyrites, but, so far as can be seen, nothing of any value.

Martin's Show.—About a mile south of Murphy's Section, on freehold property standing in the name of Richard Lewis, a little trenching has been done on what is known as Martin's Show. This is a dyke formation, striking about N. and S. and dipping W., but its full width is not seen. The porphyry has been considerably altered by hydrothermal action, and is seamed with small veins of opal. In places there is a good deal of marcasite, or white iron pyrites, and one specimen I brought away contained pyromophite (phosphate of lead). This dyke has, I believe, been traced for a considerable distance, but the surface is now much overgrown with thick scrub. It deserves further prospecting.

Alluvial Gold.

A little alluvial gold has been found in several of the gullies near Port Cygnet, and at Lymington some rich patches were obtained, but they were of small extent. A company was formed some years ago to work on private property belonging to Mr. Coad; a small dam was made and a long tail-race fluming built, but the latter is not low enough, and the water supply seems to have been very poor. I have been unable to obtain particulars of the amount of gold won, but I was informed that the company nearly paid expenses for about two years, when work was abandoned, and all the old prospecting holes have since been filled in. I was shown a sample of about 10 ozs. of coarse shotty gold obtained from a small paddock on Mr. Coad's farm, and several dishes of the surface stuff washed in my presence all showed a few fine colours of gold. Probably systematic prospecting along Forster's Rivulet would reveal richer patches, but all the land is freehold property, and there does not seem to me to be sufficient inducement to warrant the destruction of the apple orchards and beds of raspberry canes which this would necessitate.

It is probable that the gold exists disseminated through the trachytic porphyries (of which the surrounding hills are largely composed), rather than in true reefs, and by the long continued wearing down of these it has been concentrated in the alluvial, but there is no reason to suppose that it exists in payable quantities in the parent rock. I take this opportunity of thanking Mr. Cranny, who very kindly acted as my guide at Lymington.

Concluding Remarks.

The great Mount Morgan Mine is stated by Mr. R. L. Jack, Government Geologist for Queensland, to lie in an area of permo-carboniferous rocks traversed by a series of basic igneous dykes; and in the United States and various other parts of the world considerable quantities of gold have been obtained in rocks of this or later age, generally associated with andesites, trachytes, and other volcanic rocks, so that, although no payable lodes have hitherto been discovered in the permo-carboniferous or younger rocks in Tasmania, there is no inherent impossibility of their occurring. In the present case, however, I am afraid the gold only occurs in sufficient quantities to induce money to be spent in search for more, without much prospect of ultimate success.

NOTE ON THE REPORTED DISCOVERY OF GOLD NEAR HOBART.

On my return from Port Cygnet I visited the so-called gold mine on Mount Wellington, and have now the honour to submit the following brief notes thereon :—

The scene of operations is on an extended prospecting area of 25 acres adjoining Regan's estate, the workings being situated close to the Sandy Bay Rivulet, about a mile above the Hobart Waterworks Reservoir. An inclined shaft has been sunk about 90 feet, and from the bottom a drive put in 30 feet to the south. Some years ago a shaft was sunk about 75 feet, and it is said that good assays were obtained for gold, silver, and cobalt, but I could see no sign of any lode or other formation likely to carry valuable minerals. The present shaft was sunk through the old ground for about 35 feet, when it was turned a little to the south to get into the solid country and continued along the dip of the strata. On the footwall side is a bed of black shale, the full thickness of which is not seen, but it is said to be 4 feet thick, and the manager informed me that in putting in some timber in the drives he had come on to limestone underlaying the shale. Above this is a somewhat gritty sandstone with occasional patches of quartz conglomerate, the general strike being about N. and S., with a varying but rather flat dip to the east. No fossils were seen here, but a little higher up the creek are the remains of an old lime-kiln, and the fragments of calcareous mudstone lying about are full of remains of typical *Permo-carboniferous* fossils, amongst which I recognised the following forms :—Spirifera, Strophalosia, Terebratula, Productus, Aviculopecten, Fenestella, &c.

Disseminated through the sandstone are numerous minute garnets, and for a thickness of about two feet there is a good deal of iron pyrites, such as is very frequently met with in the Coal Measures all over the world. A sample of this from the drive was assayed by Mr. Ward, who found it to contain nothing of value, and I cannot see the slightest reason for expecting that any improvement will take place either in driving or sinking. In my opinion it is simply waste of money to continue mining operations here.

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

J. HARCOURT SMITH, *B.A., Government Geologist.*

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

SUPPLEMENTARY NOTE ON LIMURITE IN TASMANIA.

BY W. H. TWELVETREES, F.G.S., AND W. F. PETTERD, C.M.Z.S.

In this paper the authors refer to their Note on the same rock presented to the Society last year, since when they have further examined it microscopically, and have studied its occurrence on the spot. They acknowledge their indebtedness to Mr. R. Williams, the Manager of the Colebrook, for many useful and interesting specimens. The mine is between Rosebery and Ringville, on the saddle of a hill about 1500 ft. above sea-level, and is remarkable for the quantity of pyrrhotite occurring in the rock, associated with copper pyrites in relatively small quantities. The authors do not regard the occurrence as a lode, but rather as a rock mass, in the form of an irregular dyke or intrusion. Generally, the country to the west is serpentine, and to the east slates; and the rock in question has been intruded along or near the line of contact, though at the top of the ridge it appears to have come up through the slates in several branches or bodies, leaving horses of metamorphic slate standing in its mass. Viewing the rock as a mass, it is composed of augite (altered largely to uralite and actinolite), axinite, calcite, datholite, danburite, with secondary chlorite and sphene. Essentially it is an ultrabasic rock (pyroxenite), which here and there receives the addition of other boric minerals and then becomes limurite, a composite rock, consisting practically of augite and axinite. How were the boric emanations introduced? Were they escapes from a neighbouring acid basin? That there was an acid reservoir not far off is shown by the tourmaline quartz porphyry at the Renison Bell Mine, and by the axinite quartz veins found on the West Coast Prospecting Association Section, and by the granite near the latter. A slide prepared from this vein-rock is referred to, and mention made of the association of tourmaline with axinite in other parts of the world. The authors arrive at the conclusion that the West Coast granite, or its elvan dykes, consolidated at the same time as the limurite dyke at the Colebrook. The action of boron vapours in the granite area to the west is shown by the tourmaline and axinite just alluded to, and if these vapours extended to the pyroxenic magma at the Colebrook, and were carried up with it, the origin of the limurite rock would be accounted for. Last year a Note on Datholite was submitted by Mr. W. F. Petterd, and now the authors state the results of a microscopical examination of this mineral. Another new mineral is added to the list of the components of this singular rock, viz., the boro-calcium silicate, danburite, and its microscopical characters are enumerated. A further mineral with characters suggestive of its being a precipitate from a boric solution is mentioned. It is somewhat similar to the decomposition product of boracite known as parasite, a hydrous magnesian borate. The authors consider that the limurite rock throws light on the question of the age of the granite on the West Coast, as the Colebrook intrusion appears to be younger than the serpentinous and gabbroid rocks to the west of the mine.

ON HAÜYNE-TRACHYTE AND ALLIED ROCKS IN THE DISTRICTS OF PORT CYGNET AND OYSTER COVE.

BY W. H. TWELVETREES, F.G.S., AND W. F. PETTERD, C.M.Z.S.

THE igneous rock at Port Cygnet, in Southern Tasmania, has been known for a long time by the name of felspar-porphyry. As the porphyritic crystals of felspar are rather strikingly displayed in the rock, specimens have now and again, through collectors, found their way to different parts of the Colony. Microscopical study of some of these samples made us aware that the handsome porphyries were soda-trachytes, and we classed them as such in our last year's sketch of the igneous petrology of Tasmania.* Since then we have found the felspathoid mineral haüyne or nosean in them, which confirms our previous determination, and a recent excursion to the locality has enabled us to recognise quite a group of these rocks, as well as to fix their geological age.

The country round Lovett and Lymington furnishes several sections which may be used by the geologist, but one of the most valuable of these is, perhaps, that which is afforded by the Livingstone mine. The mine shaft and buildings are on the crest of a hill, 600 feet above sea-level, about two miles N.E. of the township of Lovett. Just before reaching the crest the trachyte may be seen in the road-cutting underlying the sandstones and slaty arenaceous beds which form a large portion of the hill. On the saddle there are some fossiliferous beds of the Permo-Carboniferous System, charged with spirifera and fenestellidae, and a little higher the trachyte appears again. In one form here it has a slabby habit, due to its being largely composed of parallel layers of large tabular crystals of orthoclase felspar, some of which measure as much as two inches in length. The Livingstone mine shaft is close by, and appears to be sunk in banded trachyte and quartz. One hundred and fifty feet below this a tunnel has been driven for 360 feet, passing through Permo-Carboniferous sedimentary beds, and intersecting several bands of trachyte in its course. First it cuts a 12 ft. layer; subsequently a 2 ft. band of the coarse porphyritic trachyte seen at surface (the miners' name for this is "magpie"), and near the end of the drive 12 to 15 feet of white trachyte rock is passed through, called "diorite" by the miners, and referred to under that name in the published reports of the company. It is important to note that these bands or lava sheets are conformable with the sedimentary strata, and we cannot entertain any doubt of their geological contemporaneity. In this hill, as in the entire region, considerable variety exists in the different flows of these trachytes. Some are coarse in texture, others are fine-grained and compact. Some of them have their counterparts on the Mount Mary Hill rising on the west side of Lovett. In particular the slabby trachyte, distinguished by its large tabular felspars ("magpie") is found again at the Mount Mary mine on the western side of the valley, only there it is much decomposed, and has an abundant development of epidote.

The Mount Mary trachytes may be seen cropping out in the quarry on the hillside in front of Harvey's Hotel at Lovett, where they have been used for road metalling and building purposes. At least two varieties are distinguishable in the quarry face—one a tough dense speckled rock, the other a smooth porphyritic, somewhat fissile, stone of a light bluish-grey hue, suggestive of a sodic lava. The compact type contains a fair amount of epidote. Passing up the hill to the west the rising ground above Mount Mary mine exposes outcrops of several varieties of trachytic rocks, which continue right through the hill to the Lymington-Wattle Grove Road. Opposite Martin's cottage on that road is a bold outcrop of a rather plutonic-looking grey hornblendic rock, at first sight much resembling syenite, but which on microscopical examination we found to be an undoubted trachyte, with beautifully zoned felspars.

There are good exposures of sections on the beach between Lovett and Lymington, where the beds are lying rather flat. On this beach we found additional evidence of the contemporaneity of the trachyte with the Permo-Carboniferous sediments. We discovered some fresh syenite (augite-syenite) along this line, and specimens of a similar rock and of an intrusive micaceous trachyte have since been given us by the Government Geologist (Mr. J. Harcourt Smith, B.A.), who collected them from the shore at low-water, just south of the Lovett regatta-ground. A very remarkable dioritic rock occurs on Mr. Patrick Cranny's property at Lymington. It consists of hornblende + plagioclase felspar, with the hornblende greatly preponderating. We have placed this dark basaltic looking rock among the dioritic aplites called malchite.

That this petrographical province extends further north we have satisfied ourselves by the discovery of blocks of garnetiferous trachyte at the base of the Sugar-loaf Hill, behind Mrs. Cleary's cottage on the road to Cradoc. It is there also associated with Permo-Carboniferous fossiliferous marine beds. It is well known, moreover, that it extends to Oyster Cove in a N.E. direction.

The word "felspar-porphyry" was applied to the Port Cygnet rocks as a field term, indicating a porphyritic texture. It meant simply that the uniformity of the micro-crystalline ground-mass is interrupted by a profusion of larger crystals which were formed during the intra-telluric period of the history of the rock. The term is only admissible as a temporary expedient for the designation of such rocks prior to definitive examination. It can be discontinued now that the trachytic nature of these rocks is beyond doubt.

It may be useful to trace the lines along which our enquiry has travelled, and show how they lead up to the results now submitted.

As a rule, when the colors are white, yellow, grey, we may take it that a lava does not belong to the basic series of rocks. It will be a member either of the acid series, containing over 66 per cent. silica, or of the intermediate series with 55 per cent. to 66 per cent. As a whole, the Port Cygnet rocks are remarkable for the small quantity of their free silica. They are essentially quartzless rocks. Of course they contain silica in combination, but only sufficient to bring up the SiO_2 per cent. to the limit for intermediate rocks, those lying between the acid granites and rhyolites and the basic gabbros, dolerites, and basalts. The silica per cent. corresponds with the specific gravity, which averages 2·5 to 2·6. These facts help us in locating

* Trans. Aust. Inst. Mining Engineers, 1898, Vol. V., p 108.

the rock in a definite division. Now, in this division the andesites and diorites are characterised by plagioclase felspars, while in the trachytes and syenites orthoclase is dominant. In the Port Cygnet rocks orthoclase unquestionably predominates. Trachyte is the volcanic form, syenite the plutonic.

Haüy first gave the name of trachyte ($\tau\rho\alpha\chi\acute{\iota}\varsigma$ = rough) to volcanic rocks feeling rough to the touch. In these rocks there is generally very little glass, the ground-mass being more or less crystalline. When they contain plagioclastic felspar it is an acid variety. When this felspar increases in quantity, and grows more basic, we are led to the andesites; and it is not always easy to understand the meaning of the term trachyte as used by some authors, who extend it in the direction of the andesites till it becomes useless for the purpose of classification. In this connection we cannot do better than bear in mind Rosenbusch's definition of trachyte as implying the dominant presence of a potash felspar and the absence of quartz among the porphyritic constituents. He says :—

"The trachytes are neo-volcanic effusive rocks which may be designated equivalents of the syenitic plutonic rocks and of the palæo-volcanic quartzless porphyries in all their modifications."*

The only modification which we would venture to make in this admirable description would be to include palaeo-volcanic rocks in the trachyte group. Some carboniferous trachytes have been found in Britain, but these have been ranked by the illustrious author just named among "orthophyres" or "quartzless porphyries having completely the habit of trachytes." We cannot see, apart from the question of age, that anything would be gained by calling the Port Cygnet lavas, orthophyres. Many of the felspars are brilliant to the eye and pellucid in thin section. On the other hand, some of them have lost their glassy appearance and acquired a yellowish opaque aspect, sometimes, however, retaining a vitreous interior, to which the peripheral decomposition has not extended. We seem here to have intermediate stages between glassy sanidine and opaque orthoclase. No doubt, the mineralogist would deny the term sanidine to these opaque crystals and call them orthoclase. Of course, those who postulate sanidine as an essential constituent of trachyte will have to call some of these rocks trachytic orthophyres, and reserve trachyte as the name for the varieties with glassy orthoclase. But this seems to us a needless multiplication of classes, and we anticipate that the sanidine variety of orthoclase will not always be regarded as an essential ingredient of trachyte, nor will the name trachyte be confined to rocks of Tertiary age solely.

Assuming, then, that we are now dealing with the trachytic group, we take a further step and define these volcanic rocks as soda trachytes. This is shown by the presence of one or more of the soda minerals, haüyne, analcime, aegirine, aegirine-augite, cataphoritic hornblende, and the green pleochroic augite rich in the acmite molecule ($Na\ Fe\ Si_2\ O_6$). Such trachytes are very closely allied to phonolites, and become phonolite by the addition of either of the felspathoids, leucite or nepheline. The roughness of ordinary trachytes is characteristically absent, and the disposition of felspar crystals in layers is a marked feature, imparting a certain degree of fissility to the rock. The rock has evidently possessed in its molten state exceptional viscosity, which has impeded free flow and caused crowding of the porphyritic elements. This, again, is not unknown among phonolitic trachytes and phonolites.† The presence of haüyne is considered by some authors sufficient to remove a rock from the trachytes to the phonolytes, and they would call some of the Port Cygnet rocks phonolytes. It is interesting to note that, as nosean (haüyne) in the first British phonolite (Wolf Rock, Cornwall) was discovered by Mr. Allport, in 1871, by means of the microscope, the same instrument has led to the discovery of haüyne and phonolitic trachytes at Port Cygnet.

Though the eruptive rocks of this province are evidently products of one and the same magma, yet different flows at different times show varieties of mineral composition in all probability characteristic of each eruption, in addition to which there are structural differences dependent upon the physical conditions of consolidation. We are able, more or less plainly, to arrange the numerous varieties provisionally, as follows :—

Effusives— Soda Trachyte Group.

Haüyne Trachyte, with porphyritic haüyne.
Aegirine Trachyte, with aegirine needles and aegirine-augite.
Melanite Trachyte, with abundant melanite-garnet.
Trachyte, with green sodic augite.

These comprise various types, described in detail further on.

Intrusives— Soda Aplite Group.

Sanidine-augite-haüyne Aplite.
Sanidine-augite-biotite Aplite.
Malchite or dyke-Diorite, (an aberrant member).

Plutonics— Soda Syenite Group.

Alkali-augite-Syenite, with micro-perthite and analcime.
Alkali-augite-Syenite, with elaeolite, (Little Oyster Cove).

The minerals which we have detected in these rocks may be enumerated as follows :—

	Trachyte.	Aplite.	Syenite.
Essential—	Orthoclase (Sanidine)	Orthoclase (Sanidine)	Orthoclase
			Microperthite
	Oligoclase	Augite	Albite
	Augite	Biotite	Elaeolite
	Hornblende		Augite
			Hornblende
Accessory—	Haüyne	Haüyne	
	Aegirine	Apatite	Melanite-Garnet
	Melanite-Garnet	Sphene	Biotite
	Biotite	Zircon	Apatite
	Apatite		Sphene
	Sphene		Zircon
	Zircon		
	Magnetite		
Secondary—	Analcime	Natrolite	Analcime
	Epidote	Opal	
	Quartz	Quartz	
	Natrolite		
	Actinolite		
	Muscovite		
	Pyrites		
	Limonite		
	Chlorite		
	Clinochlore		

Alkali Syenite (Augite Syenite).

Sp. gr. 2·6.

Found *in sitû* on beach south of Regatta Ground, Port Cygnet. No massive exposure, but lying at the water-level.

Macroscopic characters.

Medium grain; brownish grey, syenitic looking; has an elaeolitic appearance, with greasy feel. With porphyritic tendency by reason of a few large glistening felspars (nearly $\frac{1}{2}$" long) scattered sparingly. No rhomb-shaped sections of felspars seen. Numerous small brilliant dark garnets appear as specks, which can be well recognised with the pocket-lens; many of these seem enclosed in the felspars. The rock resists decay well, as shown by the thinness of the weathered crust, decomposition not extending far into the interior of the stone.

* Mik. Phys. d. massigen Gesteine, 1896. p. 738.

† "We find that acid lavas are very decidedly less mobile than basic ones, and so flow less readily and to smaller distances; and, further, that certain intermediate lavas, rich in alumina and potash, are remarkably viscous, as is illustrated by the peculiar dome-like forms assumed by some trachytic and phonolitic eruptions." Daubrée "believes that some trachytic domes must have been erupted in a nearly solid, not even pasty, condition." Nat. Hist. of Igneous Rocks. A. Harker, Sc. Prog. Vol. VII. pp. 204–6.

Microscopic characters.

