

TASMANIA.



REPORT

OF THE

SECRETARY FOR MINES

FOR

1902-1903

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



Tasmania:

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## REPORT OF THE SECRETARY FOR MINES.

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*Mines Department, Hobart,*  
27th August, 1903.

SIR,

I HAVE the honour to submit my Report upon the Mines Department, and the progress of the Mining Industry for the year ending the 30th June, 1903.

According to your instructions I have endeavoured to condense the Report on the Industry as much as possible, and have also omitted to publish with this Report the Geological Reports printed and issued during the year.

Although a saving in the cost of printing and publishing the Report will thus be made, the change will be seriously felt by the outside public, libraries, geological and other institutions, which have been in the habit of obtaining for their libraries the Annual Reports bound up in handy form, with the Geological Reports made during the year, as a permanent record of the work of the Department.

Extracts of the reports are made by Geological Societies and the Press in different parts of the world, particularly in Germany, France, and America; which, besides advertising the State's mineral resources and drawing attention to some of the rarer mineral deposits, have been the means of introducing capital for the development of the same.

In order to keep in touch as much as possible with these Societies it will be necessary to have an extra number of the Geological Reports printed as they are from time to time published. The reports are printed in pamphlet form, and are issued gratis. A large number is forwarded to the Agent-General in England for free distribution, and exchanges are made with the principal Mining and Geological Institutions of the world.

#### *General Remarks.*

Tasmania, like the other States, has not yet fully recovered from the mining depression which has existed for some time, and the value of the Minerals and Metals raised during the year shows a decrease of £206,983 as compared with last year.

Notwithstanding this decrease, which was probably owing to the prolongation of the South African war, which prevented the introduction of English capital for the development of some of our extensive tin deposits, the Mining Industry is steadily progressing, and a small rise in the market price of metals would give a great impetus to the Industry, and cause a considerable increase in the value of the output.

A large area of land in the Blue Tier district has recently been taken up on behalf of a Melbourne syndicate, with the object of obtaining foreign capital for the development of the immense tin deposits known to exist there.

Owing to the discovery of payable tin deposits in the vicinity of Heemskirk and Waratah, there has been a considerable revival in mining and prospecting for that mineral in those localities, and large areas of land have been applied for.

This State possesses very large deposits of tin which must be worked upon a very extensive scale to be made profitable,

and this can only be secured by inducing outside capitalists to invest. It is intended, during the present session of Parliament, to introduce a Bill giving security of tenure to leaseholders upon certain conditions, and issuing leases entirely eliminating the labour covenants, upon payment, in advance, of an increased rent for the whole or any part of the lease; and it is hoped that by so doing capital will be obtained for the development of some of the now dormant mines.

The prospects for next year are very bright, and it is expected that the discoveries of tin at Mounts Agnew and Bischoff, together with the recent developments in the Mathinna District, will add considerably to the value of the output.

*Appendices.*

Appended will be found the following Reports and Papers :—

Annual Report of the Mount Cameron Water-race Board.

Mine Managers' Examination Papers.

Report of the Government Geologist.

Report of the Assistant Government Geologist.

Report of the Chief Inspector of Mines.

Reports of the Inspectors of Mines.

Reports of the Commissioners of Mines.

Papers by :—

W. H. Twelvetrees, Esq., F.G.S., on the Trachydolerite in Tasmania.

Professor E. G. Hogg, M.A., on Certain Calcareous Nodules.

Colonel V. Legge, R.A., Contribution to the Physiography of Tasmania.

W. H. Twelvetrees, Esq., on a Geological Excursion to Port Cygnet.

James B. Lewis, Esq., on the Removal of the Overburden at the New Brothers' Home No. 1 Tin Mine.

J. J. Muir, Esq., M.I.C.E., on the Profitable Treatment of Silicious Low-grade Copper Ores.

### *Gold Mining.*

*Beaconsfield.*—This district has given employment to between 500 and 600 men. The output of the field has sustained a temporary check, owing to the abnormal influx of water in the reef channel of the Tasmania Mine in driving the level at 1000 feet. The sinking pumps were unable to cope with it, and the unworked ground above the 818 feet level has consequently had to be exclusively relied upon for production. The Company proposes to provide more powerful pumping plant for developing the mine at the deeper levels. The new main shaft is down to 1100 feet from the surface, and at that level a crosscut towards the reef was being driven when the interruption occurred in August last. The reef at the 1000 feet closely resembles the stone worked in the upper parts of the mine, and winzes are being sunk from the 818 feet level on a good and payable reef. The Company has been approached by financiers in England, who are anxious to acquire an interest in this important mine, and the shareholders have recently authorised their Board to dispose of the mine to a new company with a capital of £500,000, which is practically a re-construction of the present company with the acquisition of £160,000 new working capital. Various engineers of repute have examined the mine, and there is a consensus of opinion that, when the water difficulty is overcome, the mine will resume its former prosperous career.

Since the formation of the Company 495,895 tons of quartz have been crushed, yielding 569,778 ounces of gold (inclusive of returns from chlorination), of the value of

£2,090,938. The dividends distributed have amounted to £772,071 15s.

The outside mines in this district have continued their exploratory work. The Moonlight-cum-Wonder Company is driving on the reef at the 500 feet level with indifferent results so far, the stone, though gold-bearing, being bunchy. Surface or shallow work is also proceeding on the Olive Branch sections of the Company's property, but the good shoots have been very short and irregular.

The Bonanza Proprietary is down 300 feet with its shaft, which is designed to cut the Tasmania reef on its underlay, and has intersected a lode channel carrying visible gold.

The Tasman Ophir Gold Mining Company has carried on work at its mine in the alluvial lead at Beaconsfield, and during the year cut auriferous wash at the 400 feet level. Preparations are being made for deeper work, and quite recently some gold-bearing wash has been found at a shallower level by a prospecting shaft; this can be cut from the level in the main shaft.

The Amalgamated West Tasmania has resumed work during the year. The mine formerly worked by the Tasmania United Company, on the west side of the Cabbage-tree Hill, has been taken up again, and there is some likelihood of the Tasmania West Extended Mine coming again into active work. The country on that side of the hill has been subjected to shallow trials only, and is regarded geologically as worthy of tests at greater depths.

At the Salisbury Tier the Salisbury Gold Mining Company has driven a crosscut level into the hill from its shaft, with a view of intersecting the old Victoria line of lode, at a depth of 150 feet below the former workings.

The Duchess of York Company, on the adjoining property, after obtaining some sensational slugs of gold from its adit workings, started a shaft for deeper exploration, but this has

been suspended for the time, pending financial arrangements. The introduction of new capital into the Tasmania mine is expected to give a stimulus to mining throughout this field.

*Lefroy.*—The New Pinafore Company continued the search for payable quartz in its deeper levels without success, but has won some gold from the higher levels. The Company has now temporarily suspended work on its old leases, and taken up work on the neighbouring Point and Crown. The programme now being followed out is that of extending the existing levels in the Crown into virgin ground, and connecting them with the workings in the Point. The Crown shaft is down 390 feet, and driving is now going on at 190 feet. The shaft was sunk in a column of ore, each boundary of which has been disturbed by cross-courses. For the last few months the work has been payable, but the ground has now become irregular.

*Mathinna.*—At the New Golden Gate Mine the western reef has been intersected at a depth of 1500 feet from the surface. It has been driven upon for a considerable distance, showing stone of varying value, the reef being from 4 to 15 feet wide; valuable stoping ground is expected to be opened at this level. The 1200 and 1300 feet levels have also yielded payable stone. Crosscutting at 1600 feet from the surface is proceeding with a view of cutting No. 1 reef at that depth. This mine still has the deepest shaft in the State. Its prospects this year suffered temporarily from a good deal of the stone falling off in gold contents, but the outlook has begun to improve.

Up to the last cleaning up in May, the quantity of quartz crushed amounted to 218,206 tons, returning 191,357 ozs. of gold, valued at £730,598 14s. 2d. Up to the same date the dividends paid amounted to £326,400.

A British company, The Tasmanian Consols, has acquired the property north of and adjoining the Gate. It has cut,

and is now driving on one of the Gate reefs at a depth of 1200 feet, with stone steadily improving in value.

The Volunteer Mine is duplicating its battery power. Its shaft is down to 250 feet. The stone is low grade but payable.

The Volunteer Consolidated has lately cut two highly payable lodes at a depth of 450 feet, and is now crosscutting for another.

The Yellow Boy is driving on a payable lode.

The New Golden King is down 200 feet, and has a payable reef; a 10-head battery is being erected.

The Waterfalls is a new mine in the district, and reports are favourable.

The introduction of British capital to work the old City of Hobart is promised at an early date.

The Mathinna goldfield is a wide belt of auriferous country traversed by large low-grade reefs, as well as smaller and richer veins. Thousands of acres have never had a pick in the ground, and with continued judicious prospecting, adequate capital, and good management the district ought to be the largest gold producer in Tasmania. An unusual amount of prospecting is being carried on, and there are more stampers at work and in course of erection than ever in the district. A good deal of the mineral belt is private property, and practically closed to mining.

*Mangana.*—The English Company has resumed work at the Mangana Reefs, and is unwatering the deep shaft with a view to crosscutting. The South Golden Entrance is driving on its lode with varied prospects.

*Tullochgorum.*—At Abbotsford Creek a 20-head battery is being erected, which it is expected will treat the low-grade stone profitably. A low adit level is being driven.

At Mount Victoria work on a small scale has been carried on continuously by small parties, and with payable results.

The Long Struggle and The Short Struggle parties at Alberton have raised small quantities of good stone. Some fresh reefs in the district have been uncovered, and work lately started upon them.

At the South Mount Victoria the Carnegie Syndicate, Hinemoa, and others have begun work. The whole field is still in need of adequate capital for its proper development. The numerous short makes of rich gold-bearing stone require to be worked on a fairly large scale to be remunerative, and suggest the desirability of proving the ground in depth, which has not been done yet.

The Ringarooma Company, which worked successfully at Alberton a few years ago, is still endeavouring to influence fresh capital.

*Lyndhurst.*—Attention has been directed to this field again through the recent discovery of an auriferous reef on the North Cross Mine, and some syndicates are already at work in the neighbourhood.

*Lisle.*—The Lisle Dredging Company has increased its pumping power, and during the time it has been at work has got through a fair amount of dirt of rather low grade. Deeper ground is now being approached, and better results are anticipated.

*West Coast.*—The Whyte River dredge has been working intermittently, with somewhat better results. It is intended to move the dredge down into the Pieman River.

Some mining has been going on at the Long Plains, where so much surface gold was found years ago. A little gold has been met with again, but the source is ill understood, and more prospecting is needed.

On the King River claim hydraulic sluicing has continued, and small quantities of gold have been recovered.

Operations have been started at the Old Harris' Reward mine, south of the King River; steam plant is being placed on the mine, and, after unwatering the shaft, sinking will be proceeded with.

The Princess River Gold Mine, which formerly yielded its owners £4000 worth of gold, is now to be re-started, provided certain arrangements can be made with the Mount Lyell Company for taking the pure silicious stone as a flux, and recovering the gold contents. Further work in this district has been carried on at Woody Hill, Harvey's Creek, Mount Ellen, &c.

Specimens of coarse gold have been reported from near the summit of Mount Darwin, and a little prospecting has gone on there.

The mount is in a copper-gold-silver iron belt, and discoveries are possible, though not much has resulted so far.

At Black Bluff the Lea River Gold Mining Company is opening up a mine in an auriferous formation, on which former owners did some shallow work.

Another venture in that neighbourhood has been started by the Devonport Prospecting Association. If these enterprises are successful a new field will be opened up about 30 miles distant from Mole Creek, or a little more from Ulverstone.

#### *Silver Mining.*

This branch has had to contend with adverse markets during a great portion of the year, though prices have improved recently. Notwithstanding this, the established mines have maintained the value of their output. Our silver mines are situate in the western part of the Island, the chief productive ones being the British Zeehan, Zeehan Montana, Oonah, Zeehan Queen, &c., at Zeehan; the Hercules, Comet, Ring Valley, at Dundas; the North Mount

Farrell, at Mount Farrell; the Magnet, at Waratah. Besides these, there are numerous smaller mines and claims at work in these districts, swelling the aggregate output.

Tasmanian Smelting Company, Limited.—During the year the Company purchased 24,265 tons of ore, containing 6925 tons of lead, 1,147,551 ozs. of silver, and 2815 ozs. of gold, and exported in bullion 6619 tons of lead, 1,131,226 ozs. of silver, and 2474 ozs. of gold.

During the same period the Company smelted 23,981 tons of crude silver-lead ore, and purchased 6595 tons of gossan flux, in addition to which they quarried from the Balstrup section and sold to the North Mount Lyell Copper Company 4770 tons of ironstone.

The British Zeehan and Zeehan Montana (the latter the deepest mine in Zeehan), have continued putting out large quantities of high grade ore.

The Oonah output has been principally stannite; the old south workings, from which large quantities of good silver-lead ore were won, are about to be opened up again.

The Zeehan South Comstock Mine has been working its zinc-lead deposit somewhat desultorily, and is reported to have lately acquired the adjoining property of the Comstock. It is understood that active work will be resumed.

At Dundas, the Comet mine was unfortunately visited by a fire, and subsequently by a flood in February last, when all the workings below No. 1 level were completely flooded. The work of unwatering had to be set about, and production has consequently been retarded.

At Mount Read the Hercules mine has sent away large quantities of sulphide and gossan ores for smelting, the realisation of which has proved profitable. A fair rate of profit is returned from the gossan ore. Metallurgical economies having been effected at the Tasmanian Smelting works. It has been found possible to supply certain

low grade ores which might otherwise not have been mined.

The Hercules Company is driving a low adit to prove its copper ore deposit at greater depth. The mine has now reached the dividend-paying stage, the first dividend having been declared.

The North Mount Farrell Mine tramway has been completed, and the Company has erected concentrating works for dressing their milling ore. Regular consignments of ore are being made to the Smelters at Zeehan.

The Mackintosh Company has resumed work on its section at Mount Farrell, and has been sending out ore.

The Mount Farrell Company has continued its drive toward the line of the North Farrell lode. Additional ground has been taken up at Mount Farrell, and there is every reason to anticipate that the field will become a busy centre.

The Magnet mine has produced and shipped upwards of 1000 tons of ore per month during the last year. The exceptionally low market prices for silver and lead have prevented the Company's operations from being as profitable as could have been wished, but the rising rates lately have had an immediate beneficial effect on the profits.

During the year a winze from the lowest level has proved the ore downwards, and the Company is arranging to exploit this ore to a depth of 100 feet below the level. The ore chute has been shown in the upper part of the mine to extend southwards, assuring the prospects to what is considered a very satisfactory extent.

The Confidence and Long Tunnel mines, in the Heazlewood district, have been contributing to the output of ore; both of these merit the introduction of capital. With improved prices for lead and silver, many lodes in that

district will become workable. The Heazlewood is a mineral field which is capable of legitimately absorbing much more capital and labour than it has hitherto enjoyed.

### *Copper.*

The Mount Lyell Mine has continued to deliver nearly 1000 tons of ore every day to the smelters at Queenstown, and has carried out considerable progressive work during the year in the way of contouring and penetrating the ore body in the deeper levels. Important economies have been effected by the General Manager (Mr. Sticht) in the consumption of coke, realising the theory of pyritic smelting without fuel other than the sulphur contained in the ore. Prospecting on the acquired leases has been persevered in. In the beginning of the period now under review the London price of copper was £54 10s. per ton, and, after fluctuations, it is now £57. Any augmentation will materially assist the Mount Lyell enterprise. The copper mining industry of this centre is now destined to receive a momentous impulse from the recent amalgamation of the Lyell and North Lyell properties. The ore of each mine is the natural complement of the other, and highly important results are anticipated from the application of Mount Lyell methods to the North Lyell undertaking. Per contra must be placed the distress caused by the sudden dislocation of business, and the probable abandonment of the North Lyell railway line to Pillinger is also unfortunate. The total quantity of blister copper produced at the Company's works, Queenstown, up to 31st March last, was 46,856 tons, valued at £3,941,689, and the total amount paid in dividends was £900,636 19s. 8d.

At the Mount Lyell Blocks a large deposit of copper-bearing clay has been worked. Operations were interrupted for some time during a re-construction of the Company. Prospecting has proceeded on half-a-dozen other properties

in the Lyell district, but the low price of copper restricts expenditure for the present.

A little work has been done on Mount Jukes, but nothing particular has resulted. Further operations are anticipated on this field. Both Jukes and Darwin have possibilities which may at any time develop a large industry.

The Tasmania Copper Company, at Rosebery, has been hampered in its endeavour to place its more profitable class of ore with smelting companies by the decline in market rates, and as regards the bulk of its ore deposit, no further progress has been made towards finding a process of profitable treatment. Failure in this has led the Company to invest its capital in South Australia.

At Barn Bluff the task of exploring the low-grade pyritic formation is being proceeded with, and it is hoped that the economic value of the deposit may be established.

On the East Coast arrangements are in progress for resuming work at the Eastern Proprietary's mine with English capital.

#### *Tin Mining.*

The Mount Bischoff Mine has continued to produce its usual quantities of tin ore, between 1200 and 1300 tons during the year. The dividends during the year amounted to £54,000, making a total of £1,885,500 since the formation of the Company, equivalent to £157 2s. 6d. per share.

The Briseis Mine has raised 386 tons 14 cwt. 3 qrs. 16 lbs. of tin ore during the past year. Large quantities of overburden have been removed from the faces, and but for the work of stripping this the production of ore would have been much larger.

The Ringarooma Tin Mine, at Derby, is also one of the important mines of the district. Work for a good time ahead has been opened up in the low ground on the west side of the property.

The Arba Mine, at Branxholm, has produced fairly well this year. The plant has been re-constructed, and its prospects are considered excellent.

The Pioneer Tin Mine, at Bradshaw's Creek, has pumped and sluiced 665,000 cubic yards of drift, averaging 2.330 lbs. of stream tin per cubic yard, at a cost of 6.295*d.* for a yield of 692 tons of stream tin, at a cost of £25.215 per ton. The amount paid in dividends was £16,875. The total amount paid in dividends by the Company is £21,875.

All through this field smaller mining companies and prospectors have had a good year. In the Ringarooma division, the Star of Peace has started to produce tin ore. Activity has also prevailed in the Weldborough district. The Scotia Mine is the largest producer at Gladstone, and has been maintained by the courage and perseverance of its owner. Outside the Scotia, the claims at Gladstone have shown no improvement. The old claims may still continue to yield small quantities of ore for a considerable period, but the best ground is too high to receive water from the present Government race. The condition of the race gives cause for anxiety, and the best means of conserving the interests of the district will have to be taken into serious consideration.

The Lottah mines comprise the Anchor, Australian, Ogilvie's Lease, and a couple of dozen other claims on the Blue Tier.

The Tier has produced nearly 300 tons of tin ore during the year.

The Anchor Mine has had a fair water supply from its new race, and during the year crushed 107,882 tons of stone, from which 249½ tons of tin ore were obtained, net value £19,686.

The Australian is readjusting its haulage line, and will then be in a position to improve its production with decreased cost.

The profitable exploitation of the huge body of low-grade tin ore enclosed in this Tier is dependent on the proper handling of the questions of power, economical mining, and extraction on a sufficiently comprehensive scale. Isolated attempts on a small scale to cope with the problem would appear to be useless in view of the extreme lowness of the grade.

In the St. Helens district the principal mine is the Royal Ruby. Besides this several other alluvial claims have contributed to the output of the field (about 50 tons tin ore.)

Mount Rex Mine.—A satisfactory market has been found for the product of this mine, and regular shipments have been made; the weekly output is about four tons. There has been considerable outlay on necessary development work, and as soon as the latter is finished—in a month—it is stated that a better quality of stone can be raised. The shaft is down 250 feet, and is being sunk another 100 feet.

South Esk Mine.—A large ore-body is reported to be in sight at this mine, and the work has been mainly directed towards opening it up. The alluvial workings at the mine, though limited, have given good results.

*North-West.*—The Badger Tin Field, 5 to 7 miles from Waratah, is being opened up by several parties. What appears to be a good formation has been exposed in the granite rock, and prospectors are out in the neighbourhood searching and taking up claims.

*West Coast.*—Mayne's Mine is being actively worked, and other discoveries in the district have added to the interest being taken now in Mount Heemskirk.

The Federation Tin Mine has not yet been refloatated, but when the necessary capital is obtained the effect will be felt by the field in general. The prospects of the field are good, and with judicious management for the discoveries being

made, Mount Heemskirk ought to occupy the prominent position which was anticipated for it years ago.

The North-East Dundas district, with the Renison Bell and other properties, has not yet come forward to the extent which would be justified by the indications noticeable at many points within its area. The inevitable process of exhaustion of our alluvial deposits, which is naturally in progress, makes it incumbent to promote in every way the development of lode tin-mining.

#### *Coal Mining.*

The Cornwall and Mount Nicholas collieries are the largest producers in the State. The other producing coal mines have been Spreyton and Dulverton collieries in the Mersey basin; Jubilee and Cardiff, at St. Mary's; Mount Cygnet, on the Huon; York Plains and Glen Leith, on the Main Line Railway; and quite lately the Sandfly has begun to raise coal.

The Cornwall resumed shipments to Victoria after the strike at the mine was over, but prices were not quite up to expectation. Indications are favourable for a good market this season.

At the Cardiff the seam, at the beginning of the twelve months, was dislocated by a fault, and deliveries have been interrupted, but fresh capital is being raised, and work is to be recommenced.

A new colliery has been started at Colebrook, called the Marialva.

The Preolenna coal property, south of Wynyard, has been prospected by the lessees to some extent during the year; besides sundry other seams, a seam of oil shale and bituminous coal has been disclosed. Unfortunately it is only 20 inches thick, and 16 miles from the sea by road, but the quality of the shale is such as will make the discovery

very important when, in the future, the railway is brought into the Flowerdale district.

Some private exploration has been going on on the banks of the River Tamar, and an attempt has been made to revive an old discovery of coal near George Town.

#### *Iron Mining.*

Nothing has been done this year beyond raising and shipping limited quantities of iron ore from the Penguin mines for fluxing purposes. The large deposit at the Blythe River is still unworked, pending legislation in the Federal Parliament on assistance to be given to the iron-making industry in Australasia. A Federal Iron Bonus Committee has been sitting, and evidence as to the iron ore resources of Tasmania was submitted to it by the Government Geologist, who attended by request.

#### MINERAL PRODUCTS.

The following return shows the quantity and value of metals and minerals produced during the year ending 30th June, 1903:—

	Quantity.	Value.
Gold won (fine).....	*64,241 ounces	£272,880
Silver ore raised .....	45,450 tons	211,743
Tin ore raised.....	3463 tons	273,585
Copper ore .....	1927 tons	22,289
Copper (blister).....	6213 tons	418,570†
Copper matte .....	6227 tons	133,736
Coal .....	51,443 tons	43,726
Iron ore.....	3174 tons	1480
Flux ore .....	7076 tons	5395
Zinc ore.....	204 tons	487
TOTAL.....		<u>£1,383,891</u>

\* Including 22,278 ounces obtained from blister copper.

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

A decrease of £206,983 on the previous year.

The total amount paid in dividends and bonuses was £150,851.

*Geological Branch.*

In the Geological and Mining Branch of the Service work has proceeded steadily. The services of both geologists have been in continuous request, and some useful examinations of mining fields have been made during the year. The Zeehan, Heemskirk, Comstock, and part of the Dundas districts have been examined by the Assistant Geologist; who is preparing a geological sketch map of the district to accompany a report on the Zeehan Field.

It is hoped that these will be of substantial service to all in that part of the West Coast.

The Chief Geologist has inspected the Beaconsfield, Den, Preolenna, Heazlewood, Long Plains, and Penguin districts. Reports of some of these have been issued, others are being prepared.

Further impending examinations are those of West Dundas, Mount Farrell, Mount Lyell, Dial Range, Mathinna, Lyndhurst, &c.

The Launceston office continues to be a place of call, where visitors interested in mining receive information respecting the mines and minerals of the State. An increasing number of inquiries for our mining publications and other information is received from abroad (Europe and America), and this dissemination of information will no doubt bear fruit in directing attention to our mines.

*Inspection of Mines.*

The inspection of mines has proceeded as usual, the protection afforded by these inspections to the miner (against his own carelessness, as well as against neglect on the part of the mine owner) is being shown constantly. The two Inspectors on the West Coast have upwards of 90 mines and working claims under their charge, besides the examination of some of the accidents in smelting works (non-machinery

accidents). The Inspector for the northern and eastern part of the Island also visits about 90 mines and claims. These Inspectors are also charged with the inspection of roads and tracks on behalf of the Public Works Department.

The examination of the plans of underground workings takes place in the Launceston office, and, thanks to the better attention which it has been possible to bestow on these plans in the office during the last year or two, the quality of the surveys has distinctly improved.

#### *Mining Managers' Examination.*

The annual examination of candidates for Mining Managers' Certificates was held in March last. Four candidates presented themselves for examination, but only two succeeded in obtaining certificates.

At the last meeting of the Mining Managers' Examination Board, in April, four First-class Mining Managers' Certificates were granted, under Regulation 112, to persons holding equivalent certificates granted by similar examining bodies in other States, and one Service Certificate was granted under Regulation 116.

The Board is considering a scheme for the granting of certificates to candidates qualifying themselves for taking charge of stamp batteries and other ore concentrating mills. The examinations conducted by the Board have been referred to on the mainland in terms of commendation. Candidates who have successfully passed through the course at the Zeehan School of Mines are excused from further examination.

#### *Diamond Drills.*

The Government diamond drills have been at work on sundry coal fields under arrangements with several coal mining syndicates or companies.

At Recherche Bay two bores were put down in the coal measure sandstones south of the Catamaran River. Only coal markings were met with, and the drill finally entered igneous rock, in the one case at a depth of  $216\frac{1}{2}$  feet, in the other at 695 feet from the surface. It was then removed to Moss Glen Company's mine, further north, where shallow work had shown the seam to be faulty. The first exploratory bore was sunk on the shore of the bay, in the sandstone, but only passed through small coal veins, and struck the underlying eruptive rock at a depth of 515 feet. The second bore was sunk higher up the mountain, but operations were suspended after the drill had passed through an eight-foot seam of soft coal and bands, at a depth of 57 feet.

On the West Coast the No. 2 diamond drill was employed putting down bores—first at Eden, and afterwards on the Farm Cove Company's claim on the shores of Macquarie Harbour. Boring was discontinued at Eden (at 110 feet) as soon as it was seen that the indications were not favourable. The Farm Cove bore was carried down to a depth of 571 feet, in the lignite series of clays and sands of Tertiary age, and was suspended before entering the coal measure sandstones which are supposed to underlie these.

*Mount Cameron Water Race.*

The Report of the Board is appended.

*Departmental Staff.*

The following changes have been made during the year:—

J. R. Quinn, Junior Clerk, transferred to the Lands Department.

M. Vincent, Junior, Messenger, transferred to the Lands Department.

A. L. Fitzherbert, Junior Clerk, Launceston, transferred to the Lands Department.

G. C. Gilmore, Commissioner of Mines, Zeehan, retired.

J. P. Piggott, Junior Clerk, transferred from Public Works Department.

F. C. Wills, Registrar of Mines, Burnie, office abolished.

L. E. Chambers, Commissioner of Mines, Queenstown, removed to Zeehan.

*Revenue.*

The net revenue for the year amounted to £17,776 14s. 3d., being a decrease of £1694 5s. 10d. on the previous year.

The above amount does not include a sum of £2772 15s. 1d. deposited as survey fees with applications for leases.

*Conclusion.*

In conclusion, I desire to place upon record my sincere thanks to W. H. Twelvetrees, Esq., Professor E. G. Hogg, Colonel Legge, J. J. Muir, Esq., J. B. Lewis, Esq., for the papers contributed by them, also to the Officers of the Department for the efficient manner in which they have performed their duties during the year.

I have the honour to be,

Sir,

Your very obedient servant,

W. H. WALLACE,

*Secretary for Mines.*

*The Honourable the Minister of Mines.*

## DIAMOND DRILLS.

*Statement of Work done to 30th June, 1903.*

Year.	Locality.	Direction of Bore.	No. of Bores.	Total Distance Bored.	Average cost per foot, inclusive of Labour and Fuel.
	No. 1 DRILL.			feet.	£ s. d.
1882-3	Back Creek—For Gold .....	Vertical	7	1330	0 10 9
1883	Lefroy—For Gold .....	Ditto	4	1011	0 5 3
1884	Tarleton—For Coal.....	Ditto	1	401	0 5 6
1886	Longford—For Coal .....	Ditto	2	1585	0 4 0½
1886-7	Harefield Estate—For Coal .....	Ditto	1	725	0 6 5
1887	Cardiff Claim, Mount Malcolm—For Coal.....	Ditto	1	562	0 17 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 (Phoenix G.M. Co.)—For Gold .....	Ditto	1	781	2 0 2
1890	Beaconsfield (East Tasmania G.M. Co.)—For Gold	Ditto	1	978	0 14 9½
1891	Spring Bay—For Coal .....	Ditto	4	937	0 6 10
1891	Ravensdale—For Coal .....	Ditto	1	114	0 11 1½
1891-2	Back River, Prosser's Plains—For Coal.....	Ditto	2	854	0 6 1¾
1892-3	Lefroy (Deep Lead Syndicate)—For Gold.....	Ditto	4	979	0 15 9
1893	Lefroy (East Pinafore Co.)—For Gold .....	Ditto	1	317	0 10 3
1895-6	Sandfly—For Coal .....	Ditto	4	2130	0 11 5
1898 } 1900 }	Blue Tier (Anchor Co.)—For Tin .....	Ditto	9	876½	0 9 1¾
1901-2	Llandaff—For Coal.....	Ditto	3	1944	0 7 4
1902	Recherche (Catamaran Co.)—For Coal .....	Ditto	2	956	0 9 3
1903	Ditto (Moss Glen Co.)—For Coal .....	Ditto	2	667	0 7 6
	TOTAL.....	...	54	19,917½	

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No. 2 DRILL.					
1882	Beaconsfield—For Gold .....	Horizontal, underground	1	68	No record.
1883	Mangana—For Gold .....	Ditto	1	546	0 15 1
1884	Guy Fawkes Gully, near Hobart—For Coal.....	Vertical	1	612	0 5 6
1885	Malahide Estate, near Fingal—For Gold .....	Ditto	5	1397	0 5 6
1886	Carr Villa, near Launceston For Coal .....	Ditto	1	571	0 5 4
1886-7	Waratah (Mount Bischoff Alluvial T.M. Co.)—For Tin .....	Ditto	7	1548	0 6 1½
1887	Waratah (Mount Bischoff T.M. Co.)—For Tin ....	Ditto	7	841	0 11 8
1887	Ditto .....	Horizontal, underground	1	53	0 7 8
1888	Old Beach—For Coal .....	Vertical	1	593	Abt. 0 10 9
1888	Campania—For Coal .....	Ditto	1	600	0 7 7½
1888	Richmond—For Coal .....	Ditto	1	500	0 5 1¾
1889	Back Creek—For Gold .....	Ditto	4	787	0 8 5½
1891	Macquarie Plains—For Coal.....	Ditto	2	989	0 4 5½
1891	Jerusalem—For Coal .....	Ditto	1	344	0 4 9½
1892	Langloh Park - For Coal .....	Ditto	4	1249	0 5 3½
1893	Southport—For Coal .....	Ditto	1	612	0 5 3
1894	Zeehan (Tasmania Crown S.M. Co.)—For Silver ...	Horizontal, underground	2	319	1 0 2½
1902	Eden—For Coal .....	Vertical	2	566	1 0 7½
1902-3	Farm Cove—For Coal .....	Ditto	1	571	0 5 6
TOTAL.....		...	44	12,766	

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

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

X  
III

## No. 1.

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

Year.	Quantity.	Value.
	ozs. dwts.	£
1880.....	52,595 0	201,297
1881.....	56,693 0	216,901
1882.....	49,122 6	187,337
1883.....	46,577 10	176,442
1884.....	42,339 19	160,404
1885.....	41,240 19	155,309
1886.....	31,014 10	117,250
1887.....	42,609 3	158,533
1888.....	39,610 19	147,154
1889.....	32,332 13	119,703
1890.....	20,510 0	75,888
1891.....	38,789 0	145,459
1892.....	42,378 0	158,917
1893.....	37,687 0	141,326
1894.....	57,873 0	217,024
1895.....	54,964 0	206,115
1896.....	62,591 0	237,574
1897.....	77,131 0	296,660
1898.....	74,233 0	291,496
1899.....	83,992 0	327,545
1900.....	81,175 0	316,220
1901.....	*69,491 0	295,176
1902.....	*70,996 0	301,573
1903, for first Half-year .....	*28,093 0	119,331
	1,234,038 19	4,770,634

\* Fine Gold.

5 cm

Diagram showing Total Quantity & Value of Gold won in Tasmania during the years 1880-1902



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

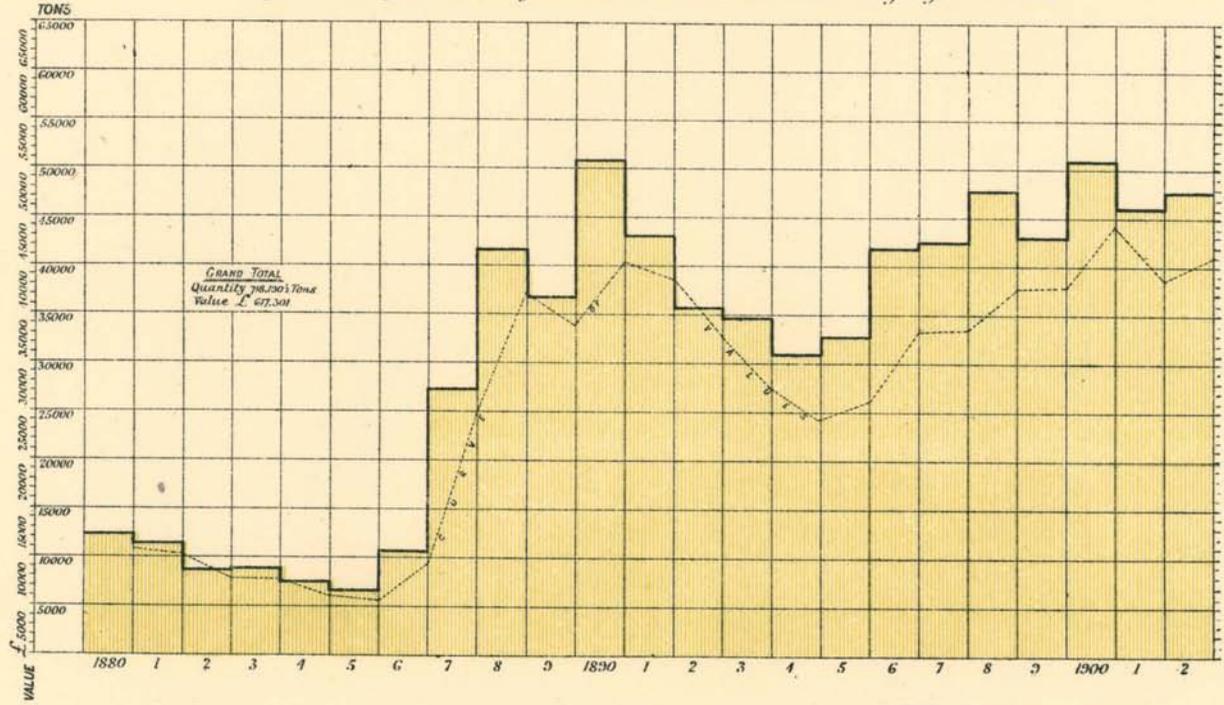
Year.	Quantity.	Value.
	ounces.	£
1880 .....	34,345	130,622
1881 .....	45,776	174,956
1882 .....	36,215	137,183
1883 .....	36,672	138,060
1884 .....	30,540	114,630
1885 .....	33,266	124,234
1886 .....	25,004	87,516
1887 .....	33,427	123,458
1888 .....	34,156	126,139
1889 .....	33,069	116,517
1890 .....	17,829	64,184
1891 .....	33,659	126,221
1892 .....	34,386	128,947
1893 .....	30,163	113,111
1894 .....	52,239	195,896
1895 .....	51,628	193,605
1896 .....	59,453	222,948
1897 .....	74,937	288,432
1898 .....	72,080	283,422
1899 .....	81,751	319,141
1900 .....	79,977	311,580
1901 .....	*68,779	292,155
1902 .....	*70,440	299,212
1903, for First Half-year.....	*27,685	117,598
	1,097,476	4,229,762

\* Fine Gold.

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

Year.	Quantity.	Value.
	tons.	£
1880 .....	12,219	10,998
1881 .....	11,163	10,047
1882 .....	8,803	7923
1883 .....	8,872	7985
1884 .....	7194	6475
1885 .....	6654	5989
1886 .....	10,391	9352
1887 .....	27,633	24,870
1888 .....	41,577	37,420
1889 .....	36,700	33,030
1890 .....	50,519	45,467
1891 .....	43,256	38,930
1892 .....	36,008	32,407
1893 .....	34,693	27,754
1894 .....	30,499	24,399
1895 .....	32,698	26,159
1896 .....	41,904	33,523
1897 .....	42,196	33,757
1898 .....	47,678	38,256
1899 .....	42,609	38,349
1900 .....	50,633	44,227
1901 .....	45,438	38,451
1902 .....	48,863½	41,533
1903, for first Half-year.....	25,108	21,342
	743,300½	638,643

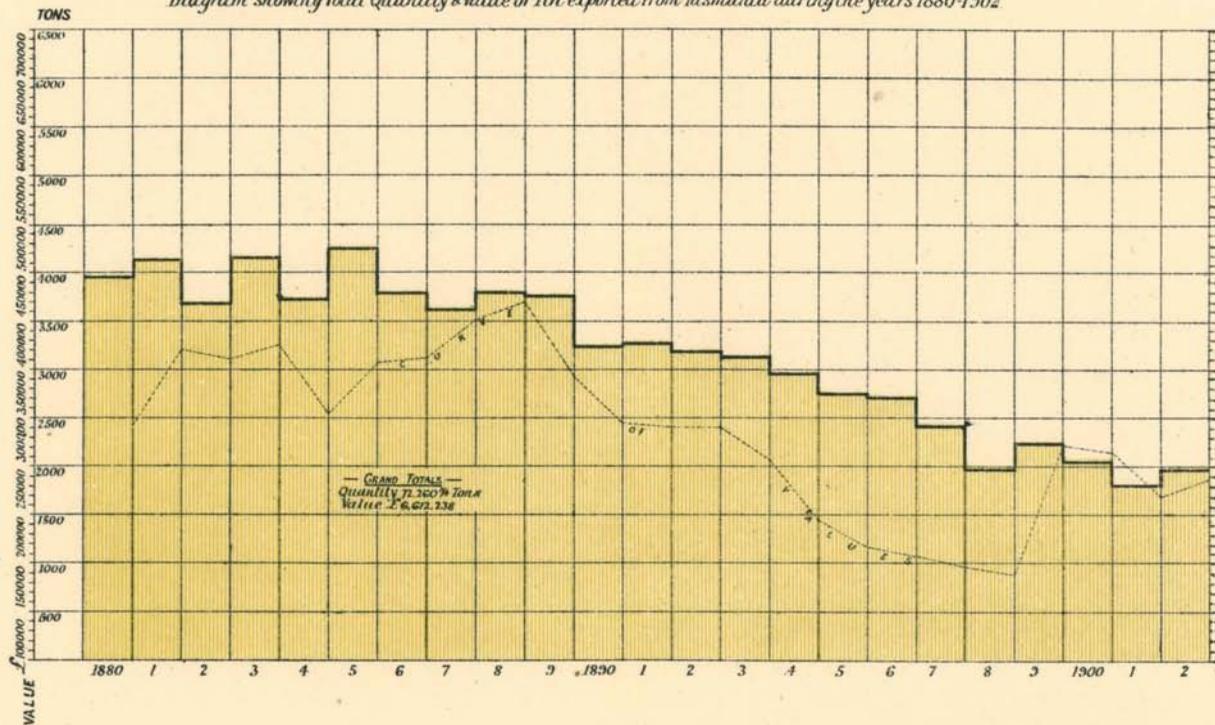
Diagram showing Total Quantity & Value of Coal raised in Tasmania during the years 1880-1902



5 cm

5 cm

Diagram showing Total Quantity & Value of Tin exported from Tasmania during the years 1880-1902



## No. 4.

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

Year.	Quantity.	Value.
	Tons.	£
1880 .....	3954	341,736
1881 .....	4124	375,775
1882 .....	3670	361,046
1883 .....	4122	376,446
1884 .....	3707	301,423
1885 .....	4242	357,587
1886 .....	3776	363,364
1887 .....	3607 $\frac{1}{2}$	409,853
1888 .....	3775 $\frac{1}{4}$	426,321
1889 .....	3764	344,941
1890 .....	3209 $\frac{1}{4}$	296,368
1891 .....	3235	291,715
1892 .....	3174	290,083
1893 .....	3128 $\frac{1}{4}$	260,219
1894 .....	2934	198,298
1895 .....	2726 $\frac{3}{4}$	167,461
1896 .....	2700	159,036
1897 .....	2423 $\frac{1}{2}$	149,994
1898 .....	1972	142,046
1899 .....	2239 $\frac{1}{4}$	278,323
1900 .....	2029	269,833
1901 .....	1789 $\frac{1}{2}$	212,542
1902 .....	1958 $\frac{1}{4}$	237,828
1903, for first Half-year .....	1113 $\frac{3}{8}$	145,827
	73,374 $\frac{3}{10}$	6,758,065

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

Year.	Quantity.	Value.
	tons.	£
1888 .....	417	5838
1889 .....	415	7044
1890 .....	2053	26,487
1891 .....	4810	52,284
1892 .....	9326	45,502
1893 .....	14,302	198,610
1894 .....	21,064	293,043
1895 .....	17,980	175,957
1896 .....	21,167	229,660
1897 .....	18,364	200,167
1898 .....	15,320	188,892
1899 .....	31,519½	250,331
1900 .....	26,564	279,372
1901 .....	28,774	207,228
1902 .....	46,480	218,864
1903, for first Half-year.....	18,935	94,694
	277,490½	2,473,973

## No. 6.

*RETURN showing the Quantity and Value of Blister Copper produced during the Years 1896, 1897, 1898, 1899, 1900, 1901, 1902, and the first Half-year of 1903.*

Year.	Quantity.	Value.
	tons.	£
1896 .....	41½	1245
1897 .....	4700	322,500
1898 .....	4955½	400,668
1899 .....	8598	735,305
1900 .....	9449	907,288
1901 .....	9981	879,625
1902 .....	7745	*462,151
1903, for first Half-year.....	2934	*262,621
	48,404	3,971,403

\* Value of Gold contained deducted.