Structure, normal hypidiomorphic-granular (granitic), with an occasional leaning to the trachytic type by an idiomorphic columnar felspar here and there. It is essentially a potash-felspar rock, but there is very little proper orthoclase in it, for the orthoclase is intergrown perthitically or rather micro-perthitically with striped felspar, often showing very fine striae indeed, giving the extinction angles of oligoclase or oligoclase-albite. These twinning-lines are generally short, not continuous, and are sometimes interrupted by similar sets at right-angles. Here and there in the slide is water-clear albite, pellucid as quartz; but apart from this, and an exceptionally clear crystal or two of orthoclase, the felspars are turbid.

Some analcime in the felspars points to the former presence of elaeolite, and its existence may be suspected, though we cannot optically demonstrate it.

An important feature is the garnet, which is very plentiful, in brown irregular grains and ill-formed crystals, having a corroded appearance. These are characteristically intergrown or associated with augite, biotite, and apatite, and in their neighbourhood is often seen a yellowish transparent flaky or zeolitic-looking mineral, with low refractive index, and giving in polarised light the appearance of a soda decomposition product. The abundance of garnet warns us that the rock is allied to the elaeolite-syenites.

There is some grass-green augite (malacolite) in granular irregular forms. It has slight pleochroism, and where vertical sections could be found they gave extinction angles of 33° and 34°. The mineral is often bleached in the interior. Besides being specially intergrown with garnet, it is associated occasionally with dark green hornblende. This hornblende is intensely absorptive. Its pleochroism is $\mathfrak{a}$ = yellowish-green, $\mathfrak{c}$ = very dark green. The $\mathfrak{b}$ direction could not be ascertained. A little light brown idiomorphic mica gave $\mathfrak{a}$ = light greenish-yellow, $\mathfrak{b}$ = dark dirty green. Zircon, present in all syenites, occurs in small quantity, likewise a little sphene in elongated wedges. Very little quartz can be definitely recognised.

This syenite cannot be considered quite identical with any of those syenites, rich in alkali, which Rosenbusch has erected into types under the names (after J. F. Williams) Pulaskite, Albany, and (after Brögger) Laurvikite types; but it is evidently related to these and to their allies, the elaeolite-syenites. The syenites which are known in other parts of Tasmania have quite other relationships, being more closely connected with the granite family.

Augite Syenite.

Found *in situ* on beach between Regatta Ground and Lymington.

Macroscopic characters.

Fine-grained, with numerous lustrous faces of felspars, and specked with green augite. Some of the felspars are idiomorphic. Colour of the rock light grey.

Microscopic characters.

Structure, hypidiomorphic-granular, many of the felspars strongly idiomorphic parallel to 001 and 010. A few of these much larger than the rest, with numerous enclosures of sphene and small felspar crystals. Zoning of felspars quite a feature. Many of the orthoclase felspars are glassy, and have a sanidine habit. There is a good deal of albite-twinned felspar and microperthitic intergrowth of albite-oligoclase with orthoclase, some of the twinning being extremely fine, and cross-twinning is well shown. The extinction angles yielded by different crystals seem to be those of both albite and oligoclase.

A pale green augite (malacolite) is frequent. Its pleochroism is very slight. Its extinction angle in the prism zone is as high as 44°. Wedge-shaped crystals and grains of sphene plentiful. A little idiomorphic apatite and interstitial quartz. We have not noticed any garnet in this syenite.

Haüyne Aplite.

Sp. gr. 2·75.

Found at Port Cygnet, but the precise locality is unknown.

Macroscopical characters.

A medium-grained dark grey rock, consisting largely of small columnar and tabular sanidine crystals, some of which exceed the rest in size. A parallel arrangement of felspars occurs, but is inconstant, the crystals lying mostly in all azimuths. With a hand-magnifier granular augite seems plentiful, and crystals of yellow sphene are seen here and there. Small grey and white spots represent nosean, but this mineral can only be identified microscopically.

Microscopical characters.

The rock is seen to be essentially composed of sanidine, augite, and nosean, with the minerals sphene, apatite, and zircon as accessories. The sanidine is clear, and mostly in columnar forms, with Carlsbad twinning. Some of these prisms have been dynamically bent. They carry abundant inclusions of haüyne (nosean) decomposed to zeolitic matter of a light yellow colour, giving mottled grey and white interference appearances under crossed nicols. Augite is in prismatic elongated forms, and is a green pleochroic variety with extinction angle of 40°, though as the colour becomes yellowish the angle seems to decrease. $\mathfrak{a}$ = light green, $\mathfrak{c}$ = dark green. Bleaching is common. Grains and rods of augite border crystals of apatite. Large decomposed haüyne crystals are abundant as divergent and fan-shaped zeolites of a pale yellow colour in plain light. Allotriomorphic orthoclase felspar forms a cement uniting the above elements, and this gives the aplitic character to the rock. Yellow crystals of sphene in prismatic and acute rhombic sections are plentiful. Zircon is less common; magnetite in grains.

Soda Aplite, a Sanidine-Augite-Mica Dyke Rock.

Sp. gr. 2·85.

Locality—On the beach at Port Cygnet, south of the Regatta Ground.

Macroscopical characters.

A hard granular dark glistening rock resembling a minette (mica-trap). Numerous little brilliant faces of dark mica visible. The felspar looks granular and sugary. The green augite is too minute for satisfactory identification.

Mineral constituents.

Sanidine, augite, biotite, apatite, soda decomposition products and pyrite.

Microscopical characters.

The first thing which strikes one on looking at a slide is the panidiomorphic structure of the rock, reminding one at once of aplite. At the same time the prisms of augite and plates of mica follow linear directions like the minerals of a foliated rock.

The felspar is granular and imperfectly prismatic, with its boundaries abridged by neighbouring prisms. Carlsbad twinning is frequent. Where elongated sections are available with some approach to a prismatic character, the extinction is straight. The crystals are pellucid and contain numerous microliths, rods, ovoid and circular grains, perfectly transparent, colourless, and without any definite action on polarised light. Some are light green; these are augite. The inclusions, which are of large size, are a constant feature.

The augite seems to be diopside, of a dirty green colour, with an occasional disposition to bleach. It is in ill-formed prisms, without perfect terminations. Its extinction angle is about 40°, and it often has perceptible

pleochroism. Augite grains, too, are numerous, and large nests or agglomerations of granular augite occur.

The third constituent in order of frequency is a yellowish-brown biotite with strong basal cleavages, showing in sections perpendicular thereto. Rays vibrating parallel to $\mathfrak{a}$ undergo least absorption, $\mathfrak{c}$ being opaque-brown, and $\mathfrak{a}$ yellowish-brown. There is a little apatite in stout short prisms and large irregular grains. Some decomposition material similar to the yellow products after haüyne is present. The rock contains neither quartz nor hornblende, and is altogether an unusual one. We do not know of any similar occurrence with which it can be compared. It appears to belong to the group of aplitic dyke rocks (Rosenbusch), but the absence of aegirine and the abundance of a high-angled augite shut it out from the tinguaitic set. Still, we feel tolerably certain that its place is in the soda-trachyte series, and among the dyke rocks in that series.

Haüyne-Trachyte.

Sp. gr. 2·55.

Occurs near the shaft on hill at Livingstone Mine, near Lovett.

Macroscopical characters.

A bluish-grey porphyritic rock with crowded layers of glistening tabular sanidine felspars. The smaller porphyritic elements are hornblende, augite, brilliant dark garnets, and numerous soft white sections of haüyne. This is the only rock which we have found with comparatively fresh or unaltered haüyne (nosean).

Microscopical characters.

The felspars are clear in section. The fragments in the slides are generally too imperfect for reference to particular zones. The orthoclase is much intergrown with oligoclase: there are fragmentary sections of Carlsbad twins with albite twinning on one half, sometimes with a cross striation. Partial twinning frequent in orthoclase crystals, but sometimes very faintly visible. Some felspars seem to have been enlarged by a subsequent addition of material, which surrounds the original crystals as a fringe. This must have taken place prior to the final consolidation of the rock.

Garnet.—This is plentiful. When it occurs in such rocks it is usually referred to the variety of calcium-iron garnet known as melanite. It is in forms of the trapezohedron and dodecahedron, and sometimes zoned. In thin section the colour is yellowish to reddish brown. Its sections are margined brown, and traversed by irregular iron-marked fissures. It is quite common to find it intergrown with and enclosing crystals of hornblende and augite.

Haüyne (Nosean).—This mineral is abundant, and gives sections approximating to faces of the cube (100), dodecahedron (110), and trapezohedron (211). Hexagonal sections are common; no trigonal ones. Rounded grains very frequent, and crystals with a mutilated and corroded appearance. The mineral is sometimes colourless, but generally characterised by a soft slate-grey tint in the peripheral parts, shading off towards the interior. The colour is deepest at the border. Dark striae are often seen proceeding from the faces inwards, sometimes in sets at intersecting angles. There is none of the blue tint which is seen in some haüynes. The interiors are full of granular microlites; nearly all are undergoing decomposition into natrolite or other soda products represented by divergent scaly aggregates. Crystals of haüyne are often enclosed in the large felspars.

Nosean and haüyne are classed together by Rosenbusch under the group name haüyne. They are both silicates of alumina and soda, but in the haüyne there is the addition of lime. Dana* gives the percentage composition of the two minerals as under :—

	Silica.	Sulphur trioxide.	Alumina.	Lime.	Soda.
Haüyne...	32	14·2	27·2	10·9	16·6 = 100
Nosean ...	31 7	14·1	26·9	—	27·3 = 100

Haüyne often has a blue tint. Where this tint is absent and no lime separates out during decomposition, it is impossible to distinguish the two optically. These facts have to be borne in mind when considering authors' references to either of these two minerals.

Hornblende.—This is a somewhat peculiar variety. It has the black colour of arfvedsonite to the eye, and is deep green, sometimes nearly opaque in thin section. If the section is at all thick it is opaque. The pleochroism is strong. $\mathfrak{a}$ = yellowish green; $\mathfrak{b}$ = very dark green, sometimes opaque; $\mathfrak{c}$ = very dark green, sometimes opaque. This absorption scheme $\mathfrak{c} \geqq \mathfrak{b} > \mathfrak{a}$ agrees with that of common green hornblende, and not with that of arfvedsonite, which is $\mathfrak{a} > \mathfrak{b} > \mathfrak{c}$. But the startling opacity suggests something out of the common, and in some sections the absorption varies to $\mathfrak{b} > \mathfrak{c} > \mathfrak{a}$, which characterises the black alkali-iron hornblende of certain phonolitic trachytes and linguaites which Brögger has called cataphorite. It seems to us possible that the hornblende is of a cataphoritic nature, though its extinction angle is rather low for that species. $\mathfrak{c} : c = 14°$ to $17°$, whereas in cataphorite it varies from 23° to 60°.

A bright green slightly pleochroic augite occurs in prisms and grains. $\mathfrak{c} : c = 34°$ or thereabouts. Apatite in grains. The groundmass consists of small sanidine prisms in fluxional arrangement, interspersed with small grains of augite. The whole is rather obscured by decomposition.

Tertiary haüyne-trachytes occur in France (Auvergne); haüyne-phonolites in Germany, Portugal, the Canaries, Colorado; the nosean-phonolite of the Wolf Rock, Cornwall, is the nearest related rock in Britain.

Haüyne-Trachyte.

Found on the crest of the Livingstone Hill, and in the mine tunnel 150 feet below. Also in the trench at Mount Mary Mine, west of Lovett.

Macroscopical characters.

A soft light grey rock, easily recognised by its large tabular orthoclase felspars lying thickly in parallel layers, causing the rock to split more easily in that direction. These felspars are mostly between $\frac{3}{4}''$ and $1\frac{1}{2}''$ in length, and from $\frac{1}{8}''$ to $\frac{1}{4}''$ thick, and can be often chipped out from the matrix, making good specimens for the cabinet. They are tabular ‖ 010, and the cleavage parallel to this plane is perfect. The crystals are opaque externally, light yellow, but occasionally the interior is glassy, sanidine-like. Mr. Frank Rutley has aptly described them to us as having a biscuit-like appearance. The miners call this rock "magpie." The only other pronounced macroscopical element is limonite in hexagonal and other sections after some cubic mineral, probably garnet. The same rock occurs at the Mount Mary Mine, where it is more decomposed, and contains much epidote.

Microscopical characters.

The orthoclase is often intergrown with a striped felspar. It encloses numerous hexagonal and other sections of haüyne, replaced by liebenerite (?). The rock is full of porphyritic pseudomorphs of liebenerite (?) aggregates after haüyne in rectangular and rounded sections.

Sharply defined sections of a cubic mineral decomposed to limonite are plentiful. The determination of the original mineral is difficult, as we have not much beyond the forms to guide us.

* System of Mineralogy, 1898, pp. 431-2.

Dana says*—"Garnets containing ferrous 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." In one of our sections we detected a crystal of melanite-garnet undergoing this change, but we have not been able to discover any further instances of partial change. Haüyne also suffers a somewhat similar change, and the choice here appears to be between the two minerals, haüyne and garnet, with probabilities stronger in favour of the latter.

The groundmass is rather obscure, but appears to consist of prisms of straight extinction felspar. Iron ore in minute grains.

Haüyne-Trachyte.

This is another trachyte from the top of the Livingstone Hill. It is a grey rock, with the faint bluish tinge, which in the Port Cygnet trachytes we have found associated with the presence of haüyne. Groundmass compact lava-like, with numerous porphyritic crystals of dull white orthoclase $\frac{1}{4}''$ to $\frac{1}{2}''$ in length. These crystals are tabular in habit. The other visible porphyritic constituent is the limonite to which we have alluded above as being probably pseudomorphous after melanite-garnet. This is in hexagonal and other familiar sections of the isometric system.

Mineral constituents.

Orthoclase : secondary limonite, muscovite, iron oxide.

Microscopical characters.

The large orthoclase crystals are turbid, and enclose occasional sections of nosean, now replaced by micaceous aggregates in confused flakes, polarising in the vivid colours of the second order. These remind one of the secondary muscovite (liebenerite) in liebenerite-porphyry. Mingled with them is a mineral giving soft grey interference tints, and this may be natrolite. The same aggregates are frequent throughout the rock, filling up the interiors of the porphyritic haüyne (nosean) crystals which have preserved their characteristic contours. The groundmass is much decomposed, but seems to consist essentially of small sanidines. Numerous black needles obscured by ferrite may represent acmite or aegirine.

Aegirine-Trachyte.

Sp. gr. 2·61.

There are two or three varieties of trachyte, with needles of the soda-pyroxene aegirine entering largely into the composition of the groundmass. The most striking of these is a greenish rock, markedly porphyritic and fissile by reason of parallel layers of tabular sanidine crystals, found on the beach at Port Cygnet south of the Regatta Ground. The only other porphyritic mineral is augite. The plates of sanidine lie preponderatingly in one direction in layers, giving rise to divisional planes, along which the rock cleaves more easily than in a direction perpendicular thereto.

Microscopical characters.

Inclusions of minute needles of augite (or aegirine) are frequently arranged in zonal form round the periphery of the sanidines, and the margins of the large felspars often melt imperceptibly into the groundmass, the magma of which has apparently corroded them. A crop of microlites is usual along these imperfect edges. The sanidines are clear, and enclose crystals and fragments of augite, besides indefinable microlites and glass inclusions.

Augite.—Sections in the zone of 001 and 100 are common.

The colour of these porphyritic pyroxenes is a rather deep green ; they are distinctly pleochroic. The extinction angles are very variable, and the character of extinction is undulose, probably in consequence of mixtures of normal and soda pyroxene. The extinction of the central portion of a crystal will be 38°, while that of the margin will be straight or nearly so. Sometimes a crystal is found extinguishing at about 5° or 6° in one direction, with a pale yellowish fringe extinguishing at the same angle in the opposite direction. Inserting the quartz wedge with its axis of least elasticity covering the elasticity axis of the pyroxene nearest to the vertical crystallographic axis of the latter, we notice that the colour falls till it is replaced by darkness. In petrographical language, compensation has set in. By this we know that the axis of elasticity in the two crystals (the quartz and the augite) are dissimilar. As the direction in question is that of least elasticity in the quartz, it follows that it is that of greatest elasticity in the pyroxene. This is an important optical test for distinguishing soda pyroxene from normal augite. The groundmass is a remarkable feature of the rock. Small laths of sanidine, often with fluxional arrangement, form a ground-work, with which are entangled pale green rods and needles of the soda-pyroxene aegirine. These are slightly pleochroic, and might be mistaken for augite, but that they uniformly extinguish nearly parallel to their long axis, which direction of extinction the quartz wedge shows to be that of the $\mathfrak{a}$ axis of optical elasticity. The rods are sometimes acicular at one or both extremities, sometimes curved. They occasionally attach themselves end on like a fringe to the borders of crystals of augite. They call to mind the aegirine needles in the aegirine- (formerly called acmite-) trachyte of the Kühlsbrunnen in the Siebengebirge.

In one of our slides is an equilateral hexagonal section of a small water clear mineral in the groundmass, greatly resembling a section of nepheline ; but it is not perfectly isotropic between crossed nicols, and we have failed to obtain a dark cross in convergent polarised light. It has peripheral and central inclusions of colourless to pale green pyroxenic microlites. It has no border such as is common in noseans. If it is nepheline, it would remove our rock from the trachyte to the phonolites ; for the present we must leave the determination doubtful. In the groundmass there is a good deal of isotropic zeolitic matter, apparently of the nature of analcime.

Another variety of the same rock is found on Mount Mary, just above the mine. There it is a compact green rock, often laminated, strongly resembling a metamorphic rock. A few isolated scattered crystals of sanidine occur in it, together with an occasional small black garnet. Under the microscope we see that the green colour is due to the felted network of aegirine needles, and that the rock is essentially identical with the one just described, only with the porphyritic felspars reduced to a minimum. The garnet is the usual melanite variety, brown in thin section. This rock contains pyrites.

Aegirine Trachyte.

Sp. gr. 2·61.

Occurs on Mount Mary, just above the mine.

Mineral constituents.

Sanidine, augite, melanite, titanite, aegirine, biotite, apatite.

Macroscopical characters.

A compact greenish grey rock, with large isolated glistening tabular crystals of sanidine. Numerous small black garnets embedded in the rock, and dark augite prisms visible under hand-lens.

Microscopical characters.

The large sanidine crystals are clear and fresh-looking. Dodecahedral sections of brown-zoned garnet in simple and compound forms enclose prisms of augite. These large garnets are a feature in the rock slice. Green pleochroic augite in imperfect forms of the prism occurs

* System of Mineralogy, 1898, p. 446.

in nests. The extinction angle is as high as 37°, and the mineral often encloses crystals of apatite. $\mathfrak{a}$ yellowish green, $\mathfrak{b}$ yellowish, $\mathfrak{c}$ green. Some spheneis present porphyritically. A little pale yellowish brown biotite is associated with the nests of augite crystals. It can be picked out in the slide by its strong pleochroism—$\mathfrak{a}$ yellowish brown, $\mathfrak{c}$ opaque.

The groundmass consists of small lath-shaped sections of sanidine with fluxional arrangement and pale green pleochroic rods of aegirine extinguishing parallel to their length. Granules and small crystals of sphene are plentiful. There is some isotropic material of a zeolitic nature.

Melanite-Trachyte.

Stones of this rock were found at the back of Widow Cleary's cottage on the road to Cradoc, about 2 miles N.W. of Lovett, at the foot of the green conical hill which rises there from the road. The hill exposes permo-carboniferous mudstones a few hundred feet up, with abundant marine fossils. This is the most northerly extension of the trachyte which we examined, but we could not find it *in situ*.