## No. 7.

*RETURN showing Quantity and Value of Copper Matte exported during the Year 1902, and the first Half-year of 1903.*

Year.	Quantity.	Value.
	Tons.	£
1902 .....	2500	50,112
1903, for first Half-year ...	3727	83,624
	6227	133,736

## No. 8.

*RETURN showing the Quantity and Value of Copper Ore produced during the Years 1896, 1897, 1898, 1899, 1900, 1901, 1902, and the first Half-year of 1903.*

Year.	Quantity.	Value.
	Tons.	£
1896 .....	34	1020
1897 .....	75	2250
1898 .....	394	8128
1899 .....	1695	26,833
1900 .....	4221½	63,589
1901 .....	11,221	130,412
1902 .....	5994	65,270
1903, for first Half-year.....	102	790
	23,736½	298,292

## No. 9.

*RETURN showing the Quantity and Value of Iron Ore produced during the Years 1897, 1898, 1899, 1900, 1901, 1902, and the first Half-year of 1903.*

Year.	Quantity.	Value.
	Tons.	£
1897 .....	894	812
1898 .....	1598	1598
1899 .....	3577	3474
1900 .....	5375	5995
1901 .....	612	417
1902 .....	2386	1075
1903, for first Half-year.....	2430	1130
	16,872	14,501

## No. 10.

*RETURN showing the Quantity and Value of Asbestos produced during the Years 1899, 1900, 1901, 1902, and the first Half-year of 1903.*

Year.	Quantity.	Value.
	Tons.	£
1899 .....	200	363
1900 .....	128	113
1901 .....	46½	45
1902 .....	—	—
1903, for first Half-year.....	—	—
	374½	521

## No. 11.

*RETURN showing the Quantity and Value of Wolfram produced during the Years 1899, 1900, 1901, 1902, and the first Half-year of 1903.*

Year.	Quantity.	Value.
	Tons.	£
1899 .....	3½	99
1900 .....	53¼	2058
1901 .....	—	—
1902 .....	—	—
1903, for first Half-year.....	—	—
	57¼	2157

## No. 12

*RETURN showing the Quantity of Silver Lead and Copper Ore smelted for period 25th June to 31st December, 1896, and 1st January 1897, to 31st December, 1902.*

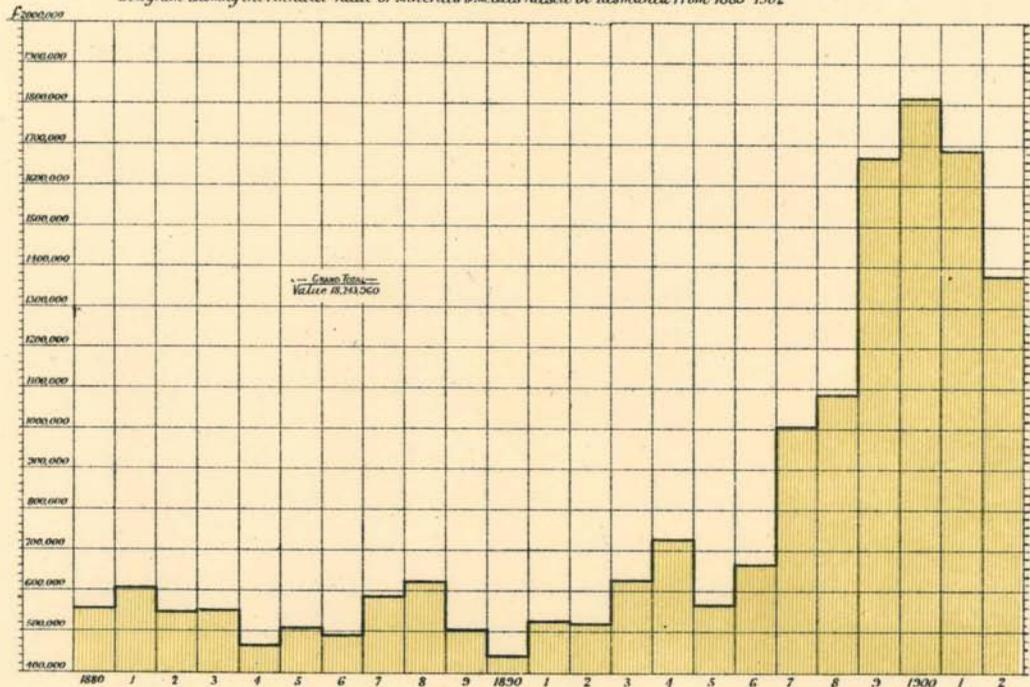
Year.	Ore Smelted.	Products.			Yield.			
		Silver Lead Bull'n.	Blister Copper.	Matte.	Copper.	Silver.	Gold.	Lead.
	Tons.	Tons.	Tons.	Tons.	Ozs.	Ozs.	Tons.	
1896	26,028 $\frac{1}{2}$ $\frac{3}{4}$	—	—	2417 $\frac{6}{10}$	1235 $\frac{1}{10}$	75,951	4707	—
1897	90,773 $\frac{1}{2}$	—	3476 $\frac{1}{2}$ $\frac{2}{10}$	257 $\frac{1}{2}$ $\frac{6}{10}$	3583 $\frac{1}{2}$ $\frac{1}{10}$	334,349	16,485	—
1898	170,933	—	4992	—	4783	606,123	24,418	—
1899	275,239	2295	8463	89 $\frac{5}{10}$	8362	1,089,657	27,615	—
1900	363,113	4817	9449	—	9341	1,215,036	26,255	—
1901	355,528	1839	9982	50	9880	800,317	21,717	—
1902	384,150	6825	7727	—	7639	1,625,179	24,420	6654

## No. 13.

*RETURN showing the Average Number of Persons engaged in Mining during the Years 1880 to 1902 inclusive, and first Half-year of 1903.*

Year.	Number.	Year.	Number.
1880.....	1653	1892.....	3295
1881.....	3156	1893.....	3403
1882.....	4098	1894.....	3433
1883.....	3818	1895.....	4062
1884.....	2972	1896.....	4350
1885.....	2783	1897.....	4510
1886.....	2681	1898.....	6052
1887.....	3361	1899.....	6622
1888.....	2989	1900.....	7023
1889.....	3141	1901.....	6923
1890.....	2868	1902.....	5934
1891.....	3219	1903, first Half-year	6430

Diagram showing the Annual Value of Minerals & Metals raised in Tasmania from 1880-1902



5 cm

No. 14.

*RETURN showing the Number and Area of Leases held under "The Mining Act 1900," in force on 30th June of each year since 1897.*

Nature of Lease.	In force on 30th June, 1897.		In force on 30th June, 1898.		In force on 30th June, 1899.		In force on 30th June, 1900.		In force on 30th June, 1901.		In force on 30th June, 1902.		In force on 30th June, 1903.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.
For Minerals, Silver, Tin, &c.....	1150	56,493	1290	66,981	1207	64,339	1487	70,500	1388	60,865	1063	45,399	950	40,068
For Coal, Slate, Shale, &c.....	38	6105	41	5943	39	6002	52	7258	55	7566	52	7819	66	10,767
For Gold .....	615	5789	702	7190	652	6725	647	6623	566	6091	425	4166	310	3117
Water Rights, Mineral and Gold .....	155	774 sluice- heads.	159	784 sluice- heads.	200	933 sluice- heads.	225	1004 sluice- heads.	267	1318 sluice- heads.	300	1691 sluice- heads.	299	1514 sluice- heads.

IIIXXX

No. 15.

*RETURN showing the Number and Area of Leases under "The Mining Act, 1900," in force on the 1st July, 1902, issued during the Year ending 30th June, 1903, cancelled during the Year ending 30th June, 1903, and remaining in force on 30th June, 1903.*

Nature of Lease.	In force on 1st July, 1902.		Issued during Year ending 30th June, 1903.		Cancelled during Year ending 30th June, 1903.		In force on 30th June, 1903.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.
For Minerals, Silver, Tin, &c.....	1063	Acres. 45,399	233	Acres. 9857	346	Acres. 15,188	950	Acres. 40,068
For Coal, Shale, Slate, &c. ....	52	7819	26	5198	12	2250	66	10,767
For Gold.....	425	4166	101	967	216	2016	310	3117
Water Rights, Mineral and Gold..	300	1691 sluice- heads	57	193 sluice- heads	58	370 sluice- heads	299	1514 sluice- heads

No. 16.

*COMPARATIVE Statement of Net Revenue from Mines, being Rents, Fees, &c., paid to the Treasury for the Years ending 30th June, from 1880 to 1903.*

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

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

## No. 17.

*RETURN showing the Total Number and Area of Leases in force on 30th June, 1903.*

Minerals.	Number.	Area.
		Acres.
Gold .....	310	3117
Minerals .....	187	10,999
Silver .....	186	9666
Copper .....	68	4103
Tin .....	485	14,044
Coal .....	38	7101
Limestone .....	11	662
Iron .....	16	756
Slate .....	1	200
Wolfram .....	3	160
Asbestos .....	2	140
Precious Stones .....	1	80
Lithographic Stone.....	1	97
Marble .....	1	317
Shale.....	14	2380
Bismuth .....	1	40
Monazite .....	1	80
Machinery Sites .....	19	78
Dredging Claims.....	30	447
Mining Easements (under "The Mining Act, 1900") .....	24	197
Dam Sites.....	57	796
Water Rights .....	299	1514 sluice-heads.

## No. 18.

*RETURN showing the Average Number of Miners employed during the Year ending 30th June, 1903.*

	Europeans.	Chinese.
Northern and Southern Division .....	675	...
North-Eastern Division.....	504	150
Eastern Division.....	777	64
North-Western Division .....	418	...
Western Division .....	3896	...
	6270	214

## No. 19.

*RETURN showing the Mining Companies registered during the Year ending 30th June, 1903.*

Number of Companies.	Capital.
16	£37,225.

In addition to the above, 10 Agents for Foreign Companies, and 11 Syndicates, under 60 Vict. No. 51, were registered.

## No. 20.

*RETURN showing the Total Area of Land applied for during the Year ending 30th June, 1903.*

Mineral.	No. of Applications.	Area.
		Acres.
Coal .....	9	1571
Copper .....	15	938
Galena .....	1	40
Gold .....	187	1869
Iron .....	4	150
Lead .....	1	80
Limestone.....	2	50
Minerals .....	80	4074
Nickel .....	2	60
Osmiridium .....	4	237
Shale .....	4	1020
Silver.....	14	476
Tin.....	210	6562
Wolfram .....	1	20
Machinery Sites .....	14	96
Dredging Claims.....	11	156
TOTAL .....	559	17,399

In addition to the above, 18 applications for Mining Easements, and 76 applications for Water Rights (316 Sluice-heads and 91 acres Dam and Dump Sites) were received.

## No. 21.

*RETURN showing the total Amount of Rents, Fees, &c., received by the Mines Department during the Year ending 30th June, 1903.*

Head of Revenue.	Amount.		
	£	s.	d
Rent under "The Mining Act, 1900," for gold and Minerals .....	16,509	15	1
Fees, ditto ditto .....	1266	19	2
Survey Fees .....	2772	15	1
Rent of Diamond-drills .....	—		
TOTAL.....	20,549	9	4

## No. 22.

*RETURN showing the Amounts paid in Dividends by Mining Companies during the Year ending 30th June, 1903.*

Mines.	Dividends.
	£.
Copper .....	55,000
Gold .....	11,000
Tin .....	71,685
Silver .....	13,166
TOTAL.....	150,851

REPORT OF THE MOUNT CAMERON WATER-  
RACE BOARD FOR THE YEAR ENDING  
30TH JUNE, 1903.

5th August, 1903.

SIR,

WE have the honour to present the Report of the Board for the year ending 30th June, 1903.

The total receipts for the year amount to £1283 7s. 4d., as against £1142 18s. 1d., and the expenditure to £765 5s. 6d., as against £701 10s. 5d. during the preceding year.

The excess in the expenditure (£63 15s. 1d.) as compared with the previous year is mainly due to the cost of maintenance, race-repairing, flumings, &c., necessitating the employment, on full pay, of one of the watermen and channel keepers for the past six months (£31 4s. 0d.), who previously had only been employed on half-time; also to the cost of cleaning the race (£30 10s.), this latter work being only performed every other year.

*Water.*

With the exception of two brief periods during the months of November and February, the supply of water available was sufficient for all the customers.

The rainfall during the autumn and winter months was greater than that of any previous year during the life of the race, and the supply of water available was far in excess of the demand.

The condition of the race has already been brought under the notice of your predecessor in office as regards the syphon pipes on the northern extension, and the flumings near the source of intake. Estimates have been furnished by the manager as to the cost of renewal of the pipes (£9000) and of the flumings, by substituting cuttings and earth embankments, as more permanent and lasting, say, £3000. He reports that, with careful attention and repairs, the syphon pipes will be likely to last several years, and that their repair is not a matter of urgency at present; but the flumings are in such a state of decay and disrepair that they may collapse at any moment, and thus cut off the main intake supply, which represents two-thirds of the whole. The immediate renewal of this portion of the race by cuttings and embankments instead of flumings, as recommended by him, has become a work of pressing urgency, that requires immediate attention.

*Race.*

*Syphon Pipes.*—One hundred and three breaks have occurred during the year, as against 75 during last year. The actual cost of repairs, however, has been £8 10s. less; this is owing to the use of smaller bands, and their being applied as soon as the pipes begin to show signs of giving way.

It has been found by experience that small plate-iron bands, applied directly a small burst or hole in the pipes occurs, effectively prevents a more serious break, and obviates the

necessity for using larger and more costly bands. This explains the reduction in the cost of material for repairs.

It is only when serious breaks occur during the night-time, and are not detected for several hours, that any great difficulty is experienced, as in such cases the water has to be turned off, and larger bands have to be applied.

The general condition of the pipes is not good, yet, from the experience of the last two years it is not anticipated that the annual cost of repairs for the next three or four years will be much greater than that of the past year.

*Flumings.*—There are 23 of these on the first five miles of the race, from the main intake on the Great Mussel Roe River to the Little Mussel Roe River; also one high fluming over Old Chum Creek, five miles lower down the race. All of these are in a very defective state of repair. The timber for the most part, both boxes and trestling, are in an advanced state of decay. Repairs have been effected from time to time, by means of old boards on hand; these have now been used up, and to obtain and use new timber for further repairs would be both unsuitable and too costly. It is, therefore, almost certain that at least two-thirds of the total water-supply will be cut off through the collapse of these flumings within a year from now. If such a thing should happen, there will be no further need to hereafter consider the question of repairs to the syphon pipes, as the further one-third supply of water available from the Little Mussel Roe River would not pay for keeping them in repair.

The estimates for reconstructing these flumings, or substituting earth and stone embankments, as furnished two years ago by the manager of the race, and afterwards verified by Mr. K. L. Rahbek, hydraulic engineer, amounted to £2859 8s., or, including supervision, &c., say, £3000.

There are also three short syphons spanning gullies on the same section of race as the flumings referred to, but renewal of these will not be required for several years to come.

With the expenditure of the sum above referred to, the race can be put in an efficient state of repair from the main intake on the Great Mussel Roe River to the "junction" (near the intake of No. 4 syphon, northern extension), a distance of 18 miles, and would thus become a permanent work. No further outlay would be required on this portion of the race, except for the three syphons referred to. If this scheme were adopted, it would insure a full supply of water being brought to the southern margin of the tin-mining areas, and to within five miles of Gladstone, in a direct line.

We beg, therefore, to respectfully bring under your notice this most important work, and to strongly recommend the renewal of the flumings by embankments be put in hand at once. If the payment of the annual subsidy to the Public Debts Sinking Fund is suspended for a time, and a sum of £3000 is advanced to the Board for a term of six years, the whole amount can be refunded within that time from the profits of the sale of water. A scheme has already been submitted by the Board for the consideration of your predecessor, a copy of which is appended hereto, and, if adopted, the State will be in possession of a permanent and substantial race of over 18 miles in length, and the water, as already stated, will be brought to within five miles of Gladstone.

Should the syphon pipes (Nos. 4, 5, and 6) collapse, and the Government decide not to renew them, at a cost of £9000, the

prospects of the district would warrant the mine-owners putting in races at their own cost to connect with the Government Race, and purchasing and conveying the water to their mines, and relieve the State of any further liability. On the other hand, should the flumings not be renewed, their collapse, and the cutting off of the sources of the water-supply, would not only mean the collapse of the race, but the total collapse of the tin-mining industry of the district, which is solely dependent upon the Government race for its existence, and the loss to the State of a work of national importance, which has cost over £34,000.

Since the opening of the race the system of mining, as carried on on the claims supplied by the race, has been confined to shallow alluvial mining; but now the deep leads are being worked, and a commencement has been made to open up the deep leads which exist, and already one mine is in course of development, which, during the past year, has taken more than half the water-supply, and the future prospects of this mine warrant us in believing that, during the coming year, its demand for water will be largely increased, and that the whole of the water-supply will be taken to meet the requirements of this and the other claim-holders hitherto supplied.

Reviewing all the circumstances connected with this work, and the future prospects of the deep alluvial mining in the locality, we feel fully justified in recommending to your favourable consideration the proposal we have submitted for the advance of the necessary £3000 required to make the race a permanent and enduring work.

We cannot close this Report without referring to the very able and satisfactory manner in which the manager has discharged his duties, and to the deep interest he has always exhibited in the progress of the work; also the watermen and channel keepers employed on the race.

The statistics for the year are as follows:—

Average per week of claims supplied, 12.  
Greatest number supplied in any one week, 16.  
Total number of heads of water supplied—

Under fixed or cash scale, 2234½, at an average of 9s. 6d. and one-sixth per head; under royalty or credit scale, 1280, at an average of 3s. 8d. and four-fifths per head.  
Total, 3514½.

Tin-ore raised, 12 tons 13 cwts. 2 qrs. 5 lbs., royalty scale; 59 tons 4 cwts. 0 qrs. 0 lbs., fixed scale. Total, 71 tons 17 cwts 2 qrs. 5 lbs.

Average number of miners employed—European, 33; Chinese, 9. Total, 42.

Total receipts for the year—Fixed scale, £1044 4s. 1d.; royalty scale, £239 3s. 3d. Total, 1283 7s. 4d.

Expenditure:—Cost of maintenance and management—

	£	s.	d.
Salary and wages ... ..	634	18	0
Cleaning race-channel ... ..	30	10	0
Repairs to syphon pipes ... ..	33	19	1
Repairs to race and flumings ... ..	36	0	9
Travelling expenses ... ..	22	7	2
Insurance and stationery ... ..	7	10	6

TOTAL ... .. £765 5 6

Paid to Public Debts Sinking Fund, 1902 (including moiety of rents of mineral land served by the race, £17 7s. 6d.), £452 10s. 10d.

Total amount paid to Public Debts Sinking Fund on the 31st December, 1902, £7623 18s. 7d.

Rate of interest for the year upon the cost of purchase and construction, 1·32 per cent.

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

W. H. WALLACE, <i>Chairman of the Board.</i>	
W. H. TWELVETREES,	} <i>Members of the Board.</i>
C. O'REILLY,	
S. HAWKES,	
JOHN SIMPSON,	

*The Hon. the Minister of Mines.*

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APPENDIX.

1. That "The Mount Cameron Water-race Act" be amended, so that the annual payment to the Public Debts Sinking Fund may be suspended for a term of, say, eight years.

2. That the Board be empowered to borrow from the Government the sum of £3000. at, say, 4 per cent., redeemable in eight years, from the earnings of the race during that period.

3. That the sum of £3000 so borrowed be expended in renewing and replacing by embankments the 23 flumings on the southern extension of race, and the one flume on Old Chum Creek, according to the plans and specifications prepared by the manager, and that the work be commenced not later than August of the current year.

This work can be performed without cutting off the water altogether, or, indeed, without any great loss, beyond the cost of temporarily diverting the water at three or four places where the new work must be laid on the old course.

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## MINE MANAGERS' EXAMINATION.

MARCH 25TH, 1903.

### *Questions set.*

#### SUBJECT A.—MINING.

1. Explain by description and diagrams the method by which a shaft 12 feet long by 5 feet wide may be divided into three compartments—(a) by frame sets and laths; (b) by close timbering, in order that two of its compartments may be utilised as an upcast and downcast respectively; (c) how would you proceed to open a plat or chamber in a close-timbered shaft in heavy ground?
2. At the 200-foot level of a shaft a 12-inch plunger workings is fixed, and it is intended to continue sinking. State the dimensions of a draw-lift suitable for the work, assuming the whole of the water is making in bottom of shaft.
3. Make a rough pen-and-ink sketch of the following :—
  - (a) "Face board," used in driving through watery strata;
  - (b) Half-set of timber for drive or stopes;
  - (c) Full set of timber for drive or stopes;
  - (d) Square sets (American system);
  - (e) "Air sollar."
4. State the conditions under which deep lode mining can be more profitably conducted through underlie shafts than by means of vertical shafts.
5. State the advantages (if any) of a four (4) compartment main shaft.
6. Name the most commonly occurring noxious gases in lode mines. Describe their properties, means of recognition, the conditions under which they are produced, the means of preventing their generation, and of removing them when present.
7. How would you timber a drive on a lode in swelling ground, and how with a soft bottom?
8. How would you place the parts of a Cornish pump in a main shaft when the water was expected to be cut in bursts?
9. What system of ventilation would you use in a deep mine?— Explain by adding sketches to the text of your answer. Take into consideration the cost of carrying out your proposals.
10. How would you open up a large ore-deposit :—
  - (1) If it was soft picking ground?
  - (2) If it was hard blasting ground?
11. Give complete details of what you consider the best system of signalling in a shaft, and what is chiefly necessary to insure safety from accidents with speed in working.

12. How would you timber and work stopes on a lode about 10 feet wide :—
  - (1) With good strong walls?
  - (2) With baulky walls?
13. What sanitary rules would you enforce underground, and what sanitary arrangements would you make?

SUBJECT B.—ORE-DRESSING AND SAMPLING.

1. Which is the best type of rock-breaker made? Why?
2. How much water do you want per ton of ore in different ore-dressing plants?
3. Give your reasons for or against classifying fine sands and slimes before treatment. Give sketches of classifying for a silver-lead plant of assumed capacity, or your method of treatment.
4. How would you decide about placing an ore-dressing plant near to or at some distance from the mine?
5. State the principal circumstances which are the cause of the loss of ore in dressing.
6. Give the principles of the chlorination process for extracting gold; also a case in which the process is not applicable.
7. A quartz-reef in a drive has been sampled in five places 10 feet apart—

No. 1	sample,	reef	5	inches	wide,	assayed	80	dwt.	of	gold	per	ton.
" 2	"	"	10	"	"	"	40	"	"	"	"	"
" 3	"	"	20	"	"	"	20	"	"	"	"	"
" 4	"	"	40	"	"	"	10	"	"	"	"	"
" 5	"	"	80	"	"	"	5	"	"	"	"	"

State average width of reef, and average gold contents over width of reef.

SUBJECT C.—MINING GEOLOGY.

1. Describe tests for the identification of stibnite, pyromorphite, chalcopyrite, cerussite, cassiterite.
2. Mention the different modes of occurrence of gold deposits.
3. Distinguish between basalt and serpentine, granite and melaphyre, conglomerate and breccia, schist and slate.
4. Mention what you know about the groupings or association of various minerals in ore veins.
5. Give a brief account of the changes which take place in different ore deposits at increasing depths from the surface.
6. Describe the indications which you would seek in prospecting for minerals in a new country.
7. Describe the ore deposits known as—(a) placers, (b) stock-works, (c) gash veins, (d) bedded veins.
8. When the course of a lode is changed by a fault, how would you proceed to pick up the heaved portion of the former?
9. Explain the terms :—hade, dip, elvan, sill, flucan, gossan, talus, strike, fault.

SUBJECT D.—MINING SURVEYING.

1. Calculate the bearing and distance of the line *E A* in the following traverse :—

Line.	Bearing.	Distance.
<i>A B</i>	N. 35° 25' E.	500
<i>B C</i>	S. 31° 30' E.	587
<i>C D</i>	S. 10° 48' W.	633
<i>D E</i>	W.	475

2. Explain how such a traverse can be plotted by rectangular co-ordinates.
3. Describe carefully the adjustments of the transit theodolite.
4. The following observations were taken with a theodolite and chain, the distances being measured parallel to the line of sight of the theodolite. Calculate the difference of level of *A* and *E* :—

	Distance.	Angle of inclination.
<i>A to B</i>	85'	10° 15'
<i>B to C</i>	183'	16° 38'
<i>C to D</i>	115' 6"	17° 43'
<i>D to E</i>	137' 3"	28° 37'

5. Describe carefully how to connect the underground workings of a mine with the surface, there being one vertical shaft. How is it possible to check the accuracy of the underground observations?
6. In a triangle, *ABC*, the sides *BA AC* are each 1000 feet long, and the side *BC* 400 feet. It is required to cut off a portion containing two acres by a line parallel to *BC*. Calculate where this line will cut *AB*.

7. Reduce the levels in the section given below. Show how your calculations may be checked.

Back sight.	Intermediate.	Fore sight.
10·26	...	...
...	8·53	...
...	6·29	...
2·10	...	4·78
...	4·76	...
5·13	...	5·31
...	3·19	...
1·18	...	2·24
...	1·19	...
...	3·57	...
5·70	...	5·35
...	4·93	...
...	...	4·05

8. Describe carefully the adjustments of the surveyor's level.

SUBJECT E.—SURFACE WORK.

1. Give working drawings, specifications, and estimate for a shed capable of being used as a storehouse, composed of hardwood framing and galvanised iron exterior, 16 feet by 24 feet inside measurement, deal floor, one door, enough window area for ordinary lighting.
2. It is proposed to put a dam for impounding water across the bed of a stream flowing over granite country. The length along top will be 40 feet, and the height in centre 12 feet. Describe the material of which it should be composed and the method of construction. You can assume as available the material you specify. Illustrate your answer with sketches.
3. It is required to carry a flume capable of holding water of a transverse section of 8 square feet across a gully 60 feet wide. Give working-drawings of the fluming and trestles required.
4. A line of 9-inch wrought iron pipes  $\frac{3}{4}$  mile long conveys water from a reservoir to some mining works. The water-level at the reservoir is 100 feet above the works. What will be the head of water available at the works? How many gallons per minute can the pipe discharge?
5. In the last question, what should be the thickness of the pipes, size of flanges and bolts? What will be the total weight of the line of pipes?
6. Explain fully the difference between the terms—(1) "Nominal," (2) "Indicated," (3) "Brake," horse-power.
7. At the bottom of an ordinary 400-gallon tank there is fixed a short piece of  $\frac{3}{4}$ -inch pipe (1 inch long) giving a clear  $\frac{3}{4}$ -inch orifice. Into this tank, when it is empty, a tap

discharging at the rate of 750 gallons of water per hour is set running. To what height will the water rise in the tank? Show how this has a bearing on the question of the utilisation of water-power.

8. Make a sketch of, and mark in the sizes for, a length of cast-iron rising main, 12 inches internal diameter, suitable for a head of 200 feet (ordinary pole-pumps).
9. What would be the weight of the above casting?
10. Show how you would calculate the stress required to break an ordinary screwed iron  $\frac{3}{4}$ -inch bolt.

SUBJECT F.—BOOK-KEEPING AND MINE ACCOUNTS.

1. Divide £65 among three persons so that their shares may be as the numbers 2, 3, 4.
2. Enumerate and give specimens of the several accounts which, as mining manager, you would furnish periodically to the head office of the company.
3. What is the tributor's part of £72 15s. 6d. at 5s. 7d. per £?
4. In making your analyses of costs, to what accounts would you debit work done in—(a) shafts, (b) crosscuts, (c) stopes?
5. Describe the books and forms of account which you consider desirable for controlling the receipt and distribution of stores.

SUBJECT G.—MINING LAW.

1. What is required to be done to abandoned shafts and shafts or excavations near roads to prevent accidents?
  2. How are leased claims required to be marked during the term of the Lease?
  3. What constitutes a "sluice-head" of water under the Mining Regulations?
  4. What portion of land held under lease may be marked off by the Lessee as a "mining reserve"?
  5. How often is a mine manager required to inspect ropes, safety appliances, &c.?
  6. When a shaft of 50 feet or more in depth is the sole means of ingress into or egress from any part of a mine, what other provision for raising or lowering men is required by the Mining Act in addition to a safety cage or other machine?
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ANNUAL REPORT OF THE GOVERNMENT  
GEOLOGIST.

*Government Geologist's Office,  
Launceston, 30th June, 1903.*

Sir,

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

During the year, besides departmental reports, I have prepared the following reports on mines and mineral districts :—

1. On the Den Hill gold deposits, 10th October, 1902.
2. On the possible existence of kainit and related salts in Tasmania, 25th November, 1902.
3. On the mineral resources of the Districts of Beaconsfield and Salisbury, 13th March, 1903.
4. On the present position of the Tasmania Mine, Beaconsfield, 8th May, 1903.
5. On possible coal country at Swan Bay and Saltwater Creek, on the River Tamar, 26th May, 1903.

In addition to the above, I examined, in March and April, the shale and coal measures at Preolenna (south of Wynyard); the Long Plains gold field, the Savage River copper deposits, the Heazlewood and Magnet mineral districts, the Badger tin field (near Waratah), and the iron-ore deposits near Penguin and on the Dial Range, as well as some iron-ore up the River Forth. Reports upon the results of these examinations are in course of preparation.

Mr. Geo. A. Waller, Assistant Government Geologist, has also written reports upon mineral districts on the West Coast, as under :—

1. On the tin-ore deposits of Mount Heemskirk, 5th September, 1902.
2. On the Western Silver Mine, Zeehan, 27th September, 1902.
3. On the iron and zinc-lead ore deposits of the Comstock district, 1st February, 1903.

Mr. Waller's reports and inspections during the year are alluded to in his Annual Report, which I beg to enclose. They comprise a very thorough examination of the ore deposits and geology of the respective districts. He is just completing a report upon the Zeehan field, which will be accompanied by a highly-useful geological map of that area.

The reports and inspections have been made at the request of those interested in the development of the mineral resources of the different districts, and have had for their object the diffusion of correct knowledge bearing upon ore deposits. With changes in the market rates for metals, and improved means of access and transport, old fields receive fresh attention. In the light of fresh work carried out, renewed inspection is solicited, and information bearing upon the prospects of the field is the result. Many old districts need re-examination at present, *e.g.*, the Mathinna field, which has not been reported upon since 1892; the Mangana field, since 1894; the Lyndhurst field, since 1881;

whilst no reports at all have been published on the Panama and Golconda district. The resinous shales of the Latrobe area have not been examined since 1861.

The country between Emu Bay and Circular Head is very imperfectly known; and on the West Coast, the districts of Farrell, Dundas, and Lyell require examining. The important Lyell field has not been reported upon since 1894. Gold-bearing country is said to await examination in the vicinity of the Frenchman's Cap; other parts of the State, too, demand attention.

The reports have been published in plain language, the greatest stress being laid upon the economic relations of the various mineral deposits, purely scientific considerations being subordinated to the attempt to discuss facts relating to mines and mining in a manner suited to the intelligent reader. I submit, with some degree of confidence, that the reports constitute, as far as they go, a useful compendium of the mining geology and mineral resources of the State. I beg to refer briefly to the contents of the several reports issued.

#### *Den Hill.*

The old Den diggings were a scene of activity between 30 and 40 years ago, when a good deal of coarse gold was won from the alluvial flat. For many years an attempt has been perseveringly carried on to locate the supposed parent reefs in the spur which rises from the flat, but unsuccessfully. The inference is that the veins seen in the hill did not contribute materially to the alluvial deposit, and that the source of the gold must be sought elsewhere. The probability is, that the metal was derived from formations concealed below the alluvium. The strata form part of the Lefroy auriferous series, and, though things are quiet at present in the Den and Lefroy district, a revival of interest will certainly recur at some time or other; for it is folly to think that all the reefs are known, and the payable ground exhausted.

#### *Beaconsfield and Salisbury.*

This district was submitted to an examination primarily for coal measures, but the examination extended to the neglected iron-ore deposits, and to sundry gold mines. Sandstone strata of the geological horizon of the Mersey measures were recognised, and coal-markings found to exist here and there, but no outcrops of coal were observed, a circumstance which leaves the existence of seams a matter of uncertainty. The doubt can only be solved by the employment of the drill.

The iron ores at Leonardsburgh and Barnes' Hill form large deposits, easily quarried, but contaminated with a little chrome in variable proportions. In 1876-77 smelting was carried on at Port Lempriere, and about 20,000 tons of ore taken from the quarries, but the bulk of the product was hard and brittle, owing to the presence of chromium. It is conceived that new trials might now result in producing a metal useful for special purposes, and commanding special prices. The mines at the Salisbury Tier were visited. These were recently started to prospect the Tier, in which rich auriferous patches were worked formerly, and the alluvium from which constituted a notable goldfield in early days. One of the new companies extracted, in a very short time, 60 ozs.

of gold; but further work here has been suspended for the time, until fresh capital can be secured.

The reef in the east end of the Tasmania Mine was examined with reference to its continuation into the property of the East Tasmania Company, and the conclusion arrived at was that, to locate it in the latter company's ground, a series of diamond-drill bores would be necessary.

The Ophir Mine workings were found to have cut wash in the lead at 400 feet. The mine is being put in order for work at the 460-foot level.

#### *Tasmania Mine.*

This mine was inspected, at the company's request, with a view of verifying the grounds for a contemplated instalment of more powerful pumping-plant. Work at the 1000 and 1100 feet has been suspended since August last year, owing to a burst of water encountered in driving at the 1000-feet. There is every reason to believe that between the 818 and 1000 feet a large body of gold-bearing quartz exists, which awaits extraction, but cannot be profitably dealt with until an adequate pumping-plant is obtained, when still deeper exploration can be also undertaken.

#### *Coal Country on the Tamar.*

Operations have been recently going on in the lignite clays on the river-bank near Swan Bay, and this area was examined for indications of the true coal measures (upper or lower). No signs of seams were found, but the sandstones which underlie the lignite may possibly enclose coal deposits. Those interested in this work are about to test the ground by boring.

#### *Kainit.*

A report upon the probability of the occurrence of kainit and other potash salts was prepared for the Council of Agriculture, and was published in their journal.

#### *Inspections.*

The visit to Preolenna showed that seams of high-class kerosene shale and bituminous coal, up to 20 inches in thickness, exist about 17 miles south of Wynyard. The coal surpasses any other in the State in gas-making and steam-generating properties; and the shale is equal to the export quality of New South Wales kerosene shale. The distance from a port is a drawback which will eventually disappear with the extension of public tramways into the district.

At Long Plains some prospecting for gold has been carried on. The quantity of gold which was formerly obtained from this field stimulates continued search for its source.

At the Heazlewood silver-lead mining has been proceeding at Mount Stewart and Bell's Reward, and at the Confidence Mine.

Near Waratah, the Magnet Mine has continued regular consignments of an ore much sought by smelting companies; and a new tinfield, at the Badger, is being opened up.

At the Penguin, the Tasmanian Iron Company is breaking rich hematite ore, which is sold for fluxing purposes to the Smelting Works at Cockle Creek, New South Wales.

Iron ore deposits were also examined on the Dial Range, near Riana, and copper mines on the east side of the range. This district has not been adequately proved. It is geologically favourable for mineral lodes, and deserves attention.

*Progress Reports on the Mineral Industry.*

I have compiled four of these during the year. They have been favourably reviewed in the other States, and the demand for them abroad continues.

*Examination of Minerals and Rocks.*

Since the discontinuance of franking privileges, the number of specimens received for examination has decreased. All samples received are, however, tested (but not assayed), and an opinion is forwarded to the sender.

*Office.*

During the year eight geological and four progress reports have been issued, and the correspondence has amounted to 2160 letters, &c., in and out. Upwards of 300 yearly plans of underground surveys have been checked and indexed by Mr. F. S. Grove, whose services I duly acknowledge. The specimens in the office collection of minerals, rocks, and fossils, have been numbered, and a catalogue of them will be prepared. The receipt of specimens from Messrs. W. F. Petterd, W. R. Bell, T. C. Goodall, H. Conder, Cecil Hawley, Leslie Jolly, L. Simson, Sydney Thow, and Professor Gregory, is thankfully acknowledged.

*Iron Bonus Committee.*

On the 24th and 25th of September I attended the meeting of the Federal Iron Bonus Committee in Melbourne, and gave evidence as to the iron ore resources of Tasmania. The deposits mentioned embrace those of the Blythe, the Penguin, and other parts of the North-West Coast; those near Beaconsfield; the iron ore outcrops of the Savage and Meredith Rivers; at the South Heemskirk; and deposits along the West Coast range.

*Government Drills.*

I beg to annex copies of the boring registers of the two diamond-drills for the past year; the cores are labelled and stored. No. 1 drill has been employed at the Catamaran River, and on the Moss Glen coalfield, Recherche Bay; No. 2 was at work at Eden and Farm Cove.

*Catamaran Borings.*

A broad plain of coal-measure sandstone exists south of the Catamaran River. In the northern part of this the existence of coal in the form of a small seam had been established by a shallow shaft on Mr. McDougall's 38-acre section, and it was decided to put down two bores on the plain, while a syndicate prepared a track for the drill, which was to prospect its claim with a good seam on the north side of the river. The first bore was started on the 21st of July last, at the site marked No. 8 on the map accompanying my report on the coalfield in the neighbourhood of Recherche Bay. It was sunk to a depth of 229 feet 10 inches; at 161 feet, shale, with coal-markings, was passed through; and, at 216 feet 6 inches, eruptive rock (diabase) was entered, and continued to the depth above-mentioned. The contact of the sedimentary rock with the diabase was formed by a band of clay  $1\frac{1}{2}$  feet in thickness, containing vesicles and amygdules of calcite. The second bore was begun at the No. 7 site, further west, on the 22nd of September, and continued to a

depth of 726 feet. It passed through sandstones and shales, with occasional coal-markings, and entered fine-grained diabase at 695 feet, in which it remained till operations were suspended. It is evident that a flow of diabase underlies this plain, and the boring work shows that, in that part of the field, at any rate, no continuous deposit of coal exists.

Coal seams, however, are known both north and south of this, and I do not look upon the experience with the drill as excluding the possibility of good seams yet being found under this area.

#### *Moss Glen Borings.*

The Moss Glen Company has been prospecting its coal seams, with its own hand-boring plant, but these were found to be cut off frequently by diabase intrusions. The Government drill was put to work at two sites; one near the shore of Recherche Bay, at sea-level, and the other 200 feet up the mountain, a little ahead of the faulted seam. The lower bore was begun on the 2nd of March, and was continued to 515 feet. It passed through sandstone and shale, with veinlets of coal, and struck the diabase at 454 feet 6 inches, which continued to the bottom of the bore.

The upper bore was started on the 27th of May, and was continued to a depth of 152 feet, leaving off in sandstone with coal markings. At 56 feet 6 inches it entered a seam of coal and bands 8 feet 7 inches thick, but of poor quality, containing from 39 to 59·8 per cent. of mineral matter (as per analysis by the Government Analyst). Coal markings and veinlets of coal were met with throughout the bore, and at 104 feet 4 inches of coal were passed through. Boring was discontinued before a depth was attained sufficient to properly prove these strata.