Macroscopical characters.

Light brown in colour, granular in texture, studded with brilliant black crystals of melanite-garnet. This mineral is such a constant and abundant accessory that the rock may well be called a melanite-trachyte.

Mineral constituents.

Orthoclase, perthite, melanite, augite, apatite, biotite, sphene, analcime, chlorite, limonite (manganese ?).

Microscopical characters.

The most frequent porphyritic element is melanite-garnet, light and yellowish-brown, in thin section, in the usual forms, and strongly zoned in successive layers. The garnet crystals are habitually intergrown with, and enclose augite. The next most important phenocrysts are those of a green pleochroic augite, with an extinction angle not exceeding 33°. $\mathfrak{a}$ light green, $\mathfrak{c}$ deep green, often encloses apatite. There are occasional large porphyritic crystals of fresh orthoclase and perthite, with zonal tendencies. The holocrystalline groundmass comprises orthoclase laths and allotriomorphic felspar; sphene in crystals and grains; some normal biotite; chlorite in scales as a pseudomorph; a little analcime and limonite, with purplish iron oxide (manganiferous ?).

Trachyte.

Sp. gr. 2·7.

On Lymington Road, opposite Martin's cottage.

Macroscopical characters.

A bold exposure on the west bank of the road of a pearl-grey granitoid rock resembling a fine-grained syenite, but essentially trachytic in nature. The groundmass is of even granular texture, with a few larger crystals of glassy felspar, with 010 faces and idiomorphic outlines. Felspar makes up the bulk of the rock; prisms of hornblende numerous; augite is present also, but cannot be distinguished macroscopically from the hornblende. The rock weathers little, but, when affected, the felspars become yellow and opaque.

Mineral constituents.

Sanidine, oligoclase (albite ?), hornblende, augite, sphene, apatite, zircon, magnetite, quartz.

Microscopical characters.

Those of a typical trachyte, somewhat near andesite, the main feature being tabular phenocrysts of zoned felspar in a granular felspathic groundmass. The hornblende phenocrysts are numerous enough to be considered as essential constituents. The augite recedes in quantity to an accessory value. It is difficult to locate this rock in any special position in the trachyte group. The forms of felspar are similar to those prevailing in andesitic trachytes, and there is a good deal of oligoclase; but there is no development of glass, and the rock is not lava-like in appearance.

Felspars.—Isometric forms prevail. Carlsbad twins with 010 faces are frequent, and zonal structure is characteristically developed. In no other rock in Tasmania have we seen the concentric zonal markings so beautifully exhibited. Striped felspar is present in quantity, its extinction angles being those of oligoclase-andesine. We have not been able to measure an angle high enough for albite on an 010 section, but a strip of felspar, intergrown with a crystal of sanidine, gave an angle of 20°, and this may be albite. The felspars are uncommonly free from inclusions of the other minerals of the rock.

Hornblende.—Next to felspar, this is the most prominent constituent in dark green columnar forms. The olive-green color is often so deep as to make the mineral opaque, and occasions difficulty in reading off the extinction angle. The absorption scheme is $\mathfrak{b} \geqq \mathfrak{c} > \mathfrak{a}$, and the pleochroism $\mathfrak{a}$ yellowish-green, $\mathfrak{b}$ very dark green, $\mathfrak{c}$ dark green, sometimes opague. The extinction angle is unusually high, the values which we obtained being 20°, 21°, 25°, 26°, 28°, 30°, 31°, 32°. These agree very well with Professor Brögger's cataphoritic hornblende, though the absorption scale does not correspond; it is evidently a hornblende with cataphoritic tendencies.

Augite is not frequent; it occurs mostly in forms of the prism. Extinction angle 38°, very pale green, non-pleochroic: crystalline sphene, apatite and zircon are constant accessories. The groundmass is not fluxional, but crystalline-granular. In it are a few rounded blebs of quartz, aurrounded by a fringe of re-crystallised felspars, and containing some moving bubbles; magnetite grains in no great quantity, and no mica discernable.

Malchite.

Sp. gr. 2·79.

This rock was found on Mr. Cranny's property, adjoining Coad's farm, at Lymington. It occurs on the side of the hill, but its geological relations were not further examined. Locally it is called "basalt."

Macroscopical characters.

Those of diorite, granular in texture, dark green in colour, owing to the green hornblende which forms the bulk of the rock. It is iron-stained along short irregular cleavage planes.

Mineral constituents.

Hornblende, biotite, augite, plagioclase, apatite, sphene.

Microscopical characters.

Essentially dioritic. What is remarkable is the decided dominance of hornblende as a constituent of the rock. This mineral forms irregular hypidiomorphic plates, often reduced to a granular condition by dynamo-metamorphism. It is intergrown with biotite, which often accumulates in nests or aggregations of flakes. In the hornblende $c : \mathfrak{c} =$ about 14°. $\mathfrak{a}$ pale yellowish green, $\mathfrak{b}$ dark brown green, $\mathfrak{c}$ dark green. The biotite is the ordinary type. Some of the felspars are larger than the rest, and these are hypidiomorphic, while the smaller felspars of the pseudo-groundmass are allotriomorphic. Many felspars are simply twinned on the Carlsbad plan, others albite twinned. A good deal of the felspar appears to be labradorite. The other constituents are apatite, sphene, quartz, and pale augite in small quantities.

The predominance of hornblende and the allotriomorphic felspars may be looked upon as exceptional for

diorite pure and simple. Our rock is certainly dioritic, but its structure is rather aplitic than plutonic, consequently belonging to the dyke series of diorites. It is somewhat schistose in thin section, though not so macroscopically. It seems allied to the plagioclase hornblende aplites described by Osann from the Odenwald, and called by him malchite. Of our slides of the malchitic rocks—orbite, luciite, and malchite—luciite most resembles ours, but we do not grasp the essential distinctions intended to be expressed by these divisions. The quartz in our variety is present in very small quantity.

It is not easy to understand the occurrence of a dioritic rock in this plexus of trachytes; and, in view of the fact that Professor Rosenbusch in his recent "Elements of Petrology" (p. 135) has stated that diorites not only have no chemical or mineralogical relationship with the alkali syenites, but have never been found integrally associated with them, we would reserve the present peculiar rock for the additional examination which it merits and requires.

DISTRICT OF LITTLE OYSTER COVE.

Alkali Syenite, with accessory Elaeolite.

This is represented by a piece of rock from Mr. Innes's property, a mile back from Oyster Cove. We have not been able to examine the occurrence *in situ*, and from the small quantity of material at our disposal we can only give a general account of the characters of the rock.

Macroscopically it is a very light-coloured stone, weathering easily, and resembling a coarse trachyte rather than a syenite. It may be compared with those elaeolitic syenites which have a tendency to trachytic structure.

Under the microscope this pseudo-trachytic appearance shows itself by the larger felspars (sometimes idiomorphic) being cemented or surrounded by a holocrystalline groundmass of smaller hypidiomorphic and allotriomorphic felspars. There is, however, great variation in the size of the latter. There is a remarkable absence of coloured constituents. A flake or two of biotite is the only ferro-magnesian mineral which we can detect. Sphene, zircon, and apatite are accessories.

Orthoclase felspar preponderates. It is fresh and often zonal. Oligoclase is freely intergrown with it. Some of it is streaky, like the orthoclase of the Norwegian elaeolite syenites, and has an undulose extinction. There is much residual felspar (albite) in its clearness resembling quartz.

In the rock are certain irregular and imperfect forms of elaeolite, a few basal sections being isotropic. This determination was confirmed by digesting the rock in HCl and obtaining a fair quantity of gelatinous silica.

There is not sufficient of the felspathoid to constitute the rock a true elaeolite syenite, besides which the pyroxene and hornblende so abundant in elaeolite syenites are here conspicuously absent. It is rather one of those alkali syenites which occasionally carry subordinate elaeolite.

Trachyte.

We have examined three varieties of trachyte rock from Little Oyster Cove. They all appear to belong to the igneous complex, which embraces both the Port Cygnet and Oyster Cove Districts. They carry identical minerals, viz:—sanidine and oligoclase, cataphoritic hornblendes, green augite, sphene, zircon, and apatite; and, from garnetiferous gold-bearing sand found in the neighbourhood, we know that melanite-garnet is also an ingregient. From the few specimens which we have seen, it is likely that, as in the Port Cygnet series, these also are rich in varieties.

On the whole they exhibit a tendency to vary in the direction of the andesites, the dominant porphyritic felspar being plagioclastic, and an increase of iron ore in the groundmass showing itself. The small felspars of the groundmass are often minutely granular or allotriomorphic, but where prismatic they show straight extinction, which may mean sanidine or oligoclase. The porphyritic felspars are large and scattered; zonal structure common. A large orthoclase crystal, giving a section parallel to the clinopinacoid, showed a characteristic extinction angle of 22°. The hornblende is green, basal sections brownish green; extinction angle about 14°, and the absorption that of cataphoritic hornblende, $\mathfrak{b} > \mathfrak{c} > \mathfrak{a}$.

The preceding form a complete series of a unique set of rocks so far as Tasmania is concerned. To the geologist they are important as being the youngest matrix of gold in the colony. The trachytes appear to have shed the gold which has been won on the alluvial field at Lymington and found in the gullies on Mt. Mary. They are in places veined with quartz, but it is not at all clear that the quartz itself is auriferous, and the veins have not the characteristics of true fissures. We have seen some sand collected from a creek about a mile back from Little Oyster Cove towards Port Cygnet, which contains flaky gold, more or less waterworn, with numerous melanite garnets, zircons, and small crystals of sphene. It is a sand which is evidently the detritus of the garnetiferous trachytes, and the occurrence in it of gold associated with the minerals just named supports the idea that the trachytes are the source of the gold throughout the whole province. There is nothing intrinsically inconsistent in the occurrence of gold in the quartz veins of trachytes. It is found in various parts of the world in much younger trachytes and andesites than these, though the gold-bearing reefs in the rest of Tasmania are of older date and traverse Silurian slates and sandstones. But, so far as we can see at present, there is no trustworthy evidence to show that the Port Cygnet quartz veins are auriferous, while, on the other hand, there is some reason for believing the trachytes themselves to contain sparingly disseminated gold, especially where they are silicified and brecciated. The miners are pursuing the right course in selecting these tuffaceous and siliceous zones for exploration. Unfortunately the mining work which is being carried on has not so far proved the existence of the precious metal in the matrix in anything like payable quantities. Whether the gold has been concentrated anywhere to a greater extent than in the parts hitherto exploited, remains for future search to decide. The pyrite in these rocks has so far proved non-auriferous.

Conclusion.

We have abstained from referring to several additional minor varieties of trachytic rock which we have collected, and which differ slightly from the foregoing, but their minute description in this connection would serve no practical purpose, and we doubt not the discovery of further types will reward the diligent collector. The results of our enquiry may be conveniently summarised as follows:—

1. All round the arm of the Huon, known as Port Cygnet, there is an extensive development of porphyritic rocks, which are phonolitic or soda-trachytes containing haüyne, aegirine, analcime, and cataphoritic hornblende. Some of these furnish the finest examples of orthoclase felspar crystals to be found in the island.

2. The trachytic area extends to Little Oyster Cove on the N.E., to the N. of Lovett as far as Sugar Loaf Hill, to the S. of Lovett as far as Lymington and the Huon, but requires further exploration beyond these limits.

3. The trachytes are lava sheets contemporaneous with Permo-Carboniferous sandstones and mudstones.

4. Associated with these trachytic lavas and their tuffs are allied plutonic and dyke rocks, also of a sodic nature; viz., alkali-syenite (containing elaeolite) and haüyne-aplite.

5. There is an interesting development of melanite-garnet in the trachytes and syenite. This garnet seems to run through the whole series, and is a constituent of the auriferous sands of the district.

6. The dark green rock of the locality described in the older literature as "metamorphic," and looking such to the naked eye, is shown by the microscope to be ægirine-trachyte, full of minute acicular crystals of the green soda pyroxene ægirine.

7. Gold has been found at Lovett, Lymington, and Little Oyster Cove, mostly alluvial, a minute quantity *in situ*. It is highly probable that the alluvial gold has been derived from the trachyte, disseminated therein in small quantities. The few quartz veins in the trachyte do not seem to have collected this gold to any special extent, though what gold has been found in the matrix has occurred in their neighbourhood. The quartz is so closely associated with, and banded with, trachyte that the assay results are inconclusive. Appearances are against these quartz veins being true lodes.

8. This highly interesting, though small, peculiar petrographical province is a purely local one, confined, so far as we know, to this part of Tasmania. Its unexpected discovery may be placed to the credit of the young and expanding science of microscopical petrology.*

* Since writing the above we have seen Prof. Rosenbusch's new work on the Elements of Petrology (Elemente der Gesteinslehre, 1898), in which he groups the trachytes and quartzless porphyries (orthophyres) in one family. He says, (pp. 265–6), "Orthophyres differ from trachytes only in their greater age and consequent inferior preservation, viz., in the more frequent red and brown color, diminished porosity of the ground-mass, dull aspect of the felspars and extreme decomposition of the colored constituents. Fresh orthophyres cannot be distinguished from trachytes." Referring to the sanidine in orthophyres, he adds, (p. 266) :—"In the quartzless porphyries sanidine has mostly, though by no means always, surrendered its glassy habit, and possesses the habit and often the red color of orthoclase."

EXPLANATION OF PLATES.

FIG. 1.—Section of trachyte showing zoned crystal of orthoclase. Mount Mary, S.W. Lovett. × nicols. × 16.

FIG. 2.—Section of melanite-trachyte with zoned crystal of melanite-garnet. Cleary's Hill, N.W. of Lovett. Plain light. × 16.

FIG. 3.—Section of haüyne-aplite or haüyne-trachyte dyke rock, with large Carlsbad twins of sanidine carrying included crystals of haüyne. Groundmass = crystals of green augite and haüyne with allotriomorphic orthoclase felspar. From Port Cygnet. × nicols. × 16.

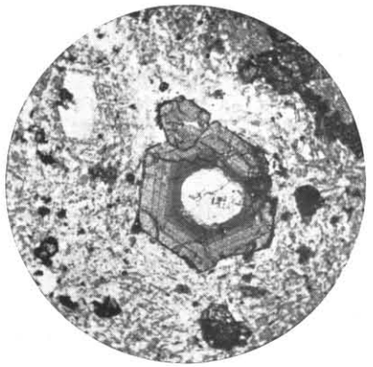
FIG. 4.—Section of trachyte from back road, two miles N.W. of Lymington. Porphyritic crystals = sanidine in Carlsbad twins and zoned, plagioclase, green hornblende and augite. × nicols. × 16.

FIG. 5.—Section of haüyne-trachyte from Livingstone Hill, N.E. of Lovett, showing large porphyritic sanidines. The dark hexagon on the left represents melanite-garnet; the smaller crystal below it is green augite. Surrounding these two crystals are small forms of haüyne. × nicols. × 16.

FIG. 6.—Section of green aegirine-trachyte from beach S. of Lovett. Porphyritic sanidine and augite. Groundmass = rods of pale green aegirine and prisms of sanidine with fluxion structure. Plain light. × 16.

FIGS. 7 AND 8.—Megascopic photographs of dull tabular orthoclase (decomposed sanidine) crystals in haüyne-trachyte on Livingstone Hill, N.E. of Lovett. Natural size.

1.



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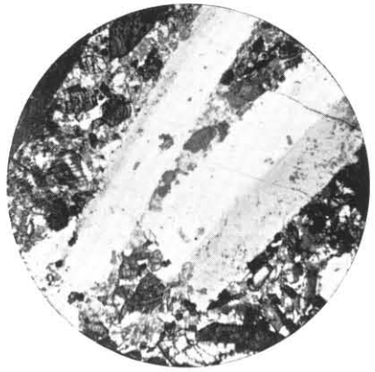

3.

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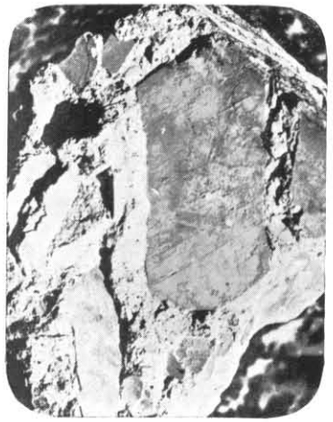
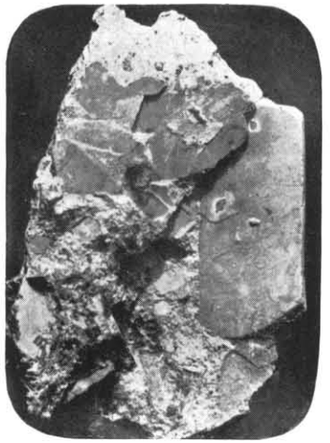


7.



8.

TRACHYTE FROM PORT CYGNET.

5 cm

NOTE ON HUMERI OF TASMANIAN LABYRINTHODONTS.

BY W. H. TWELVETREES, F.G.S., AND W. F. PETTERD, C.M.Z.S.

LAST year we received from Dr. Hy. Woodward, Keeper of the Geological Collections in the British Museum (South Kensington) the *replica* of a cast in the British Museum Collection which had been obtained from Dr. Joseph Milligan, formerly of Hobart, and was labelled by Professor Owen "Humerus of labyrinthodont reptile from sandstone, probably carboniferous, Tasmania." Soon after informing Mr. Alex. Morton, Curator of the Tasmania Museum, of this circumstance, that gentleman brought to our notice and placed in our hands for examination a fossil bone (in two pieces), found in the sandstone quarry, near Government House, in the Domain, Hobart, and presented to the Museum, in 1856, by Mr. Kay, Director of Public Works. This bone, unnoticed for over forty years, is labelled "Humerus of a labyrinthodont reptile . . . . has been examined by Professor Owen," and on the reverse is written by one of the authorities at the British Museum, "Try Eosaurus of Marsh." Both the British and Tasmanian Museum specimens are left humeri, and unquestionably belong to the same genus, if not the same species.

Geological position.

The precise age of the sandstone beds in the Domain, at Hobart, is not yet beyond question, but the evidence available points to it being either Upper Permian or Lower Trias. The Cascade, Knocklofty, and other sandstones of presumably the same geological horizon have yielded Vertebraria Australis and fish remains referred by Mr. R. M. Johnston and Mr. Alex. Morton to the genus "Acrolepis."* According to these authors, similar sandstones in this part of Tasmania succeed the Upper Permo-Carboniferous marine strata with apparent conformability, and are classed by Mr. Johnston in his latest tabular scheme of Tasmanian formations as the lower sandstone series of the Trias.† They are correlated by him approximately with the Hawkesbury beds and Narrabeen series of New South Wales, and the Burrum coal fields or Mr. R. L. Jack's Lower Trias-Jura of Queensland. We find a difficulty in naming more distant equivalents of these sandstones. The few fossils found in them and named above are consistent with an Upper Permian age. Acrolepis is a well-known Upper Carboniferous and Permian fish; but, so far, we must confess the materials do not exist for placing the beds with any degree of confidence on any distinct horizon in the Gondwana system of India or the Karoo strata of South Africa, though they evidently belonged to the ancient Gondwana land represented by those systems. In a letter received this year from Professor Amalitzky, he refers to his recent discovery of Pareiosaurus, Glossopteris with its rhizome vertebraria, Tæniopteris, &c. in the Upper Permian of the North Dwina, Russia; and we are not yet convinced that an Upper Permian age for the Hobart sandstones is definitely excluded. Be this as it may, the Upper Permian and Triassic stratified rocks all over the world—in England, Germany, Russia, United States, South Africa, and India—are known to include remains of labyrinthodont amphibia as well as the higher reptiles. Investigators are still engaged in working out the correlation of these widely-separated sedimentary formations, the exact horizon of which is not yet altogether settled. There is hardly any doubt that these sandstones, so similar in all the countries just mentioned, were laid down in fresh water, possibly in lakes, though we think more probably they belonged to large river systems.