#### *Eden.*

The No. 2 drill was started on the 28th July at the second site on the Eden Coal Company's section, and a depth of 110 feet was bored in sandstone and slate, with unfavourable indications. Although these trials have not been successful, the existence of coal-measure plants at the Henty makes it probable that coal will be found somewhere in this area.

#### *Farm Cove Boring.*

The No. 2 drill was employed boring near Farm Cove, Macquarie Harbour, in the Tertiary clays, sandstones, and shales, with a view to pierce these, and test the supposed underlying Permo-Carboniferous strata for seams of coal. The bore was started on the 11th of November, and taken down to a depth of 571 feet, leaving off in white clay. Occasional bands of lignite were passed through, the most important one being a seam 3 feet 10 inches in thickness at 9 feet 5 inches from the surface. The question whether coal-measures underlie the Tertiary ligneous beds here is still unsettled.

All the above boring operations were executed by arrangement with companies interested in the discovery of coal, and the expenses were partly borne by these.

#### *Alluvial Boring Plant.*

This has been let out on hire to the Pioneer and Ringarooma Tin Mines for their exploratory boring. The Pioneer Company

had it for 25 weeks from the 5th of July last, and the Ringarooma Tin Mine for 18 weeks from the 21st of January. It is now stored at the Ringarooma Mine.

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

W. H. TWELVETREES,  
*Government Geologist.*

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

No. 1 Diamond Drill.

RECHERCHE.

CATAMARAN No. 1 BORE.

Commenced 21st July, 1902; finished 5th September, 1902. Total depth bored, 229 feet 10 inches.

Nature of Strata bored through.	Thickness of Strata.		Total Depth.	
	ft.	in.	ft.	in.
Clay, surface ... ..	7	0	7	0
Diabase, boulders ... ..	11	2	18	2
Sandstone, floating ... ..	1	0	19	2
Shingle and boulders ... ..	0	6	19	8
Shale, soft, dark-coloured mud ... ..	2	4	22	0
Shale, hard, dark ... ..	2	2	24	2
Shale, dark and blue, soft broken ... ..	2	1	44	3
Shale, dark, and very hard ... ..	0	8	44	11
Shale, hard blue ... ..	8	7	53	6
Sandstone, hard grey ... ..	7	6	61	0
Sandstone, hard brown and blue, broken ... ..	45	0	106	0
Sandstone, hard brown, broken ... ..	29	0	135	0
Sandstone, solid ... ..	6	11	141	11
Shale, broken ... ..	9	4	151	3
Sandstone, broken ... ..	8	3	159	6
Shale, broken ... ..	1	6	161	0
Shale, broken, with coal-markings ... ..	9	3	170	3
Shale, blue and dark-coloured ... ..	10	9	181	0
Shale, blue ... ..	8	0	189	0
Sandstone, broken ... ..	4	10	193	10
Shale, pink and green talcose? penetrated by pink and white radiating zeolites in alternate bands ... ..	4	2	198	0
Shale and sandstone, broken ... ..	10	6	208	6
Shale, broken ... ..	6	6	215	0
Clay, with scattered vesicles and amygdules of calcite ... ..	1	6	216	6
Diabase ... ..	13	4	229	10

## RECHERCHE.

## CATAMARAN No. 2 BORE.

Commenced 22nd September, 1902; finished 17th December, 1902.  
Total depth of bore, 726 feet 6 inches.

Nature of Strata bored through.	Thickness of Strata,		Total Depth.	
	ft.	in.	ft.	in.
Clay, surface sandy ... ..	8	0	8	0
Shale, light-coloured micaceous ... ..	6	0	14	0
Clay, light micaceous, containing small nodules of dark clay ... ..	32	0	46	0
Sandstone, white crystalline or saccharoidal... ..	4	0	50	0
Sandstone, soft white micaceous ... ..	35	6	85	6
Conglomerate, white sandstone... ..	1	6	87	0
Sandstone, white, with mica and micaceous iron in joint planes... ..	5	0	92	0
Sandstone, white, with mica and micaceous iron ... ..	25	0	117	0
Sandstone, white crystalline, with mica and micaceous iron ... ..	14	0	131	0
Shale, white sandy ... ..	16	0	147	0
Sandstone, white crystalline ... ..	13	6	160	6
Sandstone, white micaceous ... ..	12	0	172	6
Sandstone, white, with flakes of specular iron. ... ..	14	0	186	6
Sandstone, white ... ..	38	0	224	6
Sandstone, yellowish, with mica and specular iron ... ..	23	6	248	0
Shale, grey micaceous ... ..	9	0	257	0
Sandstone, white, with specular iron ... ..	9	0	266	0
Sandstone, white ... ..	34	0	300	0
Sandstone, oxidised ... ..	1	0	301	0
Sandstone, white ... ..	12	10	313	10
Sandstone, white, with iron pyrites and specular iron ... ..	6	1	319	11
Shale, sandy ... ..	1	6	321	5
Shale, with very faint coal-markings ... ..	29	3	350	8
Sandstone, with micaceous iron ... ..	12	10	363	6
Shale, grey, with a little pyrites ... ..	11	0	374	6
Shale, dark grey ... ..	13	3	387	9
Shale, white sandy, with a little specular iron. ... ..	5	7	393	4
Sandstone, grey clayey, with much specular iron ... ..	56	8	450	0
Sandstone, with white micaceous iron... ..	25	3	475	3
Sandstone, broken ... ..	18	1	493	4
Shale, grey ... ..	36	8	530	0
Sandstone, hard, with white micaceous iron. ... ..	40	0	570	0
Sandstone, white ... ..	22	0	592	0
Rock, doubtful contact, with calcite ... ..	6	0	598	0
Sandstone, light grey ... ..	34	0	632	0
Rock, doubtful contact, with calcite ... ..	12	0	644	0
Quartzite, with fine impregnation of pyrites. ... ..	12	6	656	6
Shale, light sandy ... ..	16	3	672	9
Sandstone, blue, hard and broken ... ..	16	0	688	9
Diabase, fine-grained... ..	12	9	701	6
Diabase, altered, almost wholly replaced with calcite veins ... ..	25	0	726	6

No. 1 Diamond Drill.

RECHERCHE.

MOSS GLEN No. 1 BORE.

Commenced 2nd March, 1903; finished 22nd April, 1903. Total depth bored, 515 feet.

Nature of Strata bored through.	Thickness of Strata.		Total Depth.	
	ft.	in.	ft.	in.
Clay and sand, surface	3	0	3	0
Shingle	1	0	4	0
Sandstone, soft	2	0	6	0
Sandstone, felspathic, with coal-markings	84	0	90	0
Sandstone, solid	11	3	101	3
Sandstone and shale	5	4	106	7
Sandstone, dark broken felspathic, with coal-markings	7	8	114	3
Sandstone, with a little shale intermixed	15	9	130	0
Sandstone, felspathic, with coal-markings	21	0	151	0
Shale, carbonaceous	7	0	158	0
Sandstone and shale	7	0	165	0
Sandstone, felspathic, with coal-markings	32	6	197	6
Sandstone, broken	3	2	200	8
Shale, with coal-veins	1	8	202	4
Sandstone, felspathic, with coal-markings	43	8	246	0
Shale, dark	7	0	253	0
Coal, bright	0	6	253	6
Shale, dark sandy, with small veins of coal	7	8	261	2
Shale, dark sandy	3	0	264	2
Shale, sandy	8	1	272	3
Sandstone, felspathic	47	1	319	4
Sandstone, felspathic, with coal-markings	7	8	327	0
Shale, dark, with small veins of coal	14	2	341	2
Coal, bright	0	4	341	6
Shale, with veins of coal	1	2	342	8
Shale, dark clayey	7	0	349	8
Shale, dark sandy	13	6	363	2
Shale, dark clayey	9	2	372	4
Shale, dark	1	2	373	6
Coal	0	6	374	0
Shale	0	4	374	4
Coal	0	8	375	0
Shale, dark clayey	4	9	379	9
Shale, clayey, with veins of coal	9	8	389	5
Shale, dark clayey	7	7	397	0
Shale, dark	10	0	407	0
Sandstone, felspathic	14	0	421	0
Shale, dark micaceous	13	0	434	0
Sandstone, felspathic	13	0	447	0
Sandstone and shale	3	8	450	8
Shale, brecciated	3	10	454	6
Diabase, broken	1	6	456	0
Diabase, fine-grained	59	0	515	0

## No. 1 Diamond Drill.

## RECHERCHE.

## MOSS GLEN No. 1 BORE.

Commenced 2nd March, 1903; finished 22nd April, 1903. Total depth bored, 515 feet.

Nature of Strata bored through.	Thickness of Strata.		Total Depth.	
	ft.	in.	ft.	in.
Clay and sand, surface .....	3	0	3	0
Shingle .....	1	0	4	0
Sandstone, soft .....	2	0	6	0
Sandstone, felspathic, with coal-markings ..	84	0	90	0
Sandstone, solid .....	11	3	101	3
Sandstone and shale .....	5	4	106	7
Sandstone, dark broken felspathic, with coal-markings ..	7	8	114	3
Sandstone, with a little shale intermixed... ..	15	9	130	0
Sandstone, felspathic, with coal-markings ..	21	0	151	0
Shale, carbonaceous .....	7	0	158	0
Sandstone and shale .....	7	0	165	0
Sandstone, felspathic, with coal-markings ..	32	6	197	6
Sandstone, broken .....	3	2	200	8
Shale, with coal-veins .....	1	8	202	4
Sandstone, felspathic, with coal-markings ..	43	8	246	0
Shale, dark .....	7	0	253	0
Coal, bright .....	0	6	253	6
Shale, dark sandy, with small veins of coal ..	7	8	261	2
Shale, dark sandy .....	3	0	264	2
Shale, sandy .....	8	1	272	3
Sandstone, felspathic .....	47	1	319	4
Sandstone, felspathic, with coal-markings ..	7	8	327	0
Shale, dark, with small veins of coal .....	14	2	341	2
Coal, bright .....	0	4	341	6
Shale, with veins of coal .....	1	2	342	8
Shale, dark clayey .....	7	0	349	8
Shale, dark sandy .....	13	6	363	2
Shale, dark clayey .....	9	2	372	4
Shale, dark .....	1	2	373	6
Coal .....	0	6	374	0
Shale .....	0	4	374	4
Coal .....	0	8	375	0
Shale, dark clayey... ..	4	9	379	9
Shale, clayey, with veins of coal .....	9	8	389	5
Shale, dark clayey .....	7	7	397	0
Shale, dark .....	10	0	407	0
Sandstone, felspathic... ..	14	0	421	0
Shale, dark micaceous .....	13	0	434	0
Sandstone, felspathic... ..	13	0	447	0
Sandstone and shale .....	3	8	450	8
Shale, brecciated .....	3	10	454	6
Diabase, broken .....	1	6	456	0
Diabase, fine-grained... ..	59	0	515	0

## No. 2 Diamond Drill.

## FARM COVE BORE.

Commenced, 11th November, 1902; finished, 23rd January, 1903.

Total depth, 571 feet.

Nature of Strata bored through.	Thickness of Strata.		Total Depth.	
	ft.	in.	ft.	in.
Surface soil and sandy clay .. .. .	6	6	6	6
Lignite .. .. .	0	6	7	0
Clay, sandy .. .. .	4	11	11	11
Lignite .. .. .	0	11	12	10
Clay .. .. .	0	1	12	11
Lignite .. .. .	0	9	13	8
Clay .. .. .	0	6	14	2
Lignite .. .. .	0	4	14	6
Clay .. .. .	0	6	15	0
Lignite .. .. .	0	9	15	9
Shale, soft grey, clayey .. .. .	18	1	33	10
Shale, dark, full of carboniferous matter... .. .	1	6	35	4
Shale, grey, very soft .. .. .	13	4	48	8
Drift, coarse bluish-grey .. .. .	10	3	58	11
Shale, dark clayey .. .. .	7	9	66	8
Shale, dark sandy, carboniferous .. .. .	9	3	75	11
Shale, grey .. .. .	5	0	80	11
Shale, dark sandy .. .. .	3	1	84	0
Shale, light sandy .. .. .	3	9	87	9
Shale, very hard brown .. .. .	0	6	88	3
Sandstone, light and dark, very soft and friable	92	7	180	10
Lignite .. .. .	0	5	181	3
Sandstone, soft friable dark .. .. .	44	0	225	3
Sandstone, firm brown .. .. .	1	4	226	7
Sandstone, soft friable brown .. .. .	15	9	242	4
Clay .. .. .	0	9	243	1
Lignite .. .. .	0	3	243	4
Clay, soft grey .. .. .	3	0	246	4
Sandstone, dark soft friable .. .. .	29	6	275	10
Clay, white sandy .. .. .	3	0	278	10
Sandstone, firm brown, showing leaf impressions .. .. .	0	10	279	8
Sandstone, dark soft and friable .. .. .	26	9	306	5
Rock, light yellow... .. .	0	4	306	9
Clay, white sandy .. .. .	10	0	316	9
Sandstone, dark soft and friable... .. .	4	4	321	1
Clay, white sandy .. .. .	33	5	354	6
Sandstone, showing very thin bands of lignite	5	8	360	2
Clay, white sandy .. .. .	47	11	408	1
Sandstone, firm grey .. .. .	0	9	408	10
Sandstone, dark soft friable .. .. .	4	10	413	8
Lignite .. .. .	0	2	413	10
Sandstone, dark soft friable .. .. .	30	5	444	3
Clay, soft grey sandy .. .. .	7	11	452	2
Sand, clayey, very soft and white .. .. .	26	3	478	5
Sandstone, grey hard .. .. .	1	0	479	5
Sand, clayey, very soft and white .. .. .	26	1	505	6
Sandstone, soft, dark .. .. .	5	0	510	6
Lignite .. .. .	0	5	510	11
Sandstone, firm grey, showing fern impressions .. .. .	1	6	512	5
Sandstone, soft dark .. .. .	42	7	555	0
Clay, soft grey sandy .. .. .	16	0	571	0

## DIAMOND DRILLS.

Statement of work done during the year ending 30th June, 1903.

Locality.	Direction of Bore.	Number of Bores.	Total Distance Bored.		Average cost per foot inclusive of labour & fuel		
			ft.	in.	£	s.	d.
<i>No. 1 Drill.</i>							
Recherche (Catamaran).	Vertical	2	956	4	0	9	3
„ (Moss Glen).	„	2	667	0	0	7	6
<i>No. 2 Drill.</i>							
Eden .....	Vertical	1	110	0	1	3	0
Farm Cove.....	„	1	571	0	0	5	6
TOTAL .....	...	6	2304	4			

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

W. H. TWELVETREES,  
*Government Geologist.*

ANNUAL REPORT OF THE ASSISTANT  
GOVERNMENT GEOLOGIST.

*Zeehan, 30th June, 1903.*

SIR,

I HAVE the honor to forward you the following report on the work done by me during the year ending 30th June, 1903.

During this period I have been engaged exclusively in geological work on the West Coast, the districts examined being as follows :—

- (1) The Heemskirk tin-mining district.
- (2) The Comstock zinc-lead mining district.
- (3) The Zeehan silver-lead mining district.

My reports on the first two districts named have already been published. They contain a fairly exhaustive account of the geology of these districts, especially as regards the mining geology. All the discoveries have been described in detail, and topographical and geological plans have been prepared of the principal mines. It is most satisfactory to note that there appears every likelihood of there being a considerable influx of capital into both of these districts in the near future. As I have pointed out in my reports, both of these districts present features of very exceptional interest to the mining geologist. The Comstock district in particular affords what I have reason to believe will prove to be the clue to the origin of the Zeehan silver-lead lodes, and I believe that the conclusions which I was able to draw from the evidence presented will have a very extensive application to other types of ore deposits on the West Coast.

For the last six months I have been engaged in the Zeehan district. I have already made an exhaustive examination of all the mines which are at present accessible, and have almost completed a geological plan of the field. This plan will include an area of 16 square miles, and will give the geological and topographical features, lode formations, mine openings, roads, tramways, tracks, &c. The plan will, I believe, be a valuable aid to the mining community, and especially will be of assistance to prospectors, who will be able to locate almost all the lode formations which are at present known in the district. This plan will be ready for publication in a few weeks' time, and will be published before my report on the Zeehan district, which will still take some time to prepare.

In addition to the reports mentioned above, I forwarded you, on the 27th September, 1902, a report on the Western Silver Mine, Zeehan. This mine was examined during the previous year, before it was closed down. I understand that the mine will shortly be re-opened, a new company having been formed in London, with an efficient working capital.

I have the honour to be,

Sir,

Your obedient Servant,

GEORGE A. WALLER,

*Assistant Government Geologist.*

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

# ANNUAL REPORT OF THE CHIEF INSPECTOR OF MINES.

*Inspector of Mines Office,  
Launceston, 30th June, 1903.*

SIR,

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

I beg to enclose the yearly reports of Mr. M. J. Griffin, Inspector of Mines for the Northern, Eastern, and North-Eastern Divisions; of Mr. Jas. Harrison, Inspector of Mines for the Western and North-Western Divisions; and of Mr. C. H. Curtain, Inspector of Mines for the Lyell and Darwin Districts.

This year the number of men employed in the mines and smelting works of the State was 6484, compared with 6438 the previous year. The fatalities were 6, against 7 the preceding year; and other injuries 43, against 35 the year before. This results in a death rate from accidents of 0·925 per thousand, as against 1·088 per thousand the previous year.

The number of injuries sustained has been increased this year by inclusion of the accidents occurring at smelting works, these being for the year 9 men injured and 1 killed.

I append a comparative table giving the accident statistics for the past eleven years, and another classifying the accidents which took place in the year just ended. With our comparatively few miners it is unnecessary to represent the accidents graphically, as is often done, for the variations in the curve would be too abrupt to be of specially instructive value. The table shows the statistical features at a glance.

The percentage of accidents has not increased, as compared with ten years ago, though mining is carried on upon a much larger scale. I cannot, however, lay great stress on this, as a few accidents more or less have a sensible effect on the averages. Happily, the fatal accidents show a decrease compared with former years, and compare favourably with the other States.

In New South Wales the accident death rate for 1902 was 3·68 per thousand, raised abnormally by the disaster at the Mount Kembla Colliery; in Western Australia for 1902, 2·10; in New Zealand for 1902, 1·11; in Victoria for 1901, 1·11; in Queensland for 1901, 1·57 per thousand.

The Inspectors have, besides inspecting explosives and roads for other Departments, visited the mines in their respective districts regularly, and have discharged their responsible duties faithfully. If inspection had been less strenuous, some sources of serious danger would have continued. The calling of a miner, however, is inherently dangerous, and many mishaps are purely fortuitous, unpreventable by any amount of inspection; others are undeniably the result of carelessness on the part of the workmen, or spring from the parsimony of the mineowner. Special rules at the mine are designed to provide against some of these dangers; the general rules of the Mining Act deal with others; and the Inspector's duty is to take notice of cases where these rules are not observed, and to suggest additional precautions wherever necessary. The mineowners and mine managers are

responsible for the actual operations, but the Inspectors' visits are beneficial in inciting those in charge to compliance with obvious precautions and in giving counsel when needed.

In three cases mining managers were ordered by the Inspectors to discontinue operations: in one case until better ventilation was provided, and in the others until alterations were made to secure the safety of workmen. Proceedings were taken in one instance against a mining manager for neglecting and refusing to fence or cover an abandoned shaft, and a fine was imposed by the Court. Many of these old shafts, left open and unprotected, are dangerous to limb or life, but it is not always easy to sheet the neglect home, as in numberless cases the sections are without occupiers.

There are some 200 mines and claims inspected by the three officers, but the distances at which some of them are situated prevent visits being made to the more remote ones as often as could be wished. Owing to its distance, the Mount Cygnet Coal Mine has not been inspected this year.

A complaint was made by two miners at one of the collieries, under Section 97 of the Act, in respect of timbering and ventilation. In the absence of Inspector Griffin, I visited the mine and made enquiry into the matters objected to, without divulging the names of the complainants. I found friction existing between manager and men, and called attention to one or two things where improvement was possible, but on the whole the complaints appeared to be unsupported by the facts.

Accidents in smelting work (such as were not purely machinery accidents) have been reported to and enquired into this year by Inspectors of Mines by Ministerial direction, and at the request of those concerned. The Act includes smelting works under its definition of mines, but perhaps the embodiment in it of some more definite reference is desirable.