Description.

The British Museum bone is 66 mm. long, the Hobart one, 62 mm.: the breadth of the distal end in both specimens is 23 mm.; of the proximal end or head, 20 mm. The deltoid crest is developed into a strong bony process, which is prolonged as a ridge distad down the narrowest part of the shaft, where it subsides. The anconal depression at the distal end is sub-deltoidal, being a well-defined, shallow, trochlear groove, widening distad, and separating the extremity into the two condyles, ulnar and radial. The ends are broader across than they are thick, and are fairly expanded, though not so much as is generally the case in Anomodont and Dicynodont reptiles; neither does the bone shew the sigmoid shape of a lacertian humerus. The articular surfaces of both ends are abraded, exposing uniformly cancellous structure of the osseous substance. A transverse section of the shaft shews a loose cancellous character all through: the cancelli are coarser towards the centre, but there is no medullary cavity as in the Onomodontia, Dinosauria, and other extinct reptilia, nor is there any differentiation into peripheral bony wall and spongy cancellated centre, as in some Permian reptiles. It is true, Prof. Owen refers to a femur of Rhombopholis scutulatus as being hollow,* but it is not certain that Rhombopholis was labyrinthodont.† Indeed, very few limb bones of labyrinthodont amphibia have been determined: a glance at the annexed list shews that the species and genera of the order have been always founded on vertebræ, jaws and other parts of the skull. Hence, in discoveries of isolated bones as those under review, caution is needed in drawing conclusions.

Under the microscope the larger cancelli are seen to be filled with opaque earthy material. They are sigmoid, elliptical, branched and otherwise irregular in shape, and often contain grains of quartz derived from the sandstone and confirming the authenticity of the specimen. The osseous substance surrounding the cancelli is sprinkled with ellipsoidal and fusiform cells only faintly and occasionally discernible in the slide. These are, doubtless, bone lacunæ, masked by the balsam of the mount.

The only conclusion which can be legitimately drawn from the form and structure of these humeri seems to be that they belonged to amphibian vertebrates. Although any more definite reference is impossible at present, it, nevertheless, appears to us desirable to place these remains on record, and thus render them available for comparison with future discoveries.

* Trans. Roy. Soc., Tasmania, 1889, p. 102; 1890, p. 152.

† Historical Sketch of the Geological Relations of Australia and Tasmania: Trans. Austr. Inst. Min. Engineers, 1895.

* Owen. Palæontology, 1861, p. 215.

† On the remains of Labyrinthodonts from the sandstone of Warwick L. Miall. 2 J. Geol. Soc. 1874, p. 433.

EXPLANATION OF PLATE.

FIG. 1.—Humerus of labyrinthodont amphibian from Lower Mesozoic sandstone, Tasmania. British Museum cast. Anconal (back) aspect. Nat. size.

FIG. 2.—Ditto, ditto. Thenal (front) aspect. Ditto.

FIG. 3.—Humerus from Domain sandstone quarry. Hobart: Lower Mesozoic. Thenal (front) aspect. Nat. size.

FIG. 4.—Microscopical section of shaft of humerus, Nos. 2 and 3, showing cancellous structure of bone. × 10.

More or less well-known LABYRINTHODONT GENERA AND SPECIES, exclusive of the Salamandroid and Serpentine Forms of the Sub-Orders Microsauria, Aistopoda, and Branchiosauria.

GENERA.	LOCALITY.	HORIZON.	FOUNDED ON
Eosaurus acadianus (Marsh)	Coal Measures, Nova Scotia	Carboniferous	2 vertebral centra.
Anthracosaurus Russelli (Huxley)	Ditto, Lanarkshire	Ditto	Skull, ribs, and vertebra.
Loxomma	Gilmerton, near Edinburgh	Ditto	
Loxomma Allmani (Huxley)	Shropshire and Northumberland	Ditto	Skull, vertebrae, ribs, humerus.
Pholiderpeton	Gilmerton, near Edinburgh	Ditto	
Pteroplax	Coal Measures, Northumberland	Ditto	Skulls.
Macromerium scoticum (Lydekker)	Gilmerton, near Edinburgh	Ditto	Jaw.
Baphetes planiceps (Owen)	Picton Coal, Nova Scotia	Ditto	Part of skull.
Ichthyerpetum	Jarrow Colliery, Kilkenny	Ditto	
Dendrerpetum ?	Coal Measures, Nova Scotia	Ditto	
Pholidogaster	Edinburgh	Ditto	
Raniceps (Wyman) ?	Cannel Coal, Ohio, U.S.	Ditto	Skull, vertebrae, fore-limbs.
Actinodon latirostris (Jordan sp.)	Saarbrück	Permian	Skull.
Archegosaurus Decheni (Goldfuss)	Ditto	Ditto	Skull.
Euchirosaurus Rochei (Gaudry)	France	Ditto	Vertebrae.
Nyrania	Bohemia	Ditto	
Loxomma sp. (Fritsch)	Rothliegendes of Bohemia	Ditto	Jaw.
Macromerium Schwarzenbergi (Fritsch)	Bohemia	Ditto	Jaw.
Ditto bicolor (Ditto)	Ditto	Ditto	
Labyrinthodon Bucklandi (Lloyd)	Sandstone, near Kenilworth	Ditto	Skull.
Cochleosaurus (Fritsch) Chelyosaurus (Ditto) Gaudrya (Ditto) Sparagmites (Ditto)	Gas Coal, Bohemia	Ditto	
Micropholis Stowii (Huxley)	Beaufort Beds, Karoo, S. Africa	Ditto	
Dasyceps Bucklandi	Warwickshire	Ditto ?	
Platyops Rickardi (Twelvetrees)	Kargalinsk Sandstone, Russia	Ditto	Part of skull.
Brachyops laticeps (Owen)	Mangli, Upper Damudas, India	Ditto ?	
Gondwanosaurus bijoriensis (Lydekker)	Bijori, ditto	Ditto ?	Skeleton.
Eryops megacephalus (Cope)	Texas	Reputed Permian	Jaw.
Trimerorachis	Texas	Ditto	
Eryops Oweni (Lydekker)	Karoo, South Africa	Permian or Trias	Jaw.
Bothriceps Huxleyi	Karoo, South Africa	Trias ?	Skull.
Bothriceps australis (Huxley)	Australia	Unknown	Ditto.
Mastodonsaurus (v. Meyer)	Keuper sandstone, Würtemberg	Trias	Skull and vertebrae.
Capitosaurus robustus (v. Meyer)	Ditto, Stuttgart	Ditto	
Trematosaurus Braunii (v. Meyer)	Bunter sandstone, Bernbourg	Ditto	Skull.
Labyrinthodon leptognathus (Owen)	Keuper sandstone, Warwick	Ditto	Vertebræ, sternum, and part of skull.
Ditto pachygnathus (Owen)	Ditto	Ditto	Skulls, humerus, femur, ilium, phalanges.
Diadetognathus varvicensis (Miall)	Ditto	Ditto	Jaws.
Capitosaurus arenaceus (Münster)	Bunter sandstone, Germany	Ditto	
Metoposaurus diagnosticus (v. Meyer)	Near Stuttgart	Ditto	Skull.
Odontosaurus Voltzii (v. Meyer)	Bunter sandstone, Soultz-les-Bains	Ditto	Jaw.
Platyceps Wilkinsonii (Stephens)	Hawkesbury beds, Gosford, N.S.W.	Ditto	Skeleton.
Gonioglyptus longirostris Ditto Huxleyi Glyptognathus fragilis Pachygonia incurvata	Pánchets of India	Ditto	
Rhytidosteus capensis (Owen)	Beersheba, Orange Free State	Ditto ?	Part of skull.
Petrophryne granulata (Owen)	Cape of Good Hope	Ditto ?	Skull.
Rhinosaurus Jasikovii (Fischer)	Simbirsk, Russia	Jura ?	Skull.
Pachygonia incurvata	Maleri of India	Oolite ?	

1.

2.

3.

x 10.

4.

LABYRINTHODONT HUMERI.

5 cm

ON THE FELSITES AND ASSOCIATED ROCKS OF MOUNT READ AND VICINITY.

BY W. H. TWELVETREES, F.G.S., AND W. F. PETTERD, C.M.Z.S.

ASSOCIATED with the schists of Mount Read and district are some obscure igneous rocks, siliceous in nature, compact in grain, often slightly schistose, which are what the field geologist calls felsites or felstones. These terms, however convenient, need explanation, for in different countries they carry different meanings. In Germany the word felsite (or micro-felsite) is applied to the compact homogeneous-looking groundmass of quartz porphyries. These porphyries are the acid volcanics of pretertiary age. In England, on the other hand, felsite designates the rock, not its groundmass merely. If the petrographers of each country could throw over the historical significance of their terms and come to some international agreement as to rock nomenclature and the meaning to be attached to terms, much of the present deplorable confusion would disappear. At present the discordance is considerable. The following extracts serve to indicate the English usage :—

*Cole.**—Quartz-felsite=Eurite=" the fine-grained and compact forms of granite." " Felsite is so differently used by different writers that its reputation as a rock name is lost."

Hatch.†—Felsite=" the acid quartzo-felspathic lavas—the devitrified rhyolites and obsidians."

Rutley.‡—Felsite=" devitrified obsidians and pitchstones. Felsites are not exclusively devitrified rocks; in some cases they occur as dykes and then approximate to the micro-granites or granophyres." Quartz-felsite=" apophyres of deep-seated granite masses (Elvan group)."

Harker.§—Felsites=" acid intrusives. The name 'felsite,' or, if containing evident phenocrysts of quartz, 'quartz-felsite,' has been applied in this country not only to these rocks but also to many volcanic rocks (acid and intermediate), and their usage lacks precision and significance."

Teall.‖—Acid rocks=" Felsite, Eurite petrosilex. These terms are practically synonymous. They have been applied to compact stony rocks, the mineralogical composition of which cannot be ascertained by examination with the naked eye or with a lens."

Jas. Geikie.¶—Quartz-felsite=Quartz-porphyry. " In this rock we have a compact groundmass of felsitic matter, through which are scattered macroscopic or microscopic crystals or crystalline granules of quartz and orthoclase. . . . . It seems probable that micro-felsitic matter is simply the result of devitrification of a glassy base."

*Sir A. Geikie.***—Felsite (felstone.) " Originally vitreous lavas like the rhyolites, but which have undergone complete devitrification, though frequently the perlitic, spherulitic, and flow structures."

Teall.††—Acid intrusives=felsophyre, granophyre, micro-granite. Acid volcanic=devitrified rhyolites, obsidians, and pitchstones.

These samples show that, what with acid intrusives, acid volcanics, elvans, devitrified obsidians and rhyolites, granophyres, micro-granites, quartz-felspathic lavas and the rest, the term has come to mean nothing more precise than a compact ancient acid rock. Hence some petrographers abandon its use altogether, and parcel out the rocks covered by it, some among the ancient rhyolites, the rest among micro-granites.

A different nomenclature is adopted in Germany. This family is included by Rosenbusch in Liparites and quartz porphyries. In his recent work‡‡ he says :—" The difference between liparite and quartz porphyry is one of age : quartz porphyries are pretertiary palæo-volcanics, liparites are neo-volcanic tertiary rocks, consequently young quartz porphyries." He defines them as effusive rocks of normal granitic magma, and divides them into two sections, viz., (*a*) microgranitic and granophyric quartz porphyries, (*b*) felsophyric and vitrophyric quartz porphyries. Under different names we see there are still two main groups, the microgranitic and the rhyolitic; though, as they are both classed as effusive rocks, we cannot carry out any exact comparison with the English usage.

It is accordingly necessary to explain the sense in which we attach names to the Tasmanian rocks. While the particular name has a certain importance, it is equally important for us to understand the rocks to which it is applied. Seeing that quartz porphyry is so widely used in England for compact granitic protrusions, we propose to confine the terms felsite and quartz felsite to devitrified acid lavas. The term quartz-keratophyre is applied to the same rocks when containing an alkali-felspar rich in soda. Keratophyre, the syenitic equivalent = soda felsite : quartz keratophyre = soda quartz felsite. This terminology can be correlated with Rosenbusch as follows :—

Here defined.	*Rosenbusch.*
Felsite.	Felsophyre felsite rock.
Quartz felsite.	Felsophyric quartz porphyry.
Keratophyre = Soda felsite.	Keratophyre.
Quartz-keratophyre = Soda-quartz-felsite.	Quartz-keratophyre.

The groundmass of felsites is characteristically felsitic. What felsitic matter really is has occasioned much discussion among petrologists, and a definite result can hardly be said to have been yet attained. The compact groundmass irresolvable by the naked eye or the hand lens is often resolved by the microscope into an intimate aggregate of minute crystalline-granular quartz and felspar, giving a confused speckled appearance between × nicols.

When the component individuals of the aggregate become more minute and indefinable, the groundmass is what Rosenbusch calls crypto-crystalline. This is the felsitic material. And, following the process of resolution still further, we arrive at the ultimate isotropic vitreous base. But more frequently further resolution discloses a minute aggregate of isotropic granular or flaky material which we assume to be a devitrification product, though this is mostly not susceptible of proof (miscro-felsite, Rosenbusch). From Vogelsang's researches it is probable that this micro-felsitic material is no longer a mechanical aggregate of quartz and felspar, but an independent silicate. (See the lucid exposition given by Rosenbusch, Mass. Gest., p. 668.)

Under such conditions it is not wonderful that the Mount Read rocks, masked by great geological age, and distorted and mineralogically reconstructed by intense dynamic metamorphism, should prove puzzling to the geologist. Their felsitic nature is often obscured by green colouration due to the free development of chlorite, which gives a very different appearance from that of the light coloured hälleflinta-like aspect of so many of the more typical felsites. It must be premised that the rocks not only occur in the Zone of the West Coast argillitic and phyllitic schists, but have themselves been affected by the forces which produced the foliation of the schists. Hence they have a more or less banded or schistose appearance, though, owing to their greater hardness compared with the slates, they are not foliated to anything like the same extent. The effect is often only shown by obscure banding or streaking, while elsewhere there is a more decided approach to schistosity. Sometimes a few reddish porphyritic felspars are discernible, but as a rule the rock has a streaked reddish and greenish flinty aspect, as if the original porphyritic crystals had been rolled out and their material diffused. The colour of different varieties, however, varies a good deal, ranging from yellowish white to reddish.

* Aids in Practical Geology, 1893, p. 201.
† An Introduction to the Study of Petrology, 1891, p. 85.
‡ Granites and Greenstones, p. 15.
§ Petrology for Students, 1897, p. 100.
‖ British Petrography, p. 291.
¶ Outlines of Geology, 1888, p.p. 152-153.
** Text Book of Geology, 1893, p. 161.
†† British Petrography, p. 296.
‡‡ Elemente der Gesteinslehre, 1898, p. 239.

Specific Gravity.

Teall states the sp. gr. of felsites and liparites as ranging from 2·53 to 2·7. Our determinations of the Mount Read felsites, comprising numerous selected specimens, are :—

2·6, 2·62, 2·63, 2·65, 2·68, 2·7, 2·74.

The specific gravities of the Lenne-porphyries of Westphalia (Keratophyres and Quartz Keratophyres) given in O. Mügge's important paper may be usefully compared.

Quartz-keratophyre, 2·648, 2·654, 2·647.
Felso-keratophyre, 2·62 (non-schistose), 2·638, 2·74 (high sp. gr. due to chlorite), 2·65, 2·75.

Also those furnished by Rosenbusch :—

Keratophyre, 2·611, 2·677.
Quartz-keratophyre, 2·709, 2·647, 2·620, 2·64 2·634, 2·614, 2·632.

The specific gravity of the Tasmanian felsite is consequently quite in accord with what has been observed elsewhere.

Intrusive or Effusive.

The relations of the rocks to the argillitic metalliferous schists are far from being definitely established, and require close working out over an extended area. Owing to the densely timbered country and paucity of serious mining operations, this is a task of extreme difficulty. All that has been done hitherto has been to notice the fact of their occurrence here and there, especially where the country has been cleared a little for mining work. On the north side of Mount Read on the North Hercules, Barlen, and Consols sections, this rock is prevalent, sometimes as a greenish flinty schistose or fissile felsite, and towards the bottom of the track going down to the Ring River valley in abrupt massive cliffs of a green and reddish streaked compact siliceous felsite. It has here the appearance of an intrusive mass, but this may be with equal probability the exposure of a thick lava mass. A common characteristic of metamorphosed felsites and their tuffs in schist areas is the indefinable nature of the boundary line separating them from the schists. This seems to be the case in this region, and is a fact in support of their contemporaneity. We have seen the same felsite in the shaft at Mount Black Mine, and still further north on the Tasmanian Copper Company's property between Rosebery Township and the Pieman River. Further south, too, it occurs in the direction of Red Hills and Mount Darwin ; and a very coarse granular chlorite-stained variety of the same series is found on the White Spur between Moore's Pimple and Mount Read. This zone therefore extends in a N. and S. direction for about twenty miles, while E. and W. its breadth is comparatively small. The zone of felsites seems to mark the upturned edges of sheets of lava roughly parallel with the axis of the present West Coast range. These lavas were probably geologically contemporaneous with the argillaceous sediments now converted into schists, and with them were folded, crumpled and rolled out into the schistose, banded conditions in which we now find all the rocks of this belt of country. At least this interpretation is the one which seems to us the most feasible in the present state of our knowledge of this difficult piece of country.

Their relations to the Ore Beds.

This fact confronts us : Whenever the felsite appears in tunnels driven through the metal-bearing phyllites or schists, ore is no longer found ; the felsitic rock is barren. The occurrence of a band of this felsite in an adit is suggestive, at the first blush, of an intrusion ; but the absence of sharply-defined walls is against the idea, and it can be explained quite satisfactorily on the supposition that it is an intercalated sheet. It cuts off the ore simply because the ore is not contained in a lode fissure, but has been deposited by a process of segregation, or has replaced the original rock by metasomatic substitution. The ore bodies on Mount Read form lenticular masses in the argillitic schists parallel with the plane of foliation, and disposed at irregular intervals in directions parallel to each other. The deposition took place probably subsequently to foliation, judging from the parallelisms with the enclosing schists. This is seen on a small scale in some of these mines, where the ore follows a minute arching and folding of the schist without dislocation. These lenticular masses have been looked upon as segregations of mineral along crevices or lines of weakness in the rock. It is rather difficult to imagine cavities of the required size existing in the rock in readiness for filling up with mineral ; but there is nothing improbable in supposing the parting planes of the schists to be the first channels for the precipitation from solutions of their metallic contents. The process of replacement might then very well start from these channels and remove the country rock on either side, leaving ore in its place. The suggestion that the lenticular ore bodies represent old lake bottoms has not the testimony to support it which can be adduced in favor of the metasomatic hypothesis. The sulphides of the Rio Tinto Mine in Spain which have been appealed to are mostly bodies filling fissures which separate slates and intrusive quartz porphyry ; and it is only iron ore lying in horizontal beds of miocene age with plant remains which can be referred to a sedimentary origin. Those conditions are not comparable with the mineral zones on Mounts Black and Read. Here the ore bodies follow the dips and foliation planes of the enclosing schists which on Mount Read dip easterly at a high angle with a strike from 10° to 20° W. of N. The lenticular forms of these bodies are suggestive of replacement having gone on *pari passu* with the operation of a solvent. They differ from true lodes in always being found conformable to the surrounding schist, and from both fissure and segregation veins in having no gangue or matrix different from the country rock. The foliation planes have apparently served as initial channels for the mineralised solutions which attacked and removed the schist on each side, and left their mineral contents *in sitû*. It is obvious that in such a process there would be a beginning : the attacking solution would attain a maximum of power and gradually decrease to a minimum. The result would be a lens-shaped body of mineral. The question presents itself, are such deposits as permanent as true lodes ? But this is hardly the appropriate form for such a query. It would be more proper to ask, are these ore deposits as reliable as the *pitches* or *shoots* of ore in true lodes ? We know very well that, though mineral veins or lodes go down to apparently quite inaccessible depths in the earth's crust, the courses of ore which they contain are inconstant and irregular. A metalliferous zone is followed by a barren one, or *vice versâ*. Therefore, to institute a just comparison, we must imagine the partings of the schist to correspond with a lode fissure, and the lenticular ore bodies with the ore shoots in a lode. The depths to which these foliation planes extend depends (1) upon the magnitude of the anticlinal or synclinal flexure to which the sedimentary rocks were subjected, and (2) upon the extent to which the secondary foliating agency affected them. This form of deposit has an advantage over most bodies, in that there has often been the opportunity for the formation of numerous ore bodies on parallel lines following parallel parting planes of the schist. The ore bodies come in and die out in these channels as ore courses do in a lode ; and there is in reality no more nor any less reason for timidity or despondency in exploiting either. It will be noticed that on this supposition the ore was not deposited in the beds before they were crushed and foliated ; consequently, by simple exclusion and without further argument, the hypothesis that the metals were precipitated on ancient lake bottoms which have since been raised and tilted, falls to the ground as far as the Mount Read ore bodies are concerned. To gain some knowledge of the true nature of the slates and schists, some of the unaltered slate (a dark greasy variety) from Mount Read was powdered and treated in the test tube, first with a cold saturated solution of citric acid, then heated, but no effervescence took place. Subsequent boiling in HCl. gave the same result. The non-metalliferous schist from the same locality was subjected to the same treatment. Some of this behaved in a similar manner ; but another piece gave signs of the presence of a carbonate. The microscopical test showed calcite. Slides of the schist in the tunnels of the Hercules Mine sometimes show abundant calcite, occasionaly in a granular condition, as

if broken up by earth movements. That minor later movements have occurred is evidenced by the "greasy headings" in the mines. These are false walls, or parting planes, where the rock has been shifted by earth stress. Under the microscope the powdered schist reveals its derivation from the slate very plainly. Both consist of grains of alumina or aluminium silicate, with a little quartz. This schist is perhaps the most common on the Hercules group of sections on Mount Read. It is hardly a true schist, hardly even phyllite, which is a lustrous slate. Argillite, or argillaceous schist, would perhaps be the most suitable name. There are, however, other descriptions on the range. There are clay slates, glossy with mica; these are true phyllites. There are siliceous schists, which have resulted from the foliation of sandstones; and quartz schists, probably from quartzites; and talc schists, as on the Jupiter section, which must have had a different origin from the argillitic and quartz series. Talc schists are most likely to originate from pyroxenic rocks, but nothing is known yet of the relations of the Jupiter rocks. Micaceous schists occur, but not the true mica schists of the gneissose Archæan series. At Cutty Sark, near the Pieman River, there is a dark, compact, granular rock, of doubtful origin, which has been involved in the movements of the chain, and received an impress of schistosity. In fact, all through this zone of metamorphism and foliation, no matter what kinds of rock, they have been caught up in the process of schist formation, their original characters more or less obliterated, and a new stamp of rock structure impressed upon them. An exceptional occurrence in the schist zone is the Mount Black lode at Rosebery, which is a banded true fissure lode containing gold, wolframite, bornite, bismuthinite, chalcopyrite, iron and arsenical pyrite, and black tourmaline. The occurrence of wolframite and tourmaline is noteworthy. Just south of this, at the South Mount Black, is a dyke, black with tourmaline. The acid nature of this dyke and lode seems to indicate some connection with the movements of the granite magma in the West Coast area. This relationship naturally involves a much younger age than that of the surrounding schists and felsites. The tourmaline quartz-porphyry at South Renison Bell, the axinite at the Colebrook, and the Mount Black fluor and tourmaline rocks, probably all belong to one and the same eruptive phase.

The schists are repositories of numerous minerals and ores, which vary in the extent of impregnation to both extremes, inasmuch as these are more commonly simply represented by a few sparsely scattered minute crystals and flakes of pyrites, often of a cupriferous tendency, with occasional patches of galena and zinc sulphide. More rarely these metallic minerals are found in great quantity, sometimes wholly replacing the substance of the rocks, until they assume the character of a dense mass of sulphide ore of enormous extent. It is such masses of mineralised schist which are operated upon by the miners in the districts of Mount Reid and Rosebery. The change does not assume a general character, for often within a restricted area one or other of the copper, lead, zinc sulphides preponderates; but, as a rule, zinc is present. At the Tasmanian Copper and adjacent mines the ore is practically that of a zinc-copper nature; at the Hercules the zinc-lead impregnation is the most pronounced; while at the King River, the East Hercules, Red Hills, and others, the ore is almost zinc free; and at the Mount Read Mine almost all degrees of admixture may be obtained. A small quantity of associated gold and silver is very general, and in favourable localities for decomposition, where large masses of gossan have formed, the precious metals have been obtained in greater abundance, and have in one instance been worked by methods common to the alluvial gold-miner. In the workings of the Hercules and South Hercules mines, bunches of crystallised carbonate of manganese of great beauty are occasionally met with, and in the schists of the East Hercules the ores of bismuth have been detected, while in the vicinity of Lake Dora cobalt minerals occur; but the ores of these metals are not by any means abundant, and are, as at present known, simply curiosities of interest to the mineralogist, but of no practical value to the miner.

The following is a list of the more important minerals which have been detected:—

Arsenopyrite.	Cuprite.	Limonite.
Absolite.	Chalcocite.	Malachite.
Azurite.	Erythrite.	Psilomelane.
Barite.	Fluorite.	Pyrites.
Bornite.	Galenite.	Pyrolusite.
Bismuthinite.	Göethite.	Rhodochrosite.
Cerussite.	Gold.	Siderite.
Chalcopyrite.	Hematite.	Sphalerite (Blende).
Cobaltite.	Huascolite.	Stibnite.
Copper, native.	Jamiesonite.	Tetrahedrite.

The Mount Read felsite does not appear to have yielded sufficiently to the foliating force to provide planes along which solutions could travel freely, or was not so easily attacked by the latter; hence it contains no ore bodies. This is not, however, a universal rule. At the Red Hills an igneous rock, probably felsite, occurs, which has been more strongly foliated, and, in a specimen received from the Government Geologist (*see* Report on Lake Dora District, 1898, p. xxi.,) we noticed a decided illustration of the replacement process. A few felspar crystals remained unaltered, but the rest of the rock had been converted into hematite. But at the Mount Read mines the ore is confined to the argillitic schists. The question arises, whether the proximity of the igneous rock bears any casual relation to the ore in the schists—has the eruptive rock in any way stimulated ore deposition? An answer in the affirmative would have a practical effect on mining, as the discovery of felsite would indicate the proximity of ore. The case of the white melaphyre at Zeehan, which favourably affects the silver-lead lodes there, suggests the possibility of something similar ruling in the case of the Mount Read felsite. But the two cases are not parallel. At Zeehan the lodes in question traverse the eruptive rock; at Mount Read the ore bodies are outside it. And it is difficult to see how the latter would affect ore deposition in the schists, when, as appearances indicate, the ore was deposited subsequently to the foliation and metamorphism of both felsite and schist. It is true that ore is found never very far away from the felsite. A very natural way of accounting for this is that schists and felsite are geographically associated, and form together one mountain complex.

Age of the Felsite.

If our interpretation as set forth above be correct, the geological age of the schists and felsite is the same for both. There is no direct evidence of precise age yet available. The schists themselves in the vicinity of Mount Read are argillites and phyllites, and occasionally retain in places less altered remnants of slate, but no fossils have been found in them. The most recent determinative work done in this direction is R. Etheridge, jun.'s description of Mr. A. Montgomery's collection of Silurian fossils from the limestones of Zeehan and the Heazlewood. Mr. Etheridge says they "present both a lower and an upper Silurian facies, but with a preponderating tendency towards the latter." He thinks "it is not improbable that they represent a series of beds homotaxially equivalent to the lower portion of the upper Silurian."* Judging from the succession, the Mount Read and Mount Black schists are somewhat older than the Zeehan series, and are probably not younger than the lower Silurian. But great caution is necessary here, as the evidence is of a negative character. The test of superposition is unreliable, as the persistent easterly dip of the strata on the west slope of Mount Read points to overfolding on a large scale, which has produced an inverted succession of the beds. In any case, the felsite is much older than any of our known granite rocks.

Determination of the Felsite.

Anticipating for a moment the results of our microscopical examination, we may say that the predominance of plagioclastic porphyritic felspars led us to suspect that the rock belonged to the sub-group of soda felsites or keratophyres (in their altered sheared form often called porphyroids). To avoid all chance of error, we sent samples of the rock to Professor Rosenbusch, who very kindly

* Description of a small collection of Tasmanian fossils.—R. Etheridge, jun

favoured us with his opinion, as follows :—"Undoubtedly we have here strongly dynamically altered forms of the acid eruptive rocks. The typical porphyritic structure, the nature of the phenocrysts, the still recognisable fluidal structure, the nearly entire absence of dark constituents, the occasional spherulitic forms still recognisable in their replacement products (quartz, albite), all point with certainty to members of the quartz porphyry family, and, with great probability, not to quartz porphyry in the narrower sense, but to quartz keratophyre and keratophyre. . . . . The rocks greatly resemble our German occurrences in Westphalia, the Fichtelgebirge and Thüringen, and especially the occurrences in Wales. These are the forms which in Germany were originally called porphyroids and flaserporphyries."

Microscopical characters of the Felsite.

As the aspect of the rocks differs in the field in different parts of the same mass, so their microscopical structure varies to an equal extent. Sometimes they are typically porphyritic, though the crystals are never very large ; or the porphyritic crystals are set so closely together as to resemble somewhat a plutonic rock-like granite ; or they are broken and mutilated, giving a fragmentary appearance to the rock. The mineral constitution, too, varies. There is a set in which quartz phenocrysts accompany those of felspars, and another series from which they are absent. Nevertheless, despite all these variations, the observer recognises that he is looking at one and the same group, the acid and the sub-acid eruptives.

The mineral constituents of one or other of the members of the group may be classed as under :—

Essential.	Accessory.	Secondary.
Orthoclase.	Magnetite.	Albite.
Oligoclase ?		Chlorite.
Albite.		Epidote.
Quartz.		Sericite.
		Calcite.
		Limonite.
		Sphene.
		Zoisite.

The changes are all rung on these minerals, the secondary ones replacing or obscuring the essential constituents in varying degrees.

In addition to orthoclase, a felspar of the albite or oligoclase-albite series appears as a porphyritic constituent, and is sometimes very abundant, becoming the prevailing felspar. This shows us that these are not the ordinary orthoclastic felsites.

The material upon which we have founded these preliminary microscopical studies comprises an extensive series of rocks collected from Mount Read, on the sections owned by the South Hercules, North Hercules, East Hercules, Crown Hercules, and Ring River Companies, from Tipperary Creek on the west side of Mount Read, from the White Spur between Dundas and Mount Hamilton, from the Tyndal Track and Creek south of Mount Read, from the Red Hills east of Mount Read, from Mount Black and the Tasmanian Copper Company's property north of Rosebery, &c. The following micro. details will be of interest to students :—

We note that in the porphyritic types on the North Hercules section the felspars have a habit of collecting in nests, and there is a good deal of water-clear secondary felspar surrounding the phenocrysts. The phenocrysts float in a matrix of this secondary felspar, with which calcite is sometimes associated. Carlsbad twins may be often seen bent by dynamical stress, and strongly seriticised. In the more granitic or crystalline forms, on this property, there is abundant quartz, which often has a fragmentary aspect, being in all sorts of irregular shapes. Hexahedral forms are rare. Some of the grains are embayed ; others are stretched, cracked, or broken. Strain shadows are frequent : minute fluid cavities present occasionally. Between the felspars there is a good deal of bright green chlorite. Sericitic streaks curve between the phenocrysts ; this may represent original flow structure. The rock on the White Spur is a counterpart of that of the North Hercules. The crystalline form is the dominant type. Fragmentary deformed quartz frequent. Schistose structure marked ; the lines of schistosity bend round the unyielding quartz grains, causing a streaky appearance, and probably marking former flow lines. The ordinary porphyritic form of rock also occurs on the White Spur.

In the keratophyre of Tipperary Creek the felspars are strongly sericitic, and the rock is veined with albite. This felspar veining occurs also in the same rock at Red Hills, in which there are rather peculiar nests of albite crystals. The keratophyre here is rich in bright green chlorite. On the Tyndal Creek there is a rather fresh keratophyre, with a good deal of chlorite. On the track to Mount Tyndal the felsite is much epidotised ; some of the Carlsbad twins have one half replaced by epidote, and chlorite is developed abundantly. The felspars of the keratophyre in the Ring River adit have been replaced by aggregates of secondary albite and quartz ; the crystals of felspar here have sectional fields very characteristic of keratophyres. There is a keratophyre on the Crown Hercules overlying the ore body, with slate on both sides. At the Mount Black mine the shaft is in keratophyre, identical with that of Mount Read. The porphyritic felspars are here, too, surrounded by secondary felspathic growth. Further north, on the Tasmanian Copper Company's property, there is a band of felsite in the lower adit 40 feet wide, in which the few felspars are broken up into aggregates of secondary albite. With reference to the groundmass of these rocks, Professor Rosenbusch writes to us :—"Nothing is left of the original groundmass ; it has been converted into sericite, quartz, and albite. The newly-formed albite felspar can be distinguished quite easily from the older phenocrysts. The chlorite indicates original pyroxene rather than biotite."

Summarising the above, we have here the characteristics of felsite and quartz felsite, and especially of keratophyre and quartz-keratophyre. The rocks have a compact quartzo-felspathic (felsitic) groundmass, with quartz and orthoclase and albite phenocrysts, sometimes distributed sparingly, at other times so crowded as almost to lose the porphyritic stamp. In the typically porphyritic varieties are altered spherulites and signs of flow structure. In a word, these are ancient, now devitrified, lavas of the alkali-granite and alkali-syenite families. The quartz keratophyres are the granite volcanics ; the keratophyres are of syenitic nature.

There are no plutonic masses in the neighbourhood with which we can connect this series of lavas. The syenite, which occurs in boulders north of Rosebery, has not been found *in sitû* ; and the granite at Heemskirk is of younger date. There is some pegmatitic granite on Jolly's section at Lake Dora, which microscopically appears fresh and post-Silurian. The mass or dyke of syenite porphyry at Lynchford is evidently of great age. The mechanical deformation of its crystals indicates that it was subjected to the same earth movements as the slates ; and there is consequently a likelihood of it being quite as old as the felsites. The long line of felsite, with its axial direction parallel with that of the West Coast range, shows that below that area, in Silurian times, there must have been a corresponding plutonic body of rock, which the vast period of post-Silurian denudation has not been sufficient to uncover.

Mr. W. F. Ward's Analysis of Quartz-keratophyre from the North Hercules Section, Mount Read.

Professor Rosenbusch suggested to us that a chemical analysis of this rock was highly desirable, in order to confirm the results of optical examination. This analysis has been made by Mr. W. F. Ward, Government Analyst, who states it as follows :—

Constituents.	Per cent.
Silica	75·73
Alumina	12·70
Oxide of iron	2·25
Lime	2·00
Magnesia	0·60
Potash	2·04
Soda	3·48
Loss at red heat	1·20
	100·00

From the above it will be seen that the reference to quartz-keratophyre is fully sustained. The percentage of silica shows it to be an acid eruptive, while the excess of soda over potash indicates the keratophyre group.

REPORT ON THE ALLUVIAL TIN MINES AT DERBY.

Mines Office, Launceston, 1st May, 1899.

Sir,

In accordance with your instructions I proceeded to Derby on the 8th ultimo to examine the alluvial tin mines in that vicinity, but owing to other pressing engagements I was unable to make a complete examination, and shall have to return when opportunity offers to finish the work. In the meantime I have the honor to forward you the following interim Report.

The Town of Derby, which is largely dependent on the mines, is situated at an elevation of about 400 feet above sea-level on the Ringarooma River, distant about 23 miles by road from Scottsdale. At this point the river has cut through what is known as the Brothers' Home or Cascade Deep Lead, a thick deposit of stanniferous gravels of Palæogene age, capped with basalt, and filling the valley of an older river corresponding to the present Cascade River. To the north of Derby is an extensive basaltic plateau of rich agricultural land, under which doubtless runs the main lead corresponding to the present Ringarooma River, of which the Cascade is a tributary.

The formation of the deep leads of Tasmania has been fully described by Mr. A. Montgomery, M.A., late Government Geologist, in his Reports on the Gladstone District, on Thureau's Deep Lead, &c., but it may be well to here briefly recapitulate the principal points.

In early Tertiary times the general level of northern Tasmania, irrespective of the great denudation that has since taken place, stood considerably higher than at present. Of this we have abundant evidence. The bottom of the Launceston Tertiary Basin, for instance, has been proved by boring to be at least 200 feet below sea-level. The bottom of the Ophir Deep Lead at Beaconsfield is over 270 feet below sea-level, and the Deep Leads at Lefroy and Back Creek also run well below sea-level. The ancient rivers were then engaged in carving out their valleys, the scouring action of the water being probably increased by a gradual elevation of the land. Then followed a long period of subsidence, which caused a decrease in the grade of the rivers, and, instead of wearing their beds deeper, they began to deposit their burden of detritus, and thus the old valleys became filled to a considerable depth with gravel, sand, &c. As the land subsided the sea naturally encroached further and further inland, and remains of Tertiary marine beaches are found on the slopes of Mount Cameron and elsewhere. At the close of this period of subsidence there was a period of great volcanic activity, when showers of ashes and streams of lava were poured forth, which filled up the valleys and diverted the streams from their courses. Then the land rose again, probably slowly and gradually, and the rivers began to carve out fresh channels following the general direction of the older streams, but sometimes cutting right across them, as in the instance under consideration. Here we have a deposit of gravel and sand, in places over 150 feet thick, which has been buried beneath a thick covering of volcanic ashes and basaltic lava to a depth of over 150 feet, and so preserved from denudation except where cut through by the modern streams. It is evident that there were several outbursts of lava at considerable intervals, as we find layers of gravel with basalt below and above.