Inspector Curtin in his annual report again expresses his opinion that the height of open-cuts should be regulated by law.

Inspector Harrison has made a suggestion to me that the rule as to the maximum quantity of explosives allowed to be stored in any mine could with advantage be amended so as to make the limit not so many days' consumption, but so many cases of material. In large mines the present rule permits a large quantity to be stored, an explosion of which might have disastrous consequences, and managers like to keep large quantities in their mines, as the temperature is suitable.

In the course of a trial, *Allen v. the New Golden King Mining Co., N.L.*, the Judge at first commented adversely on Inspector Griffin's opinion that Subsection xiii. (signals) of Section 94 did not apply to shafts in course of sinking, but at the conclusion of the hearing, his Honor said he was doubtful whether the subsection really applied in this case. I think it right to mention this, as some of the press reports at the time did an injustice to the Inspector. The question of signals from the surface and along drives, as required by the Act, is receiving attention. I may say that the administration of the Act in general is governed by the requirement of Section 94, that the rules shall be observed as far as may be reasonably practicable. We are discussing now what is practicable or otherwise in this question of signals.

Inspector Griffin, in his report herewith, recommends the enactment of regulations providing for the daily and weekly

inspection of coal mines by competent persons, the daily inspection to be made before each shift, with a view of ascertaining the state of ventilation and general safety of the mine; the weekly inspection to be made with a locked safety lamp for testing the presence of inflammable gas. He has drawn up a rule which he proposes for this purpose, and with which I am substantially in accord.

No accumulations of inflammable gas are known to exist in our coal mines; but no one can safely predict its absence with the continuous increase of pressure as the workings advance further under cover. It is true that the seams of our largest collieries are not fiery, and no one has any suspicion of the presence of gas, but the terrible explosions elsewhere, attended with lamentable loss of life, in mines believed to be entirely free from gas, make it, in my opinion, incumbent on the Department not to allow stupendous risks to be run. For the past year the question of taking extra precautions in this respect has been a subject of consultation with Inspector Griffin, and has given cause for anxious thought. The result of his enquiries is expressed in his report, and I have the honour to commend it to your consideration.

In terminating this report, I beg to mention and bring to your notice the assiduous and efficient services rendered during the year by the Inspectors in their several divisions.

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

W. H. TWELVETREES,  
*Chief Inspector of Mines.*

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

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*COMPARATIVE Table of Statistics of Accidents in and about the Mines of Tasmania from 1892 to 1903.*

1st July to 30th June.	Number of Miners employed.	Number of Accidents.	Number of Persons.		Total killed and injured.	Average per 1000 killed and injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
1892-1893 .....	3295	28	4	25	29	8·8001	1·214	7·586
1893-1894 .....	3403	25	7	20	27	7·934	2·057	5·877
1894-1895 .....	3789	26	4	24	28	7·390	1·058	6·332
1895-1896 .....	4160	22	7	16	23	5·529	1·682	3·847
1896-1897 .....	4303	36	7	31	38	8·831	1·627	7·204
1897-1898 .....	5530	36	13	33	46	8·318	2·351	5·967
1898-1899 .....	6180	35	9	34	43	6·957	1·456	5·501
1899-1900 .....	6834	19	7	16	23	3·365	1·024	2·341
1900-1901 .....	7017	29	8	23	31	4·417	1·140	3·278
1901-1902 .....	6438	38	7	35	42	6·524	1·088	5·437
1902-1903 .....	6484	44	6	43	49	7·557	0·925	6·632

TABLE showing the Number of Persons Killed and Injured in and about the Mines of Tasmania during the Year 1902-1903.

PLACE OR CAUSE OF ACCIDENT.	INSPECTION DISTRICT.													
	Northern and Southern Division.		North-Eastern Division.		Eastern Division.		North-Western Division.		Western Division.				TOTAL.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Zeehan and other Districts.		Lyell District.		Killed.	Injured.
UNDERGROUND—														
Falls of Ground .....	1	1	...	...	...	2	...	...	...	2	...	2	1	7
<i>Shaft Accidents—</i>														
Suffocation by natural gases .....	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Overwinding .....	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ropes or chains breaking .....	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Machinery .....	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Falling in or into shafts .....	...	1	...	...	...	...	...	...	1	...	...	...	...	2
Things falling into shafts .....	...	2	...	...	...	2	...	...	1	...	...	...	...	5
Explosives .....	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Miscellaneous .....	...	...	...	...	...	...	...	...	1	...	...	...	1	...
Total .....	...	3	...	...	...	2	...	...	1	2	...	...	1	7

<i>Miscellaneous (underground.)</i>														
Explosives .....	...	...	...	...	...	...	...	...	...	...	...	...	...	
Suffocation by natural gases .....	...	...	...	...	...	...	...	...	...	...	...	...	...	
Haulage—														
On inclined planes .....	...	...	...	...	...	...	...	...	...	...	...	...	...	
Ropes or chains breaking .....	...	...	...	...	...	...	...	...	...	...	...	...	...	
By trams and tubs .....	...	1	...	...	...	...	...	...	1	...	...	...	2	
Machinery .....	...	...	...	...	...	...	...	...	...	...	...	1	...	
Sundries .....	...	4	...	...	...	...	...	...	...	...	1	...	5	
Total .....	...	5	...	...	...	...	...	...	1	...	1	...	7	
Total underground . . .	1	9	...	...	...	4	...	...	1	5	...	3	2	21
ON SURFACE—														
Smelting Works .....	...	...	...	...	...	...	...	...	3	1	6	1	9	
Machinery .....	...	1	...	...	...	...	...	...	...	...	...	...	1	
Boiler explosions .....	...	...	...	...	...	...	...	...	...	...	...	...	...	
Tramways .....	...	...	...	...	...	...	...	...	1	...	1	...	2	
Explosives .....	...	...	...	...	...	...	...	...	1	...	...	...	1	
Falls of ground.....	...	...	2	...	...	...	...	...	...	1	4	3	4	
Miscellaneous.....	...	1	...	1	...	1	...	1	...	1	...	...	5	
Total on surface.....	...	2	2	1	...	1	...	1	...	6	2	11	4	22
GROSS TOTAL, 1902-1903.	1	11	2	1	...	5	...	1	1	11	2	14	6	43
TOTAL, 1901-1902.....	...	5	1	3	2	2	...	2	...	16	4	7	7	35

ANNUAL REPORTS OF THE INSPECTORS  
OF MINES.

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

In submitting my Annual Report to you, I regret to have to record one fatal accident, which took place on the 22nd June, when a miner named T. Kestles lost his life through the flooding of the Florence Mine. The inquest has been held over until the jury can get below and inspect the workings. Other accidents consisted of three serious and nine not serious, many of the latter being hardly worth recording.

*Ropes and Cages.*—Ropes and cages are in good working order—one rope was condemned during the year.

*Ventilation.*—I have had no complaints in this respect, but found it necessary in one instance to compel a manager to suspend operations until better ventilation was provided for his men.

*Magazines.*—Magazines are clean and in good order. Two new ones have been erected during the year, one at Williamsford and one at Mount Farrell.

*Output.*—The output from the district is now about 4000 tons per month, with every prospect of a steady increase.

*Mines.*

*Zeehan Montana.*—This mine is keeping up a steady output, with large reserves of ore in sight.

*Mount Zeehan (Tas.)*—The mine looking well throughout. The manager has started to sink two new main shafts during the year.

*Comet.*—This mine has been very unfortunate, having been flooded out a few months ago through the fluming over the creek getting carried away in a heavy storm. This caused the company considerable expense and delay. The mine is now in full work again. The lode looking very well in No. 3 level.

*Zeehan Queen (late Silver Queen).*—Under the management of Mr. T. Vincent, jun., the machinery has been put in thorough repair, new boilers and steel poppet-heads placed in position, and the work of unwatering the mine is now being proceeded with. When this is done arrangements will be made to start sinking.

*Oonah.*—The mine is still being carried on by parties of tributors.

*Florence.*—Manager was making good progress in opening up the mine when the flooding took place. A few weeks' pumping ought to see the water out again.

*Western.*—This mine, which held the premier position on the field for several years, has been re-floated, and is to start pumping immediately. It will be under the management of Mr. J. Craze, of the Montana.

*New Mount Zeehan.*—New Mount Zeehan has only a few small tribute parties at work.

*Mount Read District.*—Hercules Mine is opening up very well; abundance of ore in sight. An air-compressing plant has been erected during the year, and No. 5 adit is being put in by this means.

*Mount Read.*—This mine, which has been idle for several years, has again made a start. A deep-level adit has been started.

*Fahl Ore Co.*—The manager is still putting out small parcels of high-grade ore, which is purchased by the Mount Lyell Company.

*Mount Farrell District.*—North Mount Farrell Mine.—A good ore-dressing mill has been erected and started; it is giving satisfaction. Mine is opening up well. An adit has been put in to cut the lode at the same level as the mill. When a connection is made with the shallower workings, all the ore, both for the picking sheds and the dressing mill, will come that way, making a big reduction in cost of delivery.

*Mount Farrell.*—Mount Farrell mine manager has struck a large formation in the end of adit, showing thin veins of ore, which assay well. It is confidently expected that good ore will be obtained when the other wall of the lode formation is struck.

*Mackintosh.*—A good lode has been struck in the mine, and sunk on to a depth of about 40 feet, when the water got too heavy for the appliances. A chamber has been cut in the side of adit, and a small pumping and winding plant is being put in position. A rise to the surface will carry away all smoke and steam.

*Murchison and Central.*—Both these mines have resumed work, with favourable prospects, after being idle for some time. Indeed, the Mount Farrell district promises to add very considerably to the output of the Coast in the near future.

*Waratah.*—At the Bischoff Mine matters are going on as usual.

*Magnet.*—This mine maintains a good output of gossan and sulphide ore, last quarter's returns showing a net value of £8940 on ore won and sent away. Preparations are being made to sink a main shaft on the course of the lode, for which purpose a compressing plant is being provided.

*Heemskirk District.*—Mayne's.—The adit through the spur to turn the creek will soon be completed. When this is done good tin returns may be confidently looked forward to.

*Connor's Tin Mine.*—Several men at work raising tin, with good results.

*Federation and Montagu* are both under offer to good strong syndicates. There are numerous parties at work in the district, some of them doing well. Many of the leases on the side of the Mount are awaiting better weather before anything can be done. The Government has made several good pack tracks up the face to the Mount, and there is another under construction now, which will open up a lot of new country to the prospector.

*Stanley River District.*—Several parties have been at work on the Stanley tinfield, and some good shows have been opened up; but the Pieman River is the drawback. A suspension bridge will have to be erected before machinery can be got on to the ground.

#### *General.*

In conclusion I may state that prospecting is going on in all directions, and all points to a brighter future for the Western District.

*LIST of Accidents in Inspector Harrison's District for 12 months—30th June, 1902, to 30th June, 1903.*

Date.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Remarks.
1902. 13 Sept.	Mount Zeehan (Tas.) S.L.	Zeehan	Fall of hammer	Arthur S. Mayne	Married	Wound on head	Helping to fix ladder in pass; man working about 20 feet above let hammer fall, and it struck Mayne on head.
20 July	Ditto	Ditto	Bucket fell out of cage	Michael A. Hoy	Ditto	Broken thigh	Was braceman. Through mistake in signals the engine-driver knocked empty bucket out of cage, and it fell on Hoy.
12 Nov.	Hercules G.S. and C.	Mt. Read	Fall of stone	Harry Hanson	Single	Both legs broken	Working in face of drive after shot; a piece of stone came away from face and struck him on the legs.
13 Nov.	Comet S.M.	Dundas	Jambed by truck	Chas. Lucas	Ditto	Brvised hand	Got his hand between the buffers of two trucks.
1903. 7 Mar.	Mount Zeehan (Tas.) S.L.	Zeehan	Thrown out of cage	Chas. Symmons	Married	Shock to system	Descending in cage; driver lost control of engine, and Symmons was thrown out.
26 Mar.	Comet S.M.	Dundas	Fall of truck	Jas. Daly	Single	Sprained ankle	Riding on a full truck; truck ran off rails and threw him off.

14 April	Tas. Smelting Co.	Zeehan	Explosion of powder	Edwd. Coleman	Married	Burns head and face	Preparing to bull a hole; in spitting the fuse about two pounds of powder, in a keg close by, became ignited.
"	Ditto	Ditto	Thrown off truck	Jas. Annear	Single	Cut on head	} Were riding on an empty bullion truck, which was accidentally thrown off the line.
"	Ditto	Ditto	Ditto	Henry Cooley	Married	Bruised shoulder	
"	Ditto	Ditto	Ditto	Winston Triffett	Single	Bruised leg	
17 May	Magnet S.M.	Waratah	Fell while lifting timber	Jas. Herrick	Ditto	Injury to bowels	Lifting a mine prop in the bush, and fell; timber struck him in abdomen.
22 June	Florence S.M.	Zeehan	Flooding of mine	Thos. Kestles	Married	Smothered by mud	Working below when mine became flooded, and failed to escape.
25 "	Zeehan Montana	Ditto	Fall of rock	Wm. Wilson	Ditto	Injury to back	Working in stope, and while stooping was struck on back by a stone.

Totals—1 fatal ; 12 non-fatal—13.

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

For the year ending the 30th of June, 1903, I have the honour to supply the following brief summary of the casualties, &c., that have taken place in my district for that period :—

(a) Mount Lyell Mining and Railway Company, Limited.—Iron Blow Workings, Gormanston : (1) William Garlick, labourer, widower, aged 43 years; had his ankle crushed and bone broken by a piece of spoil rolling down the face of No. 1 bench and jamming his foot against the skip he was filling. (2) Edward Johnson, labourer, single, aged 21 years; compound fracture of leg and ankle, caused in the No. 2A bench under similar circumstances, only the man's foot was pinned against the tramrails. (3) George Board, labourer, single, aged 42 years; small bone of leg broken and ankle dislocated, by being jammed between two pieces of overburden on the No. 2 bench. (4) Peter Thompson, labourer, married, aged 31 years; fracture of left collarbone, probably due to falling, and contusion to right of spine. Thompson was engaged doing special work on No. 4 bench (barring down) during the crib time, and noticing a quantity of ore coming away, endeavoured to save himself by scrambling down the face, but before getting clear was overtaken and knocked down. His injuries were not serious, as he left the ward within a week of his admission. (5) John Gillespie, labourer, single, aged about 47 years; paralysis of body and contused wounds of face and jaw. This was the only fatality that attended *mining work* during the year, Gillespie being injured by a rock falling from the eastern portion of the face of the No. 1 bench on the 23rd of June, and dying three days later. The Coroner's enquiry resulted in a verdict of death by accident. Reduction Works : Here on the 5th of July, 1902, an interior explosion of unknown gas took place at No. 5 furnace, severely injuring two men—(1) Leopold Burrows, potman, married, aged 25, (2) Walter Marsh, tapper, married, aged 26—and fatally injuring (3) Thomas Jukes, potman, widower, aged 60. An enquiry was held, but beyond the cause stated, nothing else could be advanced to assist the Jury, who returned a verdict of accidental death, there being no evidence of negligence on the part of any one. (b) North Mount Lyell Mining and Railway Company.—At the mine (1) Ernest Moore, miner, married, aged 36, was seriously injured on the 22nd of October, while "popping" boulders in the stopes of the No. 1 level. A large slab-shaped piece of ore, that had previously been shot down, fell on Moore, and producing concussion of the spine, resulted in paralysis of the body from the hips downwards, from which Moore is still suffering. (2) Thomas Chowley, trucker, single, aged 30 years, severely bruised on the left shoulder by a piece of country falling from the back of the No. 2 level. Timber was advanced with the ground opened, and after sounding the back, preparations by cleaning up, &c., were being made for another set (square), when the accident happened. Chowley recovered, and left for East Coast. Reduction Works, Crotty : (1) Stephen Hahn, slag-wheeler, married, aged 41 years, and (2) James Dormer, potman, single, aged 21, were with others engaged clearing away a burst of matte when, by contact with water from the granulating drain, an explosion took place, seriously injuring Hahn and slightly Dormer. Both recovered. (3) Frank Gomez, tapper, single, aged 24, severe burns to foot. Gomez attributes his

injuries to the carelessness of a fellow-workman in leaving an empty pot on his track, that caused him to fall, and the molten matte from the pot he was handling splashed into his boot, with the above result. He is still an inmate of the local hospital. (4) William Barnett, tapper, single, aged 25 years, severely burnt on back, buttocks, arms, and hands. Barnett, following the customary practice of walking backwards with a pot of matte, fell into another. Instantly realising his position, he jerked himself out again, which presence of mind saved his life. He is still an inmate of the local hospital, and making an excellent recovery. He attributes blame to no one. South Mount Lyell Mine, Gormanston.—(1) John Deegan, surface hand, single, aged 21, was engaged filling ore trucks, and while walking to his usual work, attempted to mount a loaded truck, and, falling on the line, sustained injuries to the lower part of his right leg. He made a complete recovery, and was solely blameable for the mishap, as instructions had been posted cautioning all against riding on the trucks. (2) Louis Churd, platman, single, aged 25 years. By the breaking of a strong arm, Churd fell on a piece of slab, having two wire nails protruding, that caused injuries to his left buttock. He made a speedy recovery, and resumed work in a fortnight. All these casualties can be ascribed to circumstances that were purely accidental.

*Ropes and Cages.*—These have received frequent inspection, and all that are at present in use are in good order.

*Ventilation.*—In the two principal mines this has been good, and at the time of suspending operations at the South Mount Lyell the manager was about completing a "100-feet" connection from the stopes with the shaft, that would materially benefit his future operations. At the Blocks Mine another 100 feet has been added to the depth of the shaft, which now totals 572 feet, but the manager refuses to make any further connection with the higher workings, or surface, either for the purposes of ventilation or safety.

*Open-Cuts and Quarries.*—The former continue to increase in size, and I am still of opinion that regulations of a more definite character are required in order to govern their future.

*Breach of Regulations.*—Proceedings were taken against Edward Charles Russell, who was in charge of the King River P.A.'s tribute party, for failing to cover abandoned shafts on that property. The charge was proved, and a fine of £2, with 10s. costs, was inflicted.

*LIST of Accidents in Inspector Curtain's District for Twelve Months, 30th June, 1902, to 30th June, 1903.*

Date.	Name of Mine.	Locality.	Cause of Accident.	Name of sufferer.	Married or single.	Nature of Injuries.	Remarks.
1902. 16 July	Mount Lyell M. & R.	Mt. Lyell	Falling rock	Wm. Garlick	Widower	Crushed and broken ankle	Stone rolled from face, and jammed his foot against skip.
22 Oct.	North Mt. Lyell	Ditto	Fall of stone	Ernest Moore	Married	Injury to spine, causing paralysis from hip down	Was popping boulders, which had been shot down from stopes; whilst boring a hole he was jammed by a boulder, which slipped and caught him about loins.
22 Dec.	Ditto	Ditto	Ditto	Thos. Chowley	Single	Bruised shoulder	Was trucking; a portion of the face came away, and jammed him.
1903. 8 Jan.	Ditto	Crotty	Scalded by molten matte	Stephen Hahn	Married	Severely burned	Hahn and Dormer were engaged at the smelters. Some matte escaped from the furnace, which the men proceeded to break up when considered sufficiently cool; the matte was not cool enough, and when the crust was broken began to run; some went into slag-drain, and caused an explosion.
"	Ditto	Ditto	Ditto	James Dormer	Single	Slightly burned	
17 Jan.	South Mt. Lyell	Mt. Lyell	Run over by truck	John Deegan	Ditto	Bruised knee, calf, and toes	Attempted to jump into truck in motion; his foot slipped, and wheel went over lower part of leg and foot.
24 Jan.	Mount Lyell M. & R.	Ditto	Fall of stone	E. Johnson	Ditto	Compound fracture of leg and ankle	Working on overburden bench; a piece of rock rolled about 4 feet, and caught his leg.

26 Jan.	Ditto	Ditto	Ditto	George Board	Ditto	Small bone of leg broken, ankle dislocated	Working at overburden; a piece of rock rolled about 5 feet, and caught his leg.
13 Jan.	Ditto	Ditto	Ditto	Peter Thompson	Married	Broken collarbone and bruised back	Barring down rock after a shot; some of it came away, and knocked him down.
23 June	Ditto	Ditto	Ditto	John Gillespie	Single	Injury to spine, face, and neck; causing death	Filling a waggon at open-cut; a stone came away from face, and struck him on the head. He was paralysed, and died on 19th July.
1902. 5 July	Ditto	Ditto	Explosion in furnace	Walter Marsh	Married	Severe burns	Employed at furnace of No. 1 plant; an unaccountable explosion took place, forcing out some of the molten matte on to the men. Jukes died on the 19th July.
"	Ditto	Ditto	Ditto	Leopold Burrows	Ditto	Ditto	
"	Ditto	Ditto	Ditto	Thos. Jukes	Widower	Burns; causing death	
1903. 1 Jan.	South Mt. Lyell	Ditto	Fall in drive	Louis Churd	Single	Wound in buttock	Placing truck in cage; strong arm broke, and he fell backwards on to a plank, from which two wire nails were sticking out.
13 Mar.	North Mt. Lyell	Crotty	Overflow of molten matte	Frank Gornez	Ditto	Right foot severely burned	Whilst moving a pot of molten matte he stumbled over an empty pot, which had been left in the way. Some matte splashed over on to his foot.
28 May	Ditto	Ditto	Fell into pot containing molten matte	Wm. Barnett	Ditto	Severe burns on back, hips, arms, and hands	While delivering a pot of molten matte he fell backwards into another which stood near.

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

I have the honour to submit my Annual Report on mines inspected in the Northern, Eastern, and North-Eastern Divisions, during the twelve months ending 30th June, 1903.

*Accidents.*—Fatal, 3; serious, 13; not serious, 4; total, 20.

Of the fatal accidents, William Dawson was killed whilst employed as nozzle man at the deep open-cut face of the Scotia Tin Mine, near Gladstone. After having undercut a prominent point with the hydrant, Dawson went close into the face, probably to examine the washdirt. His mate, working a little way down the tail-race, heard a thud and splash, and on looking up saw him lying on his back. A portion of the fallen mass of pug and cement, already on his feet, rolled forward on to his chest, and caused death from suffocation before assistance could be rendered. Deceased, who was for some considerable time engaged as manager of the mine, was known to be an experienced and careful man, never allowing those under his charge to run any risk. He evidently stepped backward, and his feet sticking in the soft bottom prevented him from escaping the falling mass of pug and cement. No blame is attachable to any person for this accident. Kooee Chung, a Chinaman, 70 years of age, was killed while working a miner's claim for tin at head of Black Creek, near Branxholm. He and a mate were ground-sluing—picking down the face about 8 feet in height into the sluice-race. A large stump was being taken down, and in falling one of the long roots struck deceased in the chest and knocked him down. He was immediately covered with earth and smothered. Chinese as a rule are incautious, and take but little heed of any warnings given them. Edgar Shepherd, 17 years of age, was employed as wheeler or trucker at the Dulverton Colliery. The seam being worked is only 18 inches in thickness. The practice is to work this in four-yard bords on either side of the heading or truck-road, and without breaking the roof or floor. Thus the men have to work in a recumbent position, from which it is not easy to get clear of any sudden fall from the roof. Shepherd was in such a position, and, although well protected by the propped portion of the roof under which he was lying, he had to reach forward into the 5-foot passage, between the line of props and the coal rib, so as to shovel back the coal from his brother, Nat. Shepherd, an experienced miner, working in the face. The roof in the passage referred to was not considered to be unsafe, either by the manager or the man, Nat. Shepherd, working in that bord. The shaly clod was, however, inclined to flake; a large flat piece fell suddenly from the roof, the extreme edge striking deceased on the temple, and jamming his head against a prop. Death must have been instantaneous. This accident may be classed as unavoidable; yet there seems to be necessity for a regulation requiring daily inspection on the part of the manager, or other competent person, immediately before the men commence work on any shift in our coal mines.

*Serious Accidents.*—Thomas Crook was working down loose rock, portion of the hanging-wall in stope at Tasmania Gold Mine; a large lump rolled and caught his leg, bruising it badly. No bones broken; accident unavoidable.

Alfred Watkins was raking quartz into a pass at same mine, dropped his candle, went down the pass to recover it, and was struck on the head by a stone that fell from the collar of the pass; received a nasty cut and slight fracture of outer skull-bone. Accident due to his own carelessness.

Walter Ferrall was engaged shaft-making at the New Golden King Mine. Fixed a single plank for a stage in the shaft 15 feet above the bottom, and proceeded to replace some centres knocked out by blasting. His mate, John Mortimer, went to the level 20 feet above where he was standing, and attempted to lower a centre plank to him. It slipped from the rope, and striking the stage plank, knocked it away. Ferrall fell to the bottom of the shaft into 3 feet of water; sustained severe shaking and injury to his side, which incapacitated him for work for some time. Both manager and man were to blame in this case; Mortimer for not using a cage or bucket, and properly securing small timber therein before lowering. He pleaded ignorance of General Rule Subsection xxi. The manager had provided proper means for lowering timber in a shaft, but neglected to supply Mortimer with a copy of General Rules, in accordance with Subsection xliii. of the Act. It was not considered necessary to take any legal proceedings against the offenders; an all-round severe reprimand for carelessness was thought sufficient.

William Finch was trucking at the Tasmania Gold Mine. Truck went off the rails, tipped the footplank, and threw him with force on to the corner of the truck. He sustained three broken ribs. Accident unavoidable.

William Arnold walked into a heap of hot ashes at Tasmania Gold Mine, and received severe burns to one foot and leg. Was off work for a fortnight. Accident due to his own carelessness.

John Johnstone was working in No. 2 stope at Tasmania Gold Mine. The cap over which he was standing gave way owing to defective hitch in footwall, and he fell some few feet into the stope below, amongst loose stones, and broke his ankle. He has only himself to blame for the accident; the defective hitch was his own work, and he was more than once cautioned to be more careful.

Harry Cottareil was assisting to haul a long cap into position at the Tasmania Gold Mine. The rope broke, and he fell backwards and down about 3 feet, struck a tie piece, and broke his shoulderblade, but not badly. A better rope should have been provided for work of this kind.

Alfred Johns was screwing up glands of poles in pump shaft, Tasmania Gold Mine. He slipped, and fell 10 feet on to staging, sustained shock and bruises. No bones broken. The accident was unavoidable.

Lewis Fred Butten was filling quartz into a truck at schute (Tasmania Mine) when he was struck by a flying fragment of steel, the injury received resulting in the loss of one eye. No one to blame for accident.

James Lahner was spawling rock at the Mount Rex Tin Mine, when a fragment of stone from the hammer struck him, the accident resulting in loss of one eye.

John Quinn was trying to put a belt on to the pulley of battery cam-shaft at Anchor Tin Mine. He slipped, and fell 10 feet on to the next floor, striking his head in the fall against a beam. He was unconscious for some time. The doctor pronounced injuries to be concussion of the brain. A fortnight after the accident he appeared to be all right again.

Robert Thomas was packing a gland of hydraulic-power engine at the Tasmania Gold Mine when the gland slipped and caught his hand, severing the first joint of one finger, and breaking the bone of another.

Jeremiah Maher was engaged running off overburden at the Briseis Tin Mine. He was caught by a slip of earth from top of face, and forced over the side of a bank. Sustained a severe shock, and had one rib broken.

Of the not serious accidents, Joseph Allen, underground manager at the Tasmania Gold Mine, was struck on the head by a small stone while examining an empty pass.

William Simmons was engaged shaft-sinking at the Mount Rex Tin Mine. The bucket on being hauled to the surface struck an opening set passing a level, and some of its contents was tipped out, Simmons received some slight cuts on the head from the falling dirt.

Harry Wilson was raking quartz into a pass at the New Golden Gate Mine; a large lump of stone fell from the backs, rolled over against him, and jammed his foot.

Peter Crawford was mooling a hitch in stope at Tasmania Gold Mine; his mate's hammer slipped, striking him on the knee, and causing a slight injury.

Nine out of thirteen of the foregoing serious accidents, and two out of four of the non-serious, occurred at the Tasmania Gold Mine, Beaconsfield: a rather high percentage for one mine. Carelessness on the part of the men themselves is responsible for very many of the accidents that occur; this was particularly noticeable at this mine until recently; more strict supervision is now improving matters in this direction.

*Observance of Rules and Regulations.*—It cannot be said that there is much improvement in this direction, especially on the part of the miners themselves. It was hoped that the issuing of a copy of the General Rules to each miner upon being engaged, as provided by Sub-section XLIII. of the Act, would improve matters; but such is not the case. A large percentage of the accidents that happen are due to the carelessness or negligence of the men employed; of the balance, many of course are unavoidable; only a few are caused through the negligence of owners or managers. Of the three fatal accidents, two were caused by the incautiousness of the unfortunate men who were killed; the third might possibly have been averted under a better system of supervision in the working of thin seams in coal mines.

*Defective Workings considered unsafe.*—In one case, that of the Tasman Ophir Alluvial Gold Mine at Beaconsfield, it became necessary for the inspector to order a cessation of work and departure of the men from the lower level main drive, until certain alterations and improvements to the shaft and drives, and general equipment of the mine, so as to put it in a safe condition for men to work in, were carried out. This mine is owned by a Sydney company, and worked on freehold property. Several attempts have been made during the past 20 years to reach the wash, supposed to be very rich, at the deepest part about 400 feet from the surface. The shaft was first sunk to a depth of 300 feet, for the most part in the sandstone rock; the influx of water was heavy, and work was abandoned. The ground is now thoroughly drained by the neighbouring Tasmania Quartz Mine. A couple of years ago, the present Company re-opened it; the shaft was sunk to 400 feet in a sort of a way. One end was allowed to come in, so that when the lower level was reached the length was reduced by one-third. Attempts were made to drive through the western rim-rock, and tap the wash-dirt; but with only partial success. Several mine managers succeeded

each other; and the inspector had on nearly every visit to deal with a fresh man, who promised to carry out the orders his predecessor failed to comply with. Disregard for the safety of the men employed was often shown; one lad had a narrow escape from being killed, and only saved his life by clinging to the signal-line after falling from the bucket that he and the manager were descending on. There was no hope of improvement, and I therefore ordered a cessation of work as above. The mine is now being worked in a satisfactory way under the management of Mr. J. F. Murphy.

*Cages, Ropes and Chains.*—These have been inspected and tested at regular intervals, and where found defective have been condemned. Not much to complain of in this direction, so far as the large mines are concerned, where weekly overhaul, cleaning, and inspection is the rule. Some of the small mines, however, are not so good, and require more attention from the inspector.

*Ventilation.*—I am glad to report an improvement in this. The Tasmania Gold Mine which, from the extent of its workings and quantity of natural gas in the strata, requires a more perfect system of ventilation than perhaps any other mine in the State, has at last effected a great improvement. The two main working shafts have been connected by drives, and a rise put in from the 718-foot level in the main shaft to the Reidler pump chamber, at 600-foot level in Hart's shaft; other connections have also been made in the western portion of the mine. The boxed air-drift from the Florence shaft along the 600-foot level is nearly finished. This done, the Roots' blower obtained over a year ago will be started. I understand that this machine is now to be used as an exhaust-fan to draw the light air out of the mine; reversing it, and using it in the opposite direction for what it was designed, is not likely to improve its efficiency. A proper Walker exhaust-fan would give a much better result than the reversed blower; and the initial cost would not have been greater. At the New Golden Gate Mine much has also been done to improve the ventilation, in the way of rises, and a separate connection with surface at the south of main shaft.

*Complaint made.*—Only one complaint was formally made as provided by Section 97 of the Act. Two miners at the Mount Nicholas Colliery complained, in writing, of defective timbering in travelling way, ladder insecure, and water lying in parts of drive; also bad ventilation, gate-roads too low and insecure, main heading defective. The Chief Inspector of Mines, in my absence, visited the colliery, and made a thorough inspection and enquiry, with the result that, although not entirely groundless, the complaints made, for the most part, were considered unjustifiable. A dispute between manager and men as to work required to be done by the latter, as part of their contract, had, I think, a lot to do with the making of this complaint.

*Outlying Mines.*—The Barn Bluff Mine was visited and inspected in March; only six men were then employed. The new track from Gad's Hill to the mine, finished a year ago, shortens the route as compared with the Innes track by nearly half; the former being 24 miles the latter 46 miles. Another great advantage is that half the distance—12 miles—of this new track is up the valley of the Forth River, over good sound country, no hills to speak of, and below the ordinary snow-line; so that the traveller in the most inclement weather can find shelter from the hills both east and west. The Innes track, on the other hand,

traverses the tops of dividing-ranges and high plateau country, over bleak open country, and apart from being double the distance, is only accessible for two or three months of the year; even then there is some risk of being driven back by sleet, or of being enveloped in fog. There is, of course, Gad's Hill to descend, and the hill west of the Forth to ascend, going out on the new track. The descent of Gad's Hill to the Forth River on the western side is made by a 5-foot side-cutting, in rich basaltic soil, the distance being about 3 miles through a heavily timbered country; gradients are not too steep for wheel traffic, but, of course, will require metalling for this. All the land in the vicinity has recently been selected for farming purposes. Ascending the hill on the west side of the Forth River is at present the most difficult part of the journey. Before this is reached, there is 12 miles of good travelling, in a southerly direction, up the east side of the River Forth; sound country, for the most part over sandstone, schist, and river shingles. Several large creeks come down from the east, all of which are bridged. For about 5 miles, the track lies close to the river, and there is good deal of side-cutting; the crossing is by means of a substantial low-level bridge, that from its position and construction is not likely to be damaged by floods. Having crossed the river to the western side, the track follows up-stream for two miles; some soft places occur, but the covering of peaty soil is only a couple of feet in depth, and overlying a sound bottom of river shingles, and schist. In constructing the track, many of these soft places have been got over by stripping off the peaty surface, and exposing the gravel, or the rock, as the case may be; this method ensures sound travelling, and, if rather wet in the channel track, is at least safer than having to struggle through mud and roots. Immediately after crossing the Commonwealth Creek, coming in from the west and junctioning with the Forth at this place, the ascent of a hill locally named "Razor-back" is commenced; the track is now zig-zaged for about 70 chains, the rise in this distance being something like 1700 feet. This is too steep for anything like the ordinary pack load; 1 in  $2\frac{1}{2}$  to 1 in 3 cannot be climbed without great exertion. It would not be very difficult nor expensive to reduce this zigzag to an easier gradient, by lengthening the leads. The rock, a white schist, is generally of a soft nature, and, as the country is only sparsely timbered, a moderate outlay would greatly improve the ascent of "Razor-back." Should this be done, there will then be a good practicable route over half the distance to be traversed between Liena on the Mersey, and the West Coast Mine; and a track for the reasons already stated, that will be accessible at any season of the year. Nearing the top of Razor-back, the track rounds some steep cliffs, south of Commonwealth Creek; thence, for another mile, following up the creek to the Barn Bluff Mine. The camp is situated on a spur, between the Commonwealth and its confluent, Cooks' Creek, and is about 4 miles south-east of Barn Bluff mountain; it is approximately 3300 feet above sea-level; west of the camp, the hill still rises, and another 500 feet has to be climbed to reach the plateau and Lake McRae. The latter is only one mile distant from the mine, and from this source a good supply of water for motive-power is obtained.

*Mining Operations.*—A good deal has been done in the way of open-cut and shallow pit prospecting, the principal mining work is, however, by means of tunnelling; there are three of these,—No. 1 is centrally situated between the other two, and has a

bearing for the first 255 feet of 225°, thence for 92 feet at right angles to this first section the bearing being north-west. The mineral belt passed through is composed of quartz, schists, fluor-spar, micaceous iron, and actinolite carrying copper and iron pyrites. No. 2 tunnel, about 100 feet to the north-west of No. 1, is in 96 feet, on a course parallel to the first part of No. 1. It has been driven for the most part through solid lode matter containing copper-pyrites, and is following what appears to be a fairly well defined wall; no work was being done in this tunnel at the time of my visit. No. 3 tunnel is on the south-west side of the spur, and close to the big band of chlorite schist that forms the south-west boundary of the mineral formation; it was driven only 20 feet and abandoned. Work is now confined to No. 1 tunnel, which has cut what is said to be the lode formation driven on in No. 2; it is intended to follow this, on its south-west course, until its junction with the band of chlorite schist is reached, when good results are expected. The machinery comprises a Little Giant Air-compressor, and machine drills, operated by a 24-inch Pelton-wheel, and working to a pressure of 60 lbs. The water supply is obtained from Lake McRae by means—for the first mile—of an open channel, terminating on the cliffs immediately above the mine. From this point it is conveyed to the mine through about 700 feet of 6-inch black riveted-iron piping; the "head pressure," being equal to nearly 500 feet; the efficiency obtained from this is not, however, as good as it ought to be: the defect is probably owing to the machinery not being properly set up. There is a lot of friction that should not exist. Altogether the Company have expended a lot of money, and have had many difficulties to over-come, especially in the early stages and before the new track was opened. Supplies could only be obtained at irregular intervals, owing to the roundabout and almost impassable state of the Innes' track; even now, the cost of packing from Liena—24 miles, is for food supplies 1½*d.* per lb.; and for explosives, and other mining requisites, 3*d.* per lb. Miners are paid 10*s.* per shift; there are now only 6 men, including the manager, on the mine.

*Middlesex.*—There was no work going on at the Devon Mine, nor at Shepherd and Murphys', in March; I therefore did not visit these mines.

*Coal Mines.*—The two large Collieries.—Mount Nicholas and the Cornwall, have been inspected at regular intervals; at the Mount Nicholas Colliery, work has been going on steadily throughout the year, and I am glad to report an improvement in the working of this mine, especially with regard to ventilation. The return airway has been straightened, and made higher in places, the furnace at upcast shaft bricked in, and more attention generally is given to matters concerning the safety of the men employed.

At the Cornwall Mine, work was stopped for several months, owing to the men coming out on strike, and demanding an all-round increase in the contract price for hewing, when at one or two places only did the hardness of the coal justify such a demand. The Company refused to be coerced into compliance with the demand and shut down the colliery until at last they were enabled to obtain non-union labour, many of the old hands abandoning the union and returning to the colliery to work under non-union rules. The Company was forced to abandon its contract to supply coal to the Melbourne Harbour Trust; the loss sustained in this way is—they

maintain—more than compensated for by being able to work their colliery by non-union labour. The working of this colliery with regard to the safety of the men employed was satisfactory.

*Mersey Coal Mines.*—Spreyton Mine. Mr. Allison, the proprietor, has 7 men working an 18-inch seam from a low tunnel extended about 140 yards into the hill. The conditions under which these men work with regard to height, space, and dryness, are not nice. The main tunnel is only 4 feet in height, gate-roads are even less than this, just sufficient to allow of the skips being run in. Each bord, 8 yards wide, opening off these gate-roads, has a passage for the skip down the centre, the roof being cut to obtain sufficient height for this; the 18-inch coal-seam is worked on either side, without cutting either roof or floor, the men working in a recumbent position, from which it is not easy to escape accident should a fall of roof occur. Stowing the goafs or worked out spaces with *debris* from the road brushings, also supporting the roof with timber props as the work proceeds, is carefully attended to; drainage was defective, causing a muddy state of roads and working places; this was ordered to be remedied, also repairs to tunnel timbers. The coal is worth 12s. per ton delivered at the rail station, three miles distant.

*Dulverton Colliery*, some 5 or 6 miles further south, is also an 18-inch seam; and worked under similar conditions to Spreyton, the roof and floor being somewhat harder, and drainage better. Only three or four men are employed in the summer time, more hands being put on in winter, when there is a better demand for coal. It was at this mine that the lad Edgar Shepherd, already referred to in the fatal accident list, met his death. It is quite likely that he would have escaped had there been more room between the roof and floor. A regulation, making it incumbent on the manager, or some competent person authorised by him, to carefully inspect the mine of which he has charge, immediately before the commencement of shift, is required. The usual practice in Coal mining is to work on day shift only, the mine is therefore standing for 16 hours out of every 24 and, apart from the state of the ventilation, the roof and sides may have become unsafe during the interval. This matter will receive attention in new regulations proposed to be introduced.

*York Plains and Colebrook.*—I inspected these collieries in November, 1902, and again in June last 1903. On each visit I found but little doing at Colebrook, the Marialva Company is slow in developing its mine; several changes have been made; the mode of working and equipment is not altogether satisfactory. The Glenleith mine, close by, is owned and worked by Mr. Andrew Morrison, whom I found was away at Hobart for a few days. The shaft from which the coal is landed is 64-feet in depth, and worked by a horse-whim. There is a second shaft close by this, which serves as a travelling way for the owner and the one man he employs to assist him in working below, the ladder by which they descend and ascend is a single pole with short pieces nailed across, a dangerous contrivance; everything about the mine was in a defective state, and not safe to be used. I had therefore to order the cessation of work below ground until renewals and repairs ordered are effected, and the mine put in a safe working condition. At York Plains, some few men—five or six at most, are getting coal by means of tunnelling into a hill. The seam, is worked to the dip, a new tunnel being opened when a certain distance is reached, and the haulage in the old one becomes

expensive. Contractors for coal getting are as a rule not too careful in securing the ground they work, a fall of roof in this mine, just before I visited it in June, points to something like wilful neglect on the part of the men employed. The owner, Mr. A. H. Warner, who resides in Hobart, tells me that he has had a lot of trouble in getting the men, who are all working tonnage rate for coal getting, to work the mine properly. This state of things is likely to last so long as the man he employs as manager is also one of the contract party. It will be necessary for me to visit these small coal mines at the usual quarterly rounds in future; twice a year is not often enough to inspect where such loose methods of mining are practised.