The wash consists almost entirely of quartz, ranging from pebbles the size of sparrows' eggs down to fine sand. Colourless topazes are not uncommon, and black spinels are frequently seen. These latter are sometimes mistaken for tin-ore, but may be readily distinguished by their superior hardness and lower specific gravity. In the lower drifts, as proved by boring, there is a good deal of carbonaceous matter, and pieces of lignitized and silicified wood are sometimes found in the basalt. Occasionally there are layers of pug or clay, and in places the gravel is so cemented together with silica and oxide of iron as to require the use of dynamite to break it. This is particularly the case in the Briseis workings, of which further mention will be made later on. The bed-rock, wherever exposed, consists of coarse grayish granite with large porphyritic crystals of felspar, which weathers very rapidly. A good deal of the wash has been formed from the direct disintegration of the granite, which probably carries a little tin throughout, but much of it is coarser than the quartz seen in the granite, and has doubtless come from quartz lodes; but the tin-ore is as a rule fine, and I have not heard of any specimens being found with quartz attached. In several places, however, I noticed small veins of quartz traversing the granite, and the discovery of some rich tin-bearing lodes has lately been reported near the head of the Cascade River. The mines at present working on the Cascade Lead are the Krushka Brothers, New Brothers' Home No. 1, and Briseis on the south side of the Ringarooma, and the Brothers' Home Extended on the north.

Brothers' Home Mine.—This is a private claim owned by Messrs. Krushka Brothers, to whom is credited the first discovery of tin in this locality. It is contained in Mineral Section 316, of 80 acres, extending from the Ringarooma River in a southerly direction up the lead for a distance of about 35 chains, bounded on the south by the New Brothers' Home No. 1 Mine, and on the east by the Briseis.

For some distance up the lead from the river there was comparatively little wash above the drainage-level, the present river having cut out and sluiced away a large piece of the old lead; but there is a considerable depth untouched below this level, borings on the North Brothers' Home (now Brothers' Home Extended), on the opposite side of the Ringarooma, having proved the bottom of the old channel to be over 70 feet below the present river. For about 20 chains from the river the gutter runs in a south south-westerly direction, when it takes a sharp bend round to the S.E., and the ground gradually becomes deeper, the present face being about 280 feet high, of which about half is basaltic overburden and half drift. The upper part of the face consists of decomposed basalt, which is succeeded by about 50 feet of hard columnar basalt resting on a thick layer of basaltic tuff. The bottom of the face is close up to the southern boundary, and only a comparatively small patch remains to be worked in the south-eastern corner of the section. It will be impossible to work out the whole of this without bringing down very heavy falls of basalt from the Briseis and New Brothers' Home No. 1 Companies' properties, and encroaching on their top drift. The hill above the face is seamed with cracks caused by the subsidence, due to the underground workings of the adjoining mines, and as the gravel is sluiced away from the bottom occasional big slips of the basaltic overburden take place. These slips always give good warning, and, as there is a good get-away for the men, there is very little danger with ordinary care. The boundary-line between this claim and the No. 1 is marked by a wire stretched from the top of the cliff, the original surface having long since disappeared. Much of the basalt is so decomposed as to be readily broken up by the jet of water from the nozzle, but the more solid stones have to be carted away some distance to be dumped. The tail-race has been brought up as flat as possible, and Mr. Krushka informed me that it was only about 6 feet above the actual gutter at the face, so that there must have been a great fall in the old channel between this point and the river. Owing to the silting up of the river at the outlet, it is difficult to keep the tail-race clear, and a sort of plough is occasionally dragged along it with good effect. The top 50 feet of drift are very poor in tin, and not considered payable, but towards the bottom it becomes much richer, and the last 20 feet are very good. This is only as might be expected, for when the lower gravels were being laid down the channel was comparatively narrow, and the velocity of the stream was such as to carry the lighter gravels forward and admit of some concentration of the tin ore. As the land subsided the stream became wider, its velocity was consequently decreased, and, being overloaded, it would deposit its burden much more rapidly, the carrying power of a stream being reckoned to vary as the sixth power of its velocity. The upper gravels would therefore represent a considerably less degradation of the surface than the lower ones. In the gutter itself are found large boulders of granite (generally decomposed), and round these the drift is usually exceptionally rich.

Both the eastern and western reefs (a "reef" is the miners' term for the sloping bed-rock) are exposed a short distance from the face about two chains apart, and the gutter appears to be turning more to the south.

The top part of the race is cleaned up about once a month, and the rich sand is carted a short distance to the tramline, tipped into trucks, and run down to the tin-sheds near the river, where it is streamed in boxes, dried, and bagged. No figures of the output prior to 1883 are available, but from 3rd July of that year up to 31st March, 1899, 3791 tons 11 cwt. of tin ore, assaying about 74 per cent. of metallic tin were obtained,—a magnificent result, considering the area of the ground worked, and very encouraging for the working of the deeper gravels higher up the lead. The present output is about 10 tons per month.

New Brothers' Home No. 1.—This company possesses an extensive property of 220 acres, but the main workings are confined to Section 554 of 80 acres, situated immediately south of Krushka Brothers' claim. It was originally worked from a main inclined drive by drifting and blocking out successive layers of the washdirt, and in this way a block of ground from 40 to 50 feet deep, about 700 ft. long, and up to 300 ft. wide, extending to the Briseis boundary, was worked out. This system of working such a large body of drift is very expensive, owing to the immense quantity of timber required and the cost of hauling the dirt to the sluice-boxes, and it is impossible to work out the whole of the ground. A good profit was, however, made for some time, and the bottom of the gutter had not been reached when underground operations had to be suspended owing to the damage caused to the Briseis Company's main tail-race drive. A start was then made to strip off the heavy basaltic overburden, and an immense qnantity of solid basalt was removed by manual labour, the softer portions being broken up by the hydraulic jet and sluiced away, but the old tail-race was too high to command the best of the drift. By arrangement with Messrs. Krushka, a new tail-race about 34 chains in length has been constructed through this section, striking the western reef near the boundary between the two sections, and most of the wash lying on the western reef, from which the overburden had been previously removed, was sluiced through this. The drift treated yielded about 3 lbs. of tin ore to the cubic yard, although much of the best of it had been previously blocked out, and sluicing was much hampered by the timber of the old drives. Further to the east, towards the centre of the lead, very good seams of tin ore are showing, the

best of it being below the present tail-race, which is about 35 feet above the bottom of Messrs. Krushka's face, but it would be impossible to work this at present without bringing down large falls of basalt into the Krushkas' workings. Last year tenders were invited for removing 100,000 cubic yards of the overburden, and an offer was made to do this for 1*s.* per yard, but the tender was not accepted. Over the centre of the gutter there is about 140 feet of overburden, a large part of which is solid columnar basalt, but the hill slopes towards the western reef, and on this side the basalt is more decomposed. A cut is now being made through this to the south, the stripping being removed at the rate of about 2000 cubic yards per week, which Mr. Whittle, the manager, informed me cost only about *5d.* per yard. This will probably uncover a good deal of payable drift, but the best of it will still be inaccessible. The stuff is first broken down by a giant nozzle with a pressure of over 200 feet. The solid stones are separated out by a large perforated plate placed in the tail-race and sent over the tip, the smaller stuff being carried down the tail-race and discharged into the river, and the largest stones, which are too heavy to be moved by the water, are trucked from the face, but operations are very much hampered for want of a convenient dumping ground. There is still a point of drift carrying very good tin remaining on the western reef on Messrs. Krushka's ground near the boundary, and if this were removed there would be good dumping-room for a long time to come. Some time ago an offer was made to the No. 1 Company allowing them to sluice away this gravel on condition of giving up half the tin, but the offer was refused ; now, Messrs. Kruskha require all the tin, and, as a convenient dumping-ground is absolutely necessary for economical working, the No. 1 Company would do well to accept this offer. One great drawback to this company is the want of an adequate and permanent water supply. At present the main supply is drawn from what is known as the Cascade Water Trust Race, belonging jointly to the No. 1 and Briseis Companies. Under an agreement between the two companies, when the water in the race exceeds 16 sluice-heads the No. 1 is entitled to receive and use 8 sluice-heads and the Briseis takes the balance, but when the water in the race falls below 16 sluice-heads the No. 1 Company is only entitled to 8 heads for 16 hours in each day, viz., from 4 o'clock in the afternoon till 8 o'clock in the morning, the Briseis Company being entitled to the excess over 8 sluice-heads during these hours, and to the whole of the water in the race during the remaining 8 hours, from 8 in the morning till 4 in the afternoon. The Kruskha Brothers have a prior right to 5 sluice-heads lower down the stream, and, consequently, when the available water in the Cascade River falls below this neither the Briseis nor No. 1 get any. The Briseis Company pays two-thirds and the No. 1 one-third toward the maintenance of the race, rents, &c. The No. 1 Company has lately applied for a water-right of 15 sluice-heads from the Ringarooma River, which, it is estimated, can be brought in in a race about 16 miles long. They have also applied for 8 sluice-heads at the junction of the Cascade and Ringarooma Rivers, and it is proposed to pump the water up to the mine. A Tasmanian sluice-head, it may be mentioned, is the quantity of water passing through an aperture 16 inches wide and one inch deep in the outlet, and of a horizontal gauge-box 12 feet long when the surface of the water is six inches above the centre of the aperture, and is approximately equivalent to 150 gallons per minute. To the south of the main workings there is good tin showing in shallow wash belonging to a more recent deposit along the courses of several small creeks, but the only outlet for the tailings at present is through the Briseis Company's main tail-race, and the ground cannot be worked without the consent of the latter company.

Briseis Mine.—This property, comprising Sections 452, 453, 454, 455, and 627, with a total area of 178 acres, is bounded on the west by the Krushka Brothers claim and the New Brothers' Home No. 1 Mine, and on the south by sections belonging to the latter company. It embraces the whole of the upper end of the lead, the granite which forms the rim rock on both sides of the original channel outcropping within the company's boundaries for over half a mile in length, and the lead runs out altogether in Section 454. Owing to its position it has been a very expensive mine to open up, the total expenditure up to date being approximately £190,000, and the tin-ore obtained up to 31st March, 1899, yielded 730 tons of tin, worth £51,293. The natural outlet through the Krushka's claim being precluded, it was necessary to drive a tunnel through the rim rock to tap the lead. This was started in November, 1884, and driven about 1200 feet through solid granite to the edge of the lead, and thence continued in the drift a further distance of nearly 1100 feet. From the mouth of the tunnel to the river there are over 10 chains of fluming, so that the total length of the tail-race is about 3000 feet. The tunnel, which is about 8 feet wide and 6 feet high, runs for the first 1000 feet in a S.S.E. direction, but the edge of the lead not having been reached where expected, it was curved round to the S.S.W. until the drift was cut. It was originally intended to open out here to the surface, and at the same time to continue the main tail-race drive in a south-easterly direction to what was known as the ABC Flat, where the overburden was much lighter, the greater part of the basalt having been denuded by natural agencies. With this object, stripping was started on the northern side of the main basalt hill to the east of the Krushka's workings, and a very large quantity of basalt was removed ; but, owing to the deviation in the tunnel, the point where the edge of the lead was struck was only about a chain from the western boundary of Section 455, and as the stripping at the highest point would be nearly 150 feet deep, it was decided to abandon this for the present and concentrate all the water-power in stripping a large area on the ABC Flat and open out there. Near the top of this northern stripping face a layer of gravel, mixed with basaltic clay, is seen, which is said to carry a little tin, and drift at a

corresponding elevation is found at several places further south, where the top layer of basalt has been denuded. These gravels were laid down during a period of quiet before the last outbursts of lava, which finally diverted the river from its course. At the end of the rock tunnel a large chamber was cut in the granite in which sluice-boxes were set, and a good deal of driving was done in the wash, but most of the old drives have been filled in, and it is difficult to see what they disclosed. Much of the drift was very fine, and the drives had to be very closely timbered to prevent it running.

The following particulars of the work done are largely taken from old plans and the half-yearly reports kindly placed at my disposal by Mr. Edgell :—

It was intended to keep the main tail-race along the eastern edge of the lead, and a large drive was started from the end of the rock tunnel in soft granite, bearing about S.S.E., but after going about 250 feet in this direction it was found necessary to curve the drive round to the south on account of meeting a spur of hard granite, and it was finally abandoned at 318 feet, the end being all in granite. This is probably the continuation of the granite which outcrops on the surface further south, near the old locomotive shed, and runs thence in a south-easterly direction, forming the eastern reef of the main lead. To the east of this old tail-race drive connection was made with the surface by means of an inclined drive about 470 feet long, which is still open, and is used for taking timber, &c. into the tunnel. It is said to have been driven all in drift until the basalt was reached, and it is most probable that this belongs to a branch lead coming in from the south-east.

A rise was put up 10 feet above the tunnel-chamber, and a horizontal drive carried to the south at a distance of about 55 feet from the western boundary of the section, to which several short crosscuts were driven in the wash. Granite bottom was touched at 560 feet, and a drive was then brought up to join on from the floor of the chamber on a rising grade of 2 feet to the chain, and continued with this grade in a southerly direction, bearing round to S.S.E. along the edge of the lead to connect with a shaft sunk at the lower end of the flat. The wash-dirt obtained from these drives and crosscuts is said to have averaged about one per cent. black tin, but at the lower level several bands of cement were met with. Communication having been thus established with the surface, the work of opening out was begun by sluicing away the gravel round the "dump shaft," a large paddock having been previously stripped of the basaltic overburden. A branch from the main tail-race drive was also driven over 300 feet, and connected with a second "dump shaft," lying about 200 feet south of No. 1. In this way a very large excavation was made, but unfortunately it was found that overlying the drift at this part there was a layer of hard cement, in places as much as 15 feet thick. This had to be broken up with hammers, or by means of explosives, and as it could not be sluiced down the tail-race it had to be stacked out of the way, largely increasing the cost of working, besides considerably hampering sluicing operations. Beneath the cement at the No. 1 shaft there was about 70 feet of free drift, the top portion of which was almost barren of tin; but it improved with depth, and below this there were alternate layers of cement and free drift for about 19 feet to the bottom. For some time the lower cement formed the sluicing-level, but eventually an open cut was made through this down to the level of the tail-race drive, and at the head of this the sluice-boxes were set. This is the lowest point which can be commanded by the present tail-race drive, but prospecting shafts have proved that the gutter of the lead is at least 20 feet below this. The cement bands were doubtless formed by chalybeate waters, brought down by several small creeks which joined the main stream from the south and west, and as work advanced up the lead they gradually cut out, but similar bands are likely to be found at intervals higher up the lead. The cement contains a little tin, and also a little cobalt mixed with oxide of manganese in the form of asbolite, but is not rich enough to pay for crushing.

Sluicing the tin-drift was started in 1890, and has been carried on since then with frequent interruptions, owing to insufficiency of water. To economise water, and expedite the removal of the overburden, a complete steam-stripping plant was purchased early in 1891 at a cost of over £4000; but this seems to have been more or less of a "white elephant," and the money would have been much better spent in augmenting the water supply.

From the boxes the eastern, or rather the northern, reef—for the gutter runs nearly east for some distance and then bends round to south east—has been laid bare for about 13 chains in length; and to the south the overburden has been removed to an average width of about a chain and a half for a length of about 9 chains, the portion stripped running approximately east and west. The basalt varies from 30 to 65 feet in thickness along this face, but becomes thicker to the south and east. It is partially decomposed, and is readily broken up by the jet from a 4-inch nozzle under a pressure of about 220 feet, most of it going down the tail-race, but occasional undecomposed kernels occur which have to be shifted by hand, and from surface indications it seems probable the basalt becomes more solid going south. Immediately under the basalt is a layer about 10 feet thick of stiff pug or clay quite free from grit, which is more troublesome than the basalt: the water simply bores holes into it, and it has to be broken up small with picks or mattocks before it can be sluiced away. Partly surrounded by the pug and resting on the drift, I noticed in places large boulders of rotten granite, some of them as much as 20 feet in length. It is quite impossible that these could have been brought into their present position by the action of the water, the presence of the pug showing that at that time the water was very still. Probably prior to the outpouring of the basalt there were extensive earth tremors, and these boulders rolled down from

the surrounding hills, which at that time were considerably higher than at present. Similar boulders are seen in the lower part of the Cascade River, and on the steep sides of the valley there are numerous boulders of all sizes up to huge tors, which are simply the result of the weathering of the granite.

At the time of my visit a low level tail-race, 6 feet wide, with a fall of 2 feet 6 inches to the chain, was being constructed, which will command about 50 feet of drift at the point where it is intended to start sluicing about 4 chains from the boxes. Just below this point a large quantity of basaltic *débris* and tailings was passed through, filling up a paddock which was lifted by a former manager. No particulars are available as to the size and depth of the paddock lifted, but the drift is said to have been very rich, and over 100 tons of tin ore were obtained from a small paddock.

The drift shows frequent instances of false or current bedding, pointing to the fact that it has been laid down in shallow water. The top 30 feet are very poor, but it gets richer going down, and in places near the bottom of the face very rich seams of tin-ore can be seen. These, however, are very wavy, and cannot be relied upon to continue far in any particular direction: thus it happens that a face may be showing very rich dirt, and a few feet further in on the same level the drift may be quite poor, and *vice versâ*, so that it is extremely difficult to form an estimate of the average value of the drift. A large portion of that already sluiced yielded only from 1½ to 3 lbs. of black tin to the cubic yard, but at the present high price of tin, even this low yield should give a good profit, and there is reason to expect that the drift will be richer towards the head of the lead. The present local quotation for tin-ore is 20*s*. per unit, the London market price for Australian tin being £117 10*s*. per ton. The ore from all the Derby Mines is very uniform, and can be readily dressed up to 74 per cent. tin without much loss. Thus the dressed ore is at present worth £74 per ton in Launceston, or, allowing 30*s*. per ton for cartage to Scottsdale and railway freight from there, £72 10*s*. on the mine. This is equivalent to about 7¾*d*. per lb., so that a yield of even 1 lb. to the cubic yard should more than cover the cost of stripping and sluicing. This is of course not taking into account the drift below the level of the present tail-race drive, which wherever tried has proved very much richer than the upper layers, and in this lies the wealth of the mine. Probably the best way to work this would be by hydraulic elevators, but before this is started, it would be advisable to get well ahead with the sluicing of the upper drift down to the lowest level possible by the present tail-race drive, and then sink a series of prospecting shafts or bore holes across the lead to ascertain the position and average inclination of the gutter, which at present can only be guessed at. The stripping must be kept well in advance of the sluicing, which should go on night and day, and for this purpose a better water supply is absolutely necessary. Until recently the main supply was drawn from the Cascade Trust Race, under the conditions explained in speaking of the New Brothers' Home, No. 1 Mine, and in dry seasons work had sometimes to be almost entirely suspended for several months. Last year a race over 6 miles long, carrying about 12 sluice-heads, was constructed from Main Creek, at a cost of about £2600, and the water is conveyed to the face by a 20 inch column, 29 chains long, under a head of about 230 feet. This has proved of great assistance, but cannot be relied upon in the summer. Some ten years ago a survey was made for a race to bring in 60 sluice-heads from the Ringarooma River, a distance of 22 miles, at a cost of £22,881, but it is said that the race could be shortened 8 or 9 miles by cutting a short tunnel through a ridge, and brought in at a considerably higher elevation, which is of great importance owing to the extra pressure gained for stripping and elevating purposes.

At present there is only one stripping nozzle at work, which discharges into the Cascade River by means of a tail-race cut through the intervening granite ridge. This should be deepened so as to command the whole of the stripping, it being necessary at present to send the bottom 12 to 15 feet down the main tail-race, which should be reserved entirely for tailings.

An electric light plant with several arc lamps is also required, and would greatly facilitate work at night. The dynamo could be worked by water, which could afterwards be used for flushing the main tail-race. With several faces constantly going, and the consequent larger quantity of water and tailings, it would be necessary to enlarge the fluming in the upper part of the tail-race drive, and the drive could be straightened with advantage. The rock tunnel has a very uneven grade. It is too wide for the present water supply, and has to be carefully watched to prevent it silting up; but this would be obviated by a larger water supply.

South-east of the present workings the ground rises for some distance, and provision will have to be made for the removal of considerable quantities of solid basalt, which here forms the capping. A good deal of work was done by tributors some years ago all over this hill on the later drift, much mixed with basaltic clay, which is found enclosed in the basalt. Occasional patches of cement are seen, and it may be expected that this will be also found in the lower drift underlying the basalt. To the east of the hill is a flat four or five chains wide, separated by a ridge of granite from the present Cascade River, which here runs in a general north-westerly direction on the bare granite. Two prospecting shafts were sunk on this flat about a chain apart over twelve years ago, and are said to have passed through very good tin drift. The first shaft bottomed at 69 feet, and passed through 26 feet of drift, 16 feet of which was estimated to contain 20 lbs. of ore to the cubic yard. The second shaft reached a depth of 100 feet without touching bottom, when water became too heavy to sink further. It passes through 3 feet of cement and 53 feet of drift (including 13 feet soft granite boulder), and the bottom, 46 feet, was estimated to average 40 lbs. of ore to the cubic yard. These figures are taken from the company's half-yearly report for the half-year ending 30th November, 1889, the shafts being now full of water.

Four or five chains further east the basalt cuts out altogether, and the bare granite crops out all round, so it is obvious that there must have been a very abrupt fall in the original stream at this point. The only outlet for this drift is down the old gutter, but it will be many years before the workings advance thus far. Lower down the Cascade the valley widens out, and the shallow modern deposit of the present river has been worked in places several chains in width. For some distance the river has been flumed to act as a tail-race; in places towards the lower end of this it appears to run on a false bottom, and it is quite likely that drift will be found beneath this belonging to the branch lead before mentioned as joining the main lead from the south-east. It is not likely, however, to be very deep here, as the distance between the solid granite outcropping on either side is only three or four chains in the widest part, and this rapidly decreases going up the stream, but further west there is a flat several acres in extent, bounded on the west by the main basalt hill and on the south by the ridge of granite mentioned as outcropping near the old locomotive shed. This flat is covered with a recent deposit of tin-bearing wash, and the surface has all been worked over, and yielded a good deal of tin; but, as far as I could learn, the bottom was never reached, and as there is likely to be deep ground here, it would be well worth while testing by boring or sinking.

It is a great pity that arrangements could not have been made at the first start to amalgamate with the Krushka Brothers and No. 1 Brothers' Home Company, as this would have been to the mutual advantage of all three, and large sums of money would have been saved. The Briseis, however, has at last, after many difficulties, obtained a fair start, and with an adequate water supply and systematic work should be a regular producer of tin-ore for many years to come.

I have the honour to be,

Sir,

Your obedient Servant,

J. HARCOURT SMITH, *B.A.*, *Government Geologist.*

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

ON MESOZOIC DOLERITE AND DIABASE IN TASMANIA.

BY W. H. TWELVETREES, F.G.S., AND W. F. PETTERD, C.M.Z.S.

THE following Notes lay no claim to be an exhaustive description of our familiar "diabase" or "dolerite" rock, which plays such an important part in the geology and physical configuration of our Island. The present object is rather to place upon record some inferences drawn from the examination of numerous microscopical sections of specimens collected or received from all parts of Tasmania. It is by accumulating the results of observations that stepping stones are formed to more complete knowledge. A glance at Mr. R. M. Johnston's geological map of Tasmania, issued by the Lands Office, will show the share this rock takes in the structure of the Island. It occupies the whole upland area of the Central Tiers. On the northern face of the Tiers—the Western Tiers as they are here called—there is a tongue of the rock prolonged northwards past Mount Claude. At their north-west corner it forms or caps mountains, such as Cradle Mountain (the highest in Tasmania), Barn Bluff, Mount Pelion West. Eldon Bluff forms a narrow western extension. Mount Sedgwick is a western out-lier; Mount Dundas another. In that part of the island it is also found at Mount Heemskirk Falls, and on the Magnet Range, two miles north of the Magnet Mine. Mounts Gell and Hugel are also western out-liers. Its south-west boundary is Denison Range, with Mount Field West, Mount Mueller, and Mount Picton. Southerly we find it in the Hartz Mountains; the rock goes down to the south as far as the Rivers Huon and Esperance, and even further south it is found on the isolated peaks of La Perouse and Adamson's Peak, and a narrow fringe of it runs along the coast-line south of the Huon to South East Cape and South Cape. On Bruni Island it is present in a very massive form. It is found on Tasman's Peninsula, and in the whole of the south east of the Island it cuts up the sandstones and shales of the Permo-Carboniferous and Trias-Jura country. Mount Wellington and other heights near Hobart have summits composed of this rock. From the eastern side of the Central Tiers it is continued to the Eastern Tiers and the hilly ground from Swansea northwards to St. Mary's. Ben Lomond, the Mount Nicholas Range, Tower Hill, Mount Victoria, and Mount Saddleback are north-east out-liers fringed with Permo-Carboniferous and Jura-Trias. The northern extension passes under the sands and clays of the Launceston Tertiary basin, and re-appears along both sides of the River Tamar. It extends to Mounts Barrow and Arthur and Ben Nevis. There is an isolated patch of it at the mouth of the Mersey and at Port Sorell. On the East Coast it abuts on a fringe of granite on Maria Island, Schouten Island, and Freycinet's Peninsula.

A peculiar feature is the almost invariable association with it of Permo-Carboniferous and Trias-Jura beds. The whole periphery of the area forming the Central Tiers is fringed with a narrow zone of these beds, and the same holds good in the case of all the isolated peaks. How can this association be explained? It has been suggested that dolerite capping has protected underlying sediments, and that the latter do not merely hang on the flanks of the igneous table-land, but actually lie beneath the eruptive capping, as the lower formations would do in the case of a sill. The few boring trials which have been made in different parts of the Island lend no support to this suggestion. They have been made through the Permo-Carboniferous and Trias-Jura beds, and traversing these, have penetrated into the dolerite below. On the other hand, no trial has been made of boring through the dolerite at surface with a view of reaching the coal measures: as a matter of fact, we do not know whether the rock on the Tiers is a denuded intrusive sheet, concealing sedimentary rocks below it, or whether it is a vast eruptive mass *in sitû*. The thickness in other parts of the island makes it difficult to believe that it is an intrusive sill. The thickest sill we can find mentioned in geological literature is the sill of basic rock in the Shiant Isles, off Scotland, described by Sir Archibald Geikie* as showing a sea-wall 500 feet high. But even this surprising thickness falls below the development of the massive rock which occupies the upper part of Mount Wellington. At the same time numerous minor intrusions in the form of dykes penetrate the Permo-Carboniferous and Trias-Jura sedimentary beds, so that we have two rather clear types of occurrence. Mr. R. M. Johnston places the geological horizon of this rock at the close of the Trias-Jura system, and we have no doubt in this his opinion is approximately correct. The rock has never been found *in sitû* in any of our Tertiary beds, which, however, do contain included fragments of it. The microscopical appearances of specimens from widely distant parts of the island also support the inference that the rock all over the Colony belongs to one and the same geological age. In one instance we have noticed microscopical fragments of the dolerite (diabase) included in Tertiary olivine-basalt. This occurs near Bothwell, where the basalt probably has entangled in its flow loose pieces of the older rock.

Its mineralogical constitution is rather simple, as will be seen from the following list of constituents:—

Essential.	*Accessory.*	*Secondary.*
Plagioclase.	Olivine.	Chlorite.
Augite.	Apatite.	Serpentine.
	Ilmenite.	Actinolite.
	Magnetite.	Scolecite.
	Pyrite.	Calcite.
	Mica.	
	Quartz.	
	Oligoclase. (?)	

MICROSCOPICAL CHARACTERS.

Plagioclase-Felspar.—The sections are lath-shaped, in short or long laths, sometimes in tabular forms. Of course, it must be remembered that these sections only give us a view of one particular plane, and convey to the mind, merely inferentially, the image of the solid crystal. The felspars could not be called lath-shaped; lath-shaped sections are all that is meant. Out of so many sections it is surprising to find how few are available for measurements of the extinction angle. For this purpose only such twins can be selected as give approximately symmetrical extinctions on opposite sides of the trace of composition plane. The twin forms are Carlsbad and Albite. We have seen none on the pericline type. If we take the haphazard sections of felspars in this rock, we shall find some giving low, some high, angles. The low-angled ones are probably those parallel to the base; the high-angled ones parallel to 010, and the maxima of extinctions are given by the latter. The highest angle we have noticed is 42°, but, as a rule, angles of 30°, 32° are obtained. From this the felspar may be inferred to be labradorite and labradorite-anorthite.

* Quarterly Journal Geo. Soc., 1896, p. 375.

Augite.—The augite crystallises after the felspars, sometimes enclosing them, sometimes wrapping them partially round or moulding itself on their ends. This gives rise to the structure called ophitic or diabasic. The structure has been surmised to have originated in rocks which consolidated under hydrostatic pressure, for instance, beneath the ocean; but this is purely hypothetical, and does not account for the same structure in the middle of thick subaerial lava flows. The augite is nearly colourless, or of an extremely light-brown tint; never the violet tinge which characterises the augites of Tasmanian Tertiary basalts. This colour character is occasionally rather useful in distinguishing the mesozoic from the Tertiary dolerites. Where the augites are fragmentary and small and the felspars much reduced in size, and the rock assumes an intersertal structure, as at Killafaddy, Tasman Peninsula and some other localities, doubt sometimes arises, on inspection of microscopical slices, as to whether we are looking at dolerite or basalt. In such cases the absence or rarity of olivine, which at most only occurs sporadically in the Mesozoic rock, is a useful guide. The Tertiary basalts of the island invariably contain a plentiful amount of olivine.

The augite has not been converted into diallage. Twin crystal sections, parallel to the clinopinacoid, exhibit fine oblique striæ, which must be parallel to the basal plane, and not the orthopinacoidal lamination of diallage. In sections parallel to the orthopinacoid the striæ are at right angles to the vertical axis.

Olivine.—This is not an abundant accessory. From most parts of the rock it is entirely absent. When it does occur, as at Killafaddy, Ross, Hobart, Bothwell, West Devonport, &c., it appears to be idiomorphic. It is then one of the early minerals in the rock, most likely second in point of time only to the apatite and iron ores. It appears preferentially in the finer grained varieties and those which show an approach to intersertal structure.

Apatite.—Occurs as slender needles in the felspars and in the unindividualised groundmass when this is present.

Ilmenite and Magnetite.—The iron ores in most diabases are ilmenite and titaniferous magnetite. Ilmenite cannot be recognised in our rock in any definable forms, though many of the shapeless grains may be that mineral. On the other hand the forms of magnetite can be discerned very well. In a section of the interesting rock at the Hobart Railway Station, which is of a porphyritic nature, a very fine magnetite cross is visible. This is an embryonic crystal with two axes at right angles to each other, neatly marked out by octahedral grains of magnetite growing end to end and forming a cross of singular symmetry and beauty. The iron ore is very plentiful in this variety, forming skeletal crystals everywhere. It is, as a rule, abundant in the varieties which possess any interstitial groundmass. In the holocrystalline descriptions it is present in larger grains or crystals, but in very small quantity, and from the ferriferous borders of many of the augites, it is reasonable to suppose that the iron in the rock has been largely utilised in that way.

Quartz.—This is an unexpected mineral in rocks of this class, but we have found it microscopically intergrown with felspar (granophyric intergrowth), in a piece of dolerite from the top of Mount Faulkner, kindly furnished by Mr. R. M. Johnston. Under such circumstances it must be an original constituent.

Mica.—A very little light brown biotite occurs in the Launceston dolerite at the Cataract Gorge, and at the place on the Elphin Road where the rock crops out opposite Mr. Thomas Corbett's grounds. The mineral is not associated with any chloritic products, and appears to be original.

Actinolite.—Needles of this mineral are to be found in the rock at the Railway Station, Hobart, and this is the only locality where we have observed it. It is rather strange that no hornblende is noticeable in any of our specimens, as it is not at all uncommon in the Swedish Hunne diabase, which structurally resembles many of the Tasmanian occurrences.

Chlorite.—This substance is now universally admitted to be only a secondary constituent of diabase, and to be of no value in classification. Rosenbusch traces it to the weathering of the augite mineral. Many Tasmanian dolerites are perfectly fresh, but others contain a green chloritic mineral between the felspars, and even in the felspars themselves. In some the augite has been entirely replaced by fibrous chlorite, and the rock would be called diabase by many English petrographers. Still this chloritised dolerite is not a separate geological unit, but forms part of the mass of the fresh rock, and has doubtless received its character from the purely local action of ordinary meteoric agencies. This fact suggests the old question of dolerite versus diabase. Dogmatism is inadmissible here. The consensus of petrographical opinion must be allowed to prevail.

Calcite.—This occurs in small quantities, *e.g.*, in the Organ-pipes of Mount Wellington.

Serpentine.—There is a little yellow serpentine in the olivine-dolerites, resulting from the decomposition of olivine.

Scolecite.—This zeolite is occasionally found coating the joint planes and faces of the rock at the Cataract quarry, Launceston, in white radial aggregates. It is a hydrous aluminium and calcium silicate, which has been reported from cavities and fissures of widely differing rocks, basalts, dolerite, granite. It is of no particular importance as a rock-forming mineral, but forms interesting specimens from the mineralogist's point of view. It is apparently a decomposition product originated by the access of meteoric waters.

Groundmass.—This occurs sparsely in most varieties between the angles of the felspars, and sometimes forms irregular patches in the rock. In the Hobart Railway Station rock it is in sufficient quantity to produce a porphyritic facies. It mostly forms an imperfectly individualised mass, comprising skeletal and embryonic felspars, magnetite grains, &c. Its character is well displayed in Mr. Teall's figure of sections of the High Green plagioclase augite dyke, Q.J., Geol. Soc., 1884, p. XIII., Fig. 2.

Some of the small felspars in the groundmass of the Hobart rock, and that of Ross, give straight extinctions, and may be oligoclase. The groundmass is holocrystalline felspathic, and has not a basaltic facies. It would appear to indicate that the rock did not consolidate subaerially, but, on the other hand, not very far below the surface. This felspathic groundmass is plentiful in some of the dolerite near Bothwell. The main mass of the rock between Bothwell and The Lakes, despite its general coarseness of grain, has a little of it, and it is not wholly absent from the coarse ophitic dolerite at the dam on St. Patrick's River. It is abundant in a fresh coarse dolerite near Mount Claude, which is also remarkable for containing allotriomorphic felspar. In some varieties the green chlorite has wandered into the groundmass, as at Mount Direction (south), where the rock cotains some olivine.

Besides the ophitic structure, we have another modification found chiefly in the finer grained varieties of this rock, namely, one in which an incompletely individualised or otherwise indistinct groundmass exists in the interstices of the small crystals of felspar, and round the granules or small fragments of augite which are distributed in those interstices. This is the intersertal structure of Rosenbusch. Both ophitic and intersertal structures are met with in basalts. Intersertal basalts are common all over the world: ophitic ones have been described by Judd, from the Western Isles of Scotland. Gabbros also are sometimes ophitic. It would be interesting to know whether the two modifications are characteristic of different geological occurrences; if so, one would expect to find the ophitic structure prevailing in the larger masses of rock, and the

intersertal in narrow dykes. The most can be said of the Tasmanian occurrences is that the intersertal structure is confined to the close-grained varieties.

Parts of this dolerite become converted into diabase by the chloritisation of the augite. Thus a diabase on the Blue Tier (Gould's Country) is a typical occurrence, the whole of the augite, which is ophitic, being changed into chlorite. Some of the occurrences of diabase in the island may possibly be older, but evidence of their age is not yet available. It may yet be shown that some of these altered dolerites are of Palæozoic age; for instance, there is a dyke of diabase near the Hampshire Hills, and near the Bridge on the Arthur River, Heazlewood, is a porphyritic diabase, with ophitic chloritised augite, and a little light brown biotite. The diabase occurring at the Blue Tier may belong to the older series. On the Corinna Road, 8 miles from Waratah, is what appears to be a diabase with intersertal structure. The felspars in it are smaller than usual, and grains of augite occupy the interstices. Both calcite and chlorite are present; possibly this is a melaphyre.

The European types with which the Tasmanian Mesozoic dolerite may be compared, micro-structurally, are the Hunne-diabase of Sweden, and the Kinne-diabase from the Kinne-kulle of that country. The latter rock, as exemplified by one of our slides, exactly corresponds with our typical coarse-grained dolerite. In Sweden it covers Silurian rocks in the form of a sheet. The Hunne-diabase of the Hunneberg, in the same country, and in the same geological position, contains a little bronzite, biotite, quartz, and hornblende, but in structure closely resembles some of our fine-grained varieties.

Many people look at our bold escarpments and rugged faces of "greenstone" and believe that some stupendous eruption ejected the mass from below and poured it over the land in an overwhelming flood. In view of the preceding remarks it is hardly necessary to say that these rocks were never in the form of a lava over-spreading the land in the presence of the atmosphere. They have been undeniably produced by the crystallisation of a magma which was injected or intruded into strata lying below the surface. They have not crystallised rapidly, but under the pressure of superincumbent rocks, which we seem compelled to believe have been carried away by subsequent denudation. There is absolutely nothing to show that they ever succeeded in establishing communication with the surface. If, however, they did, both the pipes by which the magma ascended, and the basaltic flows in which that ascent finally resulted, have been wasted, without leaving a trace behind. The entire absence of mesozoic basalts in the island suggests that these dolerites always were subterranean, and that the faces and cliffs which we now see are subterranean sections lifted for our inspection by one or other of the earth movements, which geological science so often reports.

The names by which this eruptive rock is known are not constant, and the discussion of them introduces us to controversial petrology. The rock is that which is called diabase in Europe and America, and dolerite by most English petrographers. It is a plagioclase-pyroxene rock, with the ophitic (and intersertal) structure which so eminently characterises diabase that it has given rise to the term "diabasic structure." The rocks related to it are, on one side, ophitic gabbros; on the other, intersertal basalts. In former days, if the rock was of pretertiary age, it was called "diabase": if more recent, "dolerite." European geologists, however, reserved the term "dolerite" for the coarse interior part of thick lava sheets. This term is not much used now-a-days by Continental petrographers, and the instances in which it is applicable are considered by them as local and unimportant. But the habit of attributing much importance to geological age as a factor in rock nomenclature has now died a natural death, even in Germany, and the only question at issue is that of convenience. Some general agreement is desirable as to whether the present group should be called dolerite or diabase. English petrographers (with the exception of Mr. Harker) use the group name dolerite, and keep diabase for altered varieties of the same rock. This usage was established by the late Mr. Allport, and has been followed by Judd, Teall, Hatch, Rutley. Mr. Harker alone retains "diabase" for massive sills, dykes, laccolites, &c., and applies dolerite to the less important intrusions of similar rocks. Rosenbusch states that diabase, when fresh, is undistinguishable from tholeites and dolerites: Professor Lacroix, in France, upholds the term diabase as the group name. Looking at the present practice of petrographers all over the world, we see that there is a preponderance of agreement in favour of the term "diabase." The future will show whether English petrologists will agree to surrender their somewhat isolated though thoroughly logical use of "dolerite," and fall into line with their colleagues in other countries. All that can be done at present is to observe the trend of petrological opinion, and if one or other of the terms becomes obsolete, it will be necessary to adopt the one which gains general recognition. Meantime we venture to adhere to the English practice, and call this rock dolerite in its fresh condition and diabase in its chloritised state.

The tertiary basalts of Circular Head, Table Cape, Lefroy, &c., often exhibit a coarse intersertal or slightly ophitic structure, and would correspond with what goes under the name of dolerite in Germany. In point of coarseness such basalts are dolerites. They may be distinguished from our mesozoic dolerite by their abundant olivine, glassy base, and greater freshness.

The discovery of a little auriferous wash in the first and second basins of the South Esk at Launceston has led a few people to believe that the mesozoic dolerite might be gold-bearing; but the fact is that the sand which was obtained contained, besides small flakes and water-worn pellets of gold, grains and crystals of quartz, zircon, sapphire, and ilmanite, all minerals of the granite and slate country in the upper reaches of the river, and must be referred to that source. No useful minerals have yet been found in this rock, and the lodes and reefs of our various mines are all of earlier date. The experience of our miners in this respect has been so uniform that search for ore deposits in the dolerite is invariably regarded as useless.

SUPPLEMENTARY NOTE ON LIMURITE IN TASMANIA.

BY W. H. TWELVETREES, F.G.S., AND W. F. PETTERD, C.M.Z.S.

SINCE we contributed a notice* of the remarkable "limurite" rock occurring on the property of the Colebrook Prospecting Association, N.E. Dundas, and more recently discovered to extend in a more or less broken sequence as far north as the Southern bank of the Pieman River, mining operations have been carried on there continuously, and have invested the occurrence with additional interest from that point of view. Renewed examination of the rock under the microscope, as well as in the field, has resulted in further conclusions along the line of our previous enquiries, and these we now submit.

The mine has been made easily accessible from both Ringville and Rosebery, being situate between those townships. The rock occupies the saddle of a hill about 1500 feet above sea level, has approximately a strike of N.E.–S.W., and has been proved to be metalliferous for at least 100 yards in width. The contained metals are magnetic pyrites, arsenical iron pyrites, copper pyrites, and a small amount of bismuth oxide, the copper combined with small gold and silver contents, giving the occurrence its chief economic value. The published assays of the mixed stuff state the copper contents at from 1 % to 2 %. The Government Analyst is said to have also ascertained the presence of 1 % of nickel and cobalt in the pyrrhotite examined by him.

Geologically, the rock is a dyke or intrusive mass, apparently developed between slates on the eastern side and serpentine on the west. The intrusion has evidently taken place along or near this line of contact, though it would appear to have come up at the top of the ridge through the slates in several branches or bodies, as horses of hard metamorphic slate have been left standing in it, to the annoyance of the miners. A clean contact is formed, near which the slate, a quartzo-felspathic variety, is micaceous, with chlorite and actinolite. Leaving the metals out of consideration, the dyke is composed of monoclinic pyroxene (largely altered to uralite and actinolite) axinite, calcite, datholite, danburite, with a little secondary quartz (?) chlorite and granular sphene, and a little talc in the rock occurring further north on the Clifton property. We are disposed to consider the presence of original hornblende not established. The axinite is in veins and massive patches, and is intergrown with datholite, danburite, and the other minerals of the rock mass. Professor A. Lacroix, in his memoir on the limurite of the Pyrenees, is of opinion that the rock does not belong to a definite petrographical type, as it is variable in structure, and its mineralogical composition differs in different parts of the same mass. This remark applies with unabated force to the Colebrook intrusion, so far as the dyke as a unit is concerned. Looking at it in this way, it is essentially a pyroxenite, which here and there receives the addition of axinite and other boric minerals. Where these minerals are developed the rock becomes locally limurite, a composite rock containing pyroxene and axinite. It is agreed that the axinite resulted from boric emanations, but how these were introduced is matter for speculation. Was the magmatic reservoir below an independent unit in course of differentiation into basic and acid layers at the time of intrusion? Or was this spot on the confines of two reservoirs, and were the boric vapours, which were carried up in the pyroxenic material, escapes, so to speak, from the neighbouring acid basin? Axinite veins are often found elsewhere injected into rocks already consolidated, but in this case it seems clear that the two elements crystallised synchronously. Even in those parts which are veined by axinite we do not think that the veining was later than the consolidation of the mass as a whole, nor that the rock as a whole had emerged from the phase to which both pyroxene and boron vapours alike belonged. One part of the intrusion may very well have advanced a little further in the crystallising process while other parts lagged behind; and one result of this would be the somewhat heterogeneous character of the dyke as a whole, which, in fact, we observe.

That there was a granite reservoir not far off is shown by the tourmaline-quartz porphyry to the west at the South Renison Bell mine, between which and the Colebrook is another occurrence of axinite, in the form of axinite quartz veins, on the West Coast P.A. sections, close to the granite. A slide prepared from this vein rock shows axinite, quartz, and an abundance of leucoxene. It is noteworthy that the axinite is confined to the vein stuff, as in Cornwall, but there is no occurrence of limurite.

Boron vapours, existing in the magma, and evolved during crystallisation, undoubtedly play a part in producing both tourmaline and axinite. In Cornwall both tourmaline and axinite are found in the granite contact zone, while other rocks, sometimes basic igneous ones, have been acted upon by granite with the same results. In the Hartz axinite and tourmaline occur at the contact of granite and diabase, and this led Lossen to correlate these two minerals.† In view of these facts, it seems to us very likely that the Western granite or its elvans and the Colebrook pyroxinite consolidated contemporaneously. Plutonic solfataric processes, which were plainly in operation in the granite area, as shown by the tourmaline and axinite just referred to, may very well have liberated the boron vapours, which, travelling eastwards by easily imaginable channels, arrived at and were entangled in the moving mass which cooled as the axinitic pyroxenite at the Colebrook. The whole question of this occurrence of axinite possesses a special interest for all occupied with the problems connected with the origin of igneous rocks.

Microscopical inspection of the tourmaline-quartz-porphyry at the South Renison Bell mine discloses a groundmass existing as a Mosaic of quartz and tourmaline, which contains porphyritic crystals of quartz and nests of large tourmaline and quartz crystals. There is no doubt as to the tourmaline. Its colour is brownish yellow and blue, often in one and the same crystal, strongly dichroic $O > E$, axis of maximum elasticity $\parallel c$. The tourmaline often enwraps grains of quartz. The quartz contains vacuum bubbles in fluid inclusions in considerable quantity.

Last year a note on datholite as occurring in the Colebrook limurite was submitted by one of us to the society, (‡) and we have since taken occasion to examine this mineral microscopically. In thin section it is colourless, but in polarised light the interference colours are high, comprising the tints of the second and third orders of Newton's scale. The double refraction is slightly under that of augite. In the only direction in which the 001 imperfect cleavage lines

* Proc. Roy. Soc., Tasmania, 1897, pp. 1-6.

† Massige Gesteine. H. Rosenbusch, 1896, p. 103.

‡ Notes on some recently discovered and other minerals occurring in Tasmania. W. F. Petterd, Proc. Roy. Soc. Tasm. 1897, p. 63.

appeared the extinction was straight. No pleochroism is perceptible. The mineral contains microscopical fluid inclusions with moving bubbles, some of which are easily visible with a half-inch objective, other bubbles are stationary.

Another new mineral, which may be added to the list of components of this singular rock, is the boro-calcium silicate danburite, famous for its crystallographic resemblance to topaz. It is disseminated through the stone and abundant on fissure planes in glistening irregular crystal aggregates, looking like quartz ; but with a hackly kind of fracture. It is colourless to pale yellow. Under the microscope the relief in Canada balsam is weak, a little less than that of quartz. It gives allotriomorphic interlocking granular sections like grains of a quartzite, and is of startling limpidity. Its interference colour is low, not above the yellow of the first order. Its only inclusions appear to be needles of actinolite.

On one of our slides we notice in the clear substance of the axinite some pale green sub-spheroidal and polygonal translucent crystals generally made up of rods or fibres somewhat curved, proceeding from the periphery to the interior. These remind one of the decomposition products of borocite called "parasite" by Volger (*), a hydrous magnesian borate. The wavy fibres are suggestive of some of the forms met with in precipitations from a saturated solution, and the phenomena seem to point to the existence of an excess of boric acid in the rock magma.

As the serpentinous and gabbroid rocks at and to the west of the Colebrook must be more ancient than the Colebrook dyke, and if our interpretation be correct, also older than the phrase of activity in the granite basin, it follows that we have here some light thrown upon the question of the age of the granite of the West Coast. We do not now formulate a theory of its age, but simply observe that the limurite rock will probably be found to constitute one of the factors to be reckoned with in settling that question.

* Zirkel, Mik Besch, min und Gesteine 1873, p. 226.

NEPHELINE AND MELILITE ROCKS FROM SHANNON TIER.

BY W. H. TWELVETREES, F.G.S., AND W. F. PETTERD, C.M.Z.S.

WE received recently from the Mines Department some specimens of rocks from the Shannon district, where they had been looked upon as indicating the possible occurrence of tin and gold. Mr. George Allison, of Hunterston, kindly supplemented these, and outlined for us their geological occurrence on that estate, and from his descriptions we are able to indicate broadly the features of the locality. The Shannon Tier forms there a high plateau of mesozoic dolerite which rises a thousand feet above the Permo-Carboniferous country at its base. On the slope below the Tier are small rounded or conical hills of a dark grey, slightly bluish, basaltic rock; and at the base of or beneath the flanks of these is a strange-looking coarse zeolitic rock called locally "tourmaline-rock." This is as much as can be stated at present respecting the geology of this rather remote place. The presence of gold is said to have been established in the tourmaline-rock, but an assay by the Government Analyst did not confirm this.

The locality gives us three varieties of eruptive rock, viz., the Mesozoic dolerite, the so-called tourmaline-rock, and the bluish basalt. We may here anticipate by diagnosing the pseudo-tourmaline rock as nephelinite, and the basalt as melilite-basalt. The geological age of these rocks, so far as can be hazarded without examination on the spot, is probably Permo-Carboniferous for the nepheline and melilite rocks. The dolerite is considered to belong to the close of the Mesozoic era.

Dolerite.—This varies in degrees of coarseness, but is the typical ophitic dolerite which occupies the summits of the Central Tiers, and of numerous mountains in every part of the island. It is a holocrystalline plagioclase-augite rock, structurally diabasic, and sometimes, where the augite is chloritised, merging into diabase. The well-formed prisms of labradorite felspar, sometimes long and slender, sometimes stout and short, are cemented together by the augite mineral; and these two elements have combined to form a non-vitreous massive rock of essentially the same mineralogical constitution as gabbro and basalt, but as regards grain and structure, intermediate between the two. If we could follow this rock to its deep-seated roots in the earth's crust, where the pressure was greater and the process of crystallisation correspondingly slower, we should probably find it existing there as coarsely crystalline gabbro. On the other hand, we must not regard its present surface as in any way its original one. Much of it, as well as all the overlying rock, has been removed by denudation. Admitting its intrusive nature, there are two theories of its occurrence which press their claims for acceptance. Seeing that its internal structure agrees closely with that of diabasic sills, has it spread laterally from fissures covering up underlying rocks, and leaving an exposed surface now owing to the removal of the overlying strata? On this hypothesis, the dolerite on the tiers and the mountain tops is only a capping, and shafts sunk through it would pierce the stratified sediments below. The level contours of the sidimentary beds abutting on the sides or faces of the Tiers, and simulating infraposition, have suggested this explanation, but we have had no demonstration by any actual trial. The enormous thickness of the dolerite is greater than that of any sills known to us.

The second hypothesis is that what we see represents the massive intra-telluric part of an immense body of eruptive rock, which, as a whole, never reached the surface, but which everywhere thrust out lateral dykes, parts of which we can still trace in the coal measures. Either explanation is surrounded with difficulties, which extended observation alone can solve. This doleritic rock is a product of the gabbroid magma; but we now proceed to notice an entirely different class of rocks, those which have issued from what Rosenbusch calls a theralitic eruptive magma. Deep-seated rocks give the key to the relationships of the volcanic ones. Hence in modern petrology the latter are referred to or compared with their plutonic representatives. Theralite is a plutonic nepheline + lime soda felspar (occasionally potash felspar) rock, the deep-seated parent of nepheline and melilite basalts.

Nephelinite.—This is a nepheline-augite rock. A brief examination serves to show that the long black prisms which form such a striking feature are not tourmaline but augite. The interstices between the prisms are occupied by light brown and yellowish nepheline, which has often decomposed and originated snow-white radiated aggregates of the Zeolite natrolite. The proportions of augite and nepheline vary greatly. Sometimes the augite is extremely abundant, otherwise more sparingly distributed.

The mineral constitution of the rock may be stated as follows:—

Essential minerals	=	Nepheline, augite.
Accessory minerals	=	Olivine, sanidine, apatite, melanite-garnet, magnetite.
Secondary minerals	=	Natrolite, serpentine.

Microscopical characters.—The structure is holocrystalline, hypidiomorphic. No groundmass is present. Nepheline, generally, forms about one-half of the entire rock, sometimes more. It gives large sections bounded by rectangular contours, margined with iron oxide, and sometimes penetrated by augite. Its substance is mostly converted into radiating natrolite: some patches, however, remain water-clear. The clear nepheline encloses slender rods of apatite, as well as other needles, which, from their oblique extinction, we surmise to be augite. The natrolite gives beautiful fan-shaped aggregates, polarising in grey, low yellow, and orange colours. The nepheline crystals are often cut up by rectangular cracks.

The augite is in large prisms of green to violet tints, sometimes showing both colours in the same crystal. Its maximum extinction angle measured from the fissure lines is 45°. It encloses prisms of apatite. A prominent element of the rock is apatite in long transversely-jointed rods and prisms, some of which are large enough to be visible to the unaided eye. Olivine is an infrequent accessory. It has crystalline contours, the usual rough-looking surface with irregular cracks, and is associated with some serpentinous material. Some orthoclase felspar is also present in small quantity. Its transparency indicates the sanidine variety.

No one who has seen the familiar slides of the nephelinite (or nepheline-dolerite as it has been called), of Katzenbuckel in the Odenwald, can fail to recognise the same type in slices of this Hunterston rock. The latter is the same rock reproduced in the Southern Hemisphere. The specific gravity of an average specimen was ascertained to be 2·66.

Melilite-Basalt.—Associated with the nephelinite is the basaltic rock of the small conical hills referred to above. This is dark grey compact basalt, with porphyritic olivine and sometimes porphyritic augite. It has a sp. gr. of 3·15,

and dissolves to a large extent in HCl. Microscopically, it is seen to consist of crystals and grains of olivine in a groundmass of crystals of melilite, accompanied by perofskite or picotite. It contains no felspar, neither do we detect nepheline. Nepheline, however, occurs in rocks in such a form as often to be only recognisable by chemical methods, and hence it would perhaps be unsafe to assert its total absence here. The melitite is the most interesting element, as we believe it has not been recorded previously in Australasia. It seems to occur only in one generation, and in thin section yields two forms—the prismatic vertical and the transverse section of the prism. The boundaries of the prism are imperfect, showing crenulated contours, and the elongated sections show a peculiar mid-rib or median line, often beaded, sometimes repeated as several vertical lines when the crystal is broad enough. According to Dana,* the peg structure of melilite, which consists of parallel peg-like inclusions passing from the base inwards, is not always easily seen. We have not seen it in the Hunterston rock, nor in our slices of melilite basalt from the Capo di Bove, near Rome, and from the Hochbohl, Württemberg. The transverse sections of the mineral in our rock have the grey interference colour of felspar, from which, however, they can easily be distinguished by their crenulate contours and isotropism in basal sections. They are mostly, but not always, water-clear, while the longitudinal sections show a prevalent granulation of the substance of the mineral. There is none of the blue interference colour, which is sometimes seen, for instance in the Hochbohl rock. Dana regards melilite as crystallising in lieu of plagioclase, but Rosenbusch† mentions the fact that while augite and melilite exist in the rock in varying proportions, their sum remains constant, and that consequently melilite takes the place of the augite, and not of felspar. He correlates melilite-basalt with the trachydolerite-limburgite series. Short prismatic and granular microlites are abundant; these are probably augite; nevertheless, the structure is holocrystalline. There are numerous minute octrahedra and grains of a highly refractive dark or imperfectly-translucent mineral, which may be spinel or perofskite. In one section we have observed a yellow garnet.

* A Text-book of Mineralogy, E. S. Dana, 1898, p. 427.
† Elemente der Gesteinslehre, H. Rosenbusch, 1898, p. 359.

We have noticed an extremely fine-grained variety in which augite is dominant in the porphyritic form as well as granular. This would appear to be an intermediate or aberrant form tending towards the nepheline melilite basalts.

The families of nephelinite, nepheline-basalt, and melilite-basalt are separated by Rosenbusch decisively from ordinary basalts, with which, he says, they have no sort of relation. He groups the three first-named families genetically together, bound to each other by ties of geological valency and association, and forming an integral volcanic or effusive formation, which (with the trachydolerites, tephrites, leucite rocks, limburgites, and augitites) belongs to theralitic magmas.‡

We may here add that we have not yet detected nepheline in any of the other Tasmanian basalts. The crystals formerly attributed to nepheline in the Tertiary olivine-basalts of Northern Tasmania have always seemed to us to be so invariably associated with longitudinal sections of apatite as to make it probable that they were the hexagonal transverse sections of the same mineral. A similar confusion seems to have occurred with respect to the Tertiary basalt of Phillip Island, Bass Straits. In a letter recently received from Prof. G. H. R. Ulrich, of Dunedin, he informs us that the late Mr. Cosmo Newberry, not long before his death, analysed the so-called nepheline of that rock and found it to be apatite. One would, however, expect nepheline-basalts to be associated with nephelinite, and it is highly probable that the Shannon district will still be found to yield those lavas.

Viewed from a mining point, these peculiar basaltic rocks do not offer anything particularly encouraging. As they are unique in Tasmania, there is little use in comparing them with mineral-bearing rocks in other parts of the island. The few localities in the world where such rocks are known to occur are not noteworthy as mining ones. The rocks are altogether incongruous with the notion of tin ore occurring in them; and though gold is not intrinsically an impossible metal, distributed in excessively small quantities as in some other eruptive rocks, such as the Port Cygnet phonolitic trachytes for instance, yet payable gold is, so far as we are aware, entirely unrecorded from this family of stone.

‡ *Ibid.* p. 352.

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