*New Regulations required.*—Now that the principal mines—Mt. Nicholas and the Cornwall—have extensive workings, extending into the hill for nearly a mile in places, and with an increasing depth of the overlying stratas, it becomes a question of whether it would not be prudent to introduce fresh enactments, requiring the owners of these and other similar mines that may be developed hereafter, to provide a means of testing for the presence of fire-damp in any mine over a certain specified depth from the surface, and extent of area worked; also, to provide and keep on the mine a certain number of safety-lamps of an approved make, to be used in case of emergency, should such arise. Inspection of the mine and all working places before the men enter at commencement of a shift, should also be required. During a visit to the coal-fields of New South Wales, Newcastle, Wollongong, and Lithgow, made in September, 1902, I had an opportunity of gaining a lot of useful information with regard to the means employed for detecting the presence of fire-damp (light carburetted hydrogen) in the mines; also other matters concerning the management and working of coal mines; and of hearing the theories advanced by experts and others as to the cause of the terrible disaster, by which 93 men and boys lost their lives in the Mount Kembla Colliery, on the 31st of July, 1902. The presence of from 5 to 13 per cent. of carburetted hydrogen, mixed with the ordinary atmosphere, when brought in contact with a naked light, is sufficient to cause an explosion. The ordinary safety-lamps used by miners in fiery mines will only detect fire-damp when the quantity reaches two per cent or upwards. Tests made in this way, with the ordinary lamps, have, in most instances, and for a great number of years, been considered as a sufficient precaution against explosions of fire-damp. It has been discovered of late years, however, that a small percentage of this gas mixed with coal-dust will, if ignited, cause an explosion. Some authorities say that 1 to 1½ per cent. is sufficient. To detect the presence of this low percentage, hydrogen gas in a specially-constructed lamp is used; by this means one-quarter per cent of fire-damp can be detected. These lamps give a dull, red light, and are only used for the purpose of inspection, and to detect the low percentage that the ordinary working lamp would not show. Explosions have been known to occur in mines where fire-damp had never been detected. This was so in the Cammerton Mine, England, which has been worked for 100 years; yet an explosion occurred, and killed several men. Fire-damp was known to exist in the Kembla Colliery many years ago, when a man, cutting through an old goaf, was badly burned; no explosion occurred then, as the gas was only in the inflammable stage. For many years prior to the late disaster no fire-

damp was discovered in the mine. Coal-dust had accumulated in appreciable quantities in dry parts of the mine; a sample of this obtained by the Chief Inspector of Coal Mines, Mr. Atkinson, and sent to Woolwich to be tested, was pronounced to be violently explosive; but as no gas had been officially reported by the inspectors, and as he, the Chief Inspector, had not discovered any when he inspected the mine a few months before the disaster, it was not considered necessary to suggest the use of safety-lamps. From expert evidence given at the inquest, mainly that of Mr. A. Atkinson, Chief Inspector of Coal Mines, the following deductions may be arrived at:—1. That coal-dust and one (1) per cent. of firedamp, with a naked light, are dangerous; but the dust must be in a cloud, and those conditions do not ordinarily exist in a mine. That an accumulation of this gas in the goafs or unstowed portions of old workings in a coal mine, or in working-places left unworked for several days, may be suddenly dispelled by a fall of roof, carrying along with it coal-dust in sufficient quantity (1 lb. to 160 cubic feet of air and 1 per cent. of gas) to cause an explosion when brought in contact with a naked light. 2. That in a naturally wet mine, or in a mine where the roads and working places are frequently watered to keep down coal-dust, there is not much danger of explosion until the firedamp, should there be any, reaches 5 per cent. This percentage, mixed with air, will, if brought in contact with flame, explode without coal-dust being present. Following a suggestion of our Chief Inspector of Mines, Mr. W. H. Twelvetrees, I made inquiry whether firedamp in New South Wales is confined to the Permian Coal Measures (= our Mersey field), or has been observed in Mesozoic Coal (= our Mt. Nicholas). The coal mines of New South Wales are mainly in the Permo-Carboniferous measures, and are all more or less "fiery;" especially so in the "Bulli" seam, where 13,800 cubic feet of inflammable gas was known to have accumulated in eight hours.

With reference to precautions necessary to be taken, the advice given by inspectors, colliery managers, and other competent persons is, "Make inspection before the shift-work commences compulsory in all coal mines; such inspection, so far as the large mines worked below a certain depth are concerned, to be made with an ordinary working safety-lamp, of the most approved up-to-date make. Inspection of "wastes, unstowed goafs," and other vacant and abandoned places, to be made periodically; a hydrogen lamp for detecting small quantities of firedamp to be used if found necessary, or in very dry mines where coal-dust accumulates."

After having conferred with Mr. Twelvetrees, Chief Inspector of Mines, on the foregoing, I have now the honour to recommend that regulations, drafts of which are appended hereto, be made law.

No one can be brought face-to-face with, or view the disastrous results of such an explosion as wrecked the vast workings of the Mt. Kembla Colliery, causing appalling loss of life, without being deeply impressed with the necessity for taking, with regard to the working of coal mines, every possible precaution to avert a similar occurrence.

*Tin Mines.*—The Mount Rex has finished blocking out stone at the No. 2 level, and made ready for stoping above this. Some fairly good stone was obtained from the north end at this level,

the extent of which is not yet known. The main shaft has been sunk 91 feet, and made ready to open out, and crosscut for the ore-body at this, No. 3 level. The new dam is finished, and it is estimated that this will give water sufficient for driving, if required, double the number of stamps now in use.

The South Esk Company is opening up a very promising tin-lode on its property, and is still getting fairly good returns from the alluvial.

Anchor Tin Mine has a good water-supply, sufficient to keep the full battery running for the greater part of the year.

Australian Tin Mine: Not doing much. The prospects of this mine warrant a larger expenditure for development than the company are apparently prepared to put into it.

Star of Peace (Upper Cascade), finished the erection of its machinery in February. The plant, which is from the Gates Co. of Engineers, America, comprises a 10-head battery, stone-crusher and elevator, buddles, jigs, and frue vanners, driven by steam power. 3268 tons of stone crushed to 30th June gave a return of 21 tons of tin-ore. The stone is taken from open-cut, on a formation similar to the Anchor Mine, but is close to the contact of slate and granite; a belt of the former rock coming in from the Mount Victoria side. The company has had many difficulties to contend against in opening up the mine and erecting machinery. The outlet for the mine-products is to Ringarooma, a distance of eight miles, over one of the worst bush-roads on the East Coast.

Arba Tin Mine finished its drainage-tunnel to carry off the overflow from the haulage bins; removed the barge and sand-pump closer to the face and commenced elevating and sluicing in September, 1902, since which time 126½ tons of tin-ore has been obtained. The drift is lifted a total vertical height of 144 feet, viz., 34 feet by the sand-pump into the bins, thence to the surface, 110 feet, by means of tanks on an inclined tramway. About 34 men are employed, including woodcutters. The depth of the ground worked is from 130 to 140 feet. This mine is worked in a systematic and intelligent way by the manager, Mr. G. J. Bondry.

The Briseis Mines have taken over the working of the New Brothers Home No. 1, by an arrangement with that company, and extensive operations in the way of removing overburden are now going on, this exceptionally wet season giving an abundant supply of water.

Pioneer Tin Mine.—315,900 cubic yards of drift have been pumped and sluiced during the year, for a yield of 392½ tons of stream-tin, and dividends declared amounting to £23,250, equal to 18s. 6d. per share. The ground is now worked in two benches; the upper bench drift is sluiced direct to the sump of the large pumping plant, while the smaller pumping plant, situated at the lower or gutter-level, raises the bottom drift to the sluicing-level of the larger plant, which then handles the material, water and sand from both faces, and lifts it into the main sluice-race, the combined lift of both plants being 115 feet, of which the larger plant is lifting 80 feet, and pumping, latterly, 6000 gallons per minute.

A large dam is being constructed on Bradshaw's Creek, about 1½ miles above the mine. It is now intended to stack the tailings in the worked-out ground, and to enable this to be done, another large centrifugal pumping plant (similar to the present one, but

rather more powerful) is ordered, and its erection will shortly be commenced.

Scotia Tin Mine (North Mt. Cameron).—The proprietor, Mr. James Gulloway, has just completed the construction of tunnel tail-race, 17 chains in length, which will greatly facilitate the working of the mine. The open-cut face is 55 feet in depth, carrying tin more or less from the surface downwards; the bottom slope of 5 feet of wash being exceptionally good.

In the vicinity of Moorina, the old mines are maintaining fairly good outputs of tin.

Messrs. Thomas and Houston have taken up ground south of the old Frome workings, on which they have about 12 men employed.

The Weldborough Tin Mining Company is extending its main rock-tunnel through into the wash-dirt, to be worked in open-cut.

The exceptionally wet autumn and winter experienced has given a good supply of water to the smaller shows depending on storm-water for their supply, and a good many men are employed in consequence.

#### REGULATIONS FOR COAL MINES.

*Inspection before work commences.*—A competent person or persons, appointed by the owner or manager for the purpose, not being contractors for getting mineral in the mine, shall, within such time immediately before the commencement of each shift, as shall be fixed by special rules made under this Act, inspect every part of the mine in which workmen are to work or pass during that shift, and shall ascertain the condition thereof so far as the ventilation, roof, sides, and general safety are concerned. No workman shall pass into the mine or into the part so examined until these have been stated by such competent person to be safe. In every mine worked at a greater depth than 100 feet below the surface, and having an area of worked-out ground, goafs, or waste spaces of over two acres in extent, an inspection, in addition to the one before work as aforesaid, shall be made once in every week with a locked safety-lamp; and such weekly inspection shall include all wastes, goafs, and old or abandoned workings within the ventilating district inspected.

A report specifying the condition of the ventilation and the defects, if any, in roof or sides, and whether noxious or inflammable gas has been discovered during such inspection, shall be recorded, without delay, in a book to be kept at the mine for the purpose, and accessible to the workmen; and such report shall be signed by, and so far as the same does not consist of printed matter, shall be in the hand-writing of the person who made the inspection.

For the purpose of the foregoing provisions of this Regulation, so far as daily inspection is concerned, two or more shifts succeeding one another without an interval may be deemed to be one shift.

*Discovery of inflammable gas to be reported to Inspector.*—If at any time the discovery is made that inflammable gas exists in a mine, it shall be the duty of the manager, or in his absence, of the person in charge, to report such discovery

forthwith to the Inspector of Mines for the district, who, after inspecting the place, if he considers the quantity of gas so discovered sufficient to render the use of naked lights dangerous, may, after having reported the same to the Minister, and obtained his consent thereto, order the use of safety-lamps in such place.

*Safety-lamps to be kept on a mine where inflammable gas is known to exist.*—Every owner of a coal mine shall, upon a discovery of firedamp or inflammable gas being made in his mine, provide and keep in good order and ready for immediate use, as many safety-lamps as may be required by men working in any part of the mine in which the use of naked lights may be considered dangerous by the inspector, or if, by reason of the small quantity of gas discovered, the inspector should consider the use of safety-lamps to be unnecessary in the working of such mine, they shall then be provided and kept as aforesaid in case of emergency.

*LIST of Accidents in Inspector Griffin's District, for the 12 Months 30th June, 1902, to 30th June, 1903.*

Date.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of injuries.	Remarks.
1902. 12 Aug.	Tasmania G.M.	Beaconsfield	Fall of rock	Thomas Crooks	Married	Bruised leg	Taking down portion of hanging wal ; large piece came away and caught his leg.
10 Sept.	Ditto	Ditto	Falling stone	Joseph Allen	Ditto	Cut on right temple	Inspecting stope recently filled with mullock ; struck by stone falling down pass.
30 Sept.	New Golden Gate	Mathinna	Fall of stone	Harry Wilson	Ditto	Injuries to foot and head	Removing quartz from stopes; large stone fell from back of stopes and rolled against him.
29 Sept.	Mt. Rex T.M.	Ben Lomond	Ditto	Wm. Simmons	Single	Injured head	Sinking main shaft ; a bucket full of stone, on being hauled up, struck cap piece at No. 2 level and some stone was knocked out, falling on him
14 Oct.	Tasmania G.M.	Beaconsfield	Ditto	Alfred Watkins	Ditto	Ditto	Stone fell from pass and struck him on head, fracturing outer bone.
25 Oct.	New Golden King	Mathinna	Fall of timber	Walter Ferrall	Ditto	Bruised left side	Assisting to sink shaft, and standing on a plank about 15 feet from the bottom ; a piece of timber, which was being lowered from about 20 feet above, slipped out of sling, struck plank, and carried it away.
30 Nov.	Tasmania G.M.	Beaconsfield	Fall on truck	Wm. Finch	Married	Three broken ribs	Trucking clay ; truck came off rails and struck plank on which he stood, throwing him on to the corner of the truck.
15 Nov.	Ditto	Ditto	Stepped into hot ashes	Wm. Arnold	Single	Foot and leg burned	Stepped into a heap of hot ashes.
15 Dec.	Ditto	Ditto	Fall in stope	John Johnston	Ditto	Broken ankle	Working in stope ; timber on which he stood gave way, and he fell on to some loose quartz.

1903.							
20 Jan.	Ditto	Ditto	Ditto	Harry Cottereill	Married	Broken shoulder blade	Pulling on rope, hauling cap piece; rope broke, and he fell 18 feet.
26 Jan.	Ditto	Ditto	Ditto	Alfred Johns	Ditto	Bruised and shaken	Screwing up glands; slipped and fell about 10 feet on to clack staging.
17 Feb.	Scotia T.M.	Gladstone	Fall of earth	Wm. Dawson	Single	Crushed to death	Sluicing down face; went forward to examine wash, and was caught by a fall of earth.
9 Feb.	Tasmania G.M.	Beaconsfield	Struck by splinter of steel	Fredk. Batten	Married	Injury to eye	Filling truck with quartz at a chute; a splinter of steel flew from the truck and penetrated his eye, causing its loss.
5 Mar.	Anchor T.M.	Lottah	Fall in battery house	John Quinn	Single	Concussion of brain	Trying to put belt on cam shaft; he slipped, and fell 11 feet, his head striking a hand-rail in the fall.
30 Mar.	Tasmania G.M.	Beaconsfield	Struck by hammer	Peter Crawford	Married	Bruised knee	Mouling a hitch; his mate's hammer slipped, and struck his knee.
4 April	Ditto	Ditto	Machinery	Robert Thomas	Ditto	Injury to hand	Packing gland of ram in hydraulic power engine; gland slipped, and took top off one finger and broke a second.
21 Feb.	Mt. Rex T.M.	Ben Lomond	Struck by flying rock	James Lahner	Single	Blow on eye	Spalling rock, and a splinter struck him on eye, causing its loss.
25 April	Miner's Claim	Brånxholm	Fall of earth and stump	Koee Chung	Ditto	Chest and body crushed, causing death	Working in tail-race which ran close to, and parallel with, a face; a fall of earth and stump came away from face and caught him, crushing him to death.
5 May	Dulverton Colliery	Dulverton	Fall of clod	Edgar J. Shepherd	Ditto	Head crushed	Portion of roof fell, and jammed his head against prop, causing death.
22 Jan.	Briseis T.M.	Derby	Fall over bank	Jeremiah Maher	Ditto	Broken rib	Removing overburden; a slip occurred, and forced him over bank.

## REPORTS OF THE COMMISSIONERS.

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

I have the honour to submit my Report for the year ending 30th June, 1903, upon the state of mining in the North-Eastern Mining District.

### GOLD.

There has not been any material improvement in the State of gold-mining in the Mount Victoria locality since my last state of gold-mining in the Mount Victoria locality since my last Annual Report, operations being carried on by small co-operative parties of miners, and confined to shallow lode-mining, and also prospecting. The gold won from crushings amounted to 521 ounces; and from alluvial mining, 24 ounces. Reefs of good average richness are known to exist upon several of the claims, but the want of capital causes the industry here to languish. I do not look forward to any marked improvement in the prospects of this place until sufficient capital is provided to test these reefs at a good depth.

At Warrentinna nothing worth noting has been done during the past year.

In the vicinity of Gladstone about 90 ounces of gold were won from the Brisbane Company's mine, formerly called the Portland; but this mine has been closed down.

There are several parties carrying on prospecting operations for gold reefs at Waterhouse and vicinity, with very satisfactory results, and a few sections have been applied for. The quartz lodes found here are of such richness as to warrant sufficient capital being provided to test them at a good depth.

### TIN.

In the Ringarooma, Maurice, and Upper Cascade localities satisfactory progress has been made during the past year.

The Star of Peace Company has erected a 10-head battery in its mine at Upper Cascade, which is in full work crushing the lode-stuff for tin ore. The workings consist of an open cutting, about 30 feet in width and 25 feet in depth. The manager estimates that it will take four months to carry the cutting up to the main shaft in which the lode was found. This mine looks fairly well. About 30 men are employed.

At the Maurice River the Red Banks Company is opening up its mine by hydraulic pressure, and prospects appear promising.

There are six leases being mined in the above localities, about 50 miners in the aggregate being employed upon them. There are also 17 miners' claims held, upon which 26 European and two Chinese are carrying on mining operations.

In the vicinity of Branhholm, the Arba Tin Mining Company has made satisfactory progress in the development of its mine, the yields on the whole being very good. About 40 men are employed in connection with the mine.

The several leases held by the Chinese at Ruby Flat continue to produce highly remunerative yields of tin ore. A new mine, named "The Contact," is being opened here by a syndicate, the prospects of which are considered very encouraging.

At Derby, the Briseis Tin Mines, Limited, having, since the completion of its new Ringarooma and Maurice water-race, an abundant supply of water for hydraulic purposes, has made considerable progress in the removal of the heavy overburden that has to be contended with before the tin drifts can be reached. A large quantity of the tailings are dumped in the river flats on its lease. Satisfactory progress has been made in the carrying out of the necessary mining operations upon this claim. About 417 tons of tin ore have been won during the past year. Considering the large quantity of overburden that has been removed during this period, this work being carried on simultaneously with the treating of the tin drifts, this yield may be looked upon as very satisfactory. The number of men employed in the mine averaged about 111. The New Brothers' Home No. 1 Company has, I understand, entered into an arrangement with the Briseis Company, under which the latter company will mine the adjoining lease held by the former company, having an abundant supply of water for the purpose. It is considered that this arrangement will prove beneficial to each of the parties to the agreement.

The Ringarooma Tin Mining Company is, I am informed, making arrangements for the erection of a more powerful plant upon its mine, so that a very much enlarged quantity of stuff can be treated. Mining operations will be suspended for a few months, until the new machinery will be erected, when mining operations will be carried on on a more enlarged scale in developing the deep lead of tin ore that intersects their lease. About 50 tons of tin-ore have been mined by this company during the past year.

The several small claims in the locality of Moorina, Weld and Frome rivers, have returned very profitable yields, and their appearance indicates that this will continue for a considerable time.

The Pioneer Tin Mining Company's Mine at Bradshaw's Creek maintains large outputs of tin-ore. The work at the mine is carried on under very able and careful management. During the past year 315,900 cubic yards of drift have been pumped and sluiced, for a yield of 392½ tons of stream-tin, and 18s. 6d. per share (equalling £23,250) declared in dividends. Since the inception of sluicing by the present company, 687 tons of stream-tin have been won, and £28,125 (equalling 22s. 6d. per share) have been paid in dividends. A large dam is being constructed in Bradshaw's Creek to provide an additional supply of water from that source for the mine. It is proposed shortly to stack the tailings in the worked-out ground. Another large pumping plant similar to the present one has been ordered, and its erection on the mine will shortly be commenced. A further series of bore-holes has been sunk between those put down some years ago, and proved the average depth and tin contents of the lead to be greater than was first estimated. The present position and future prospects of this mine are excellent.

At Wyniford River there are several small claims being mined with profitable results. The Garibaldi T.M. Co. obtained 32 tons of tin ore from its old claims.

In the South Mount Cameron district a number of miners' claims have been worked, principally by Chinese, and have yielded about 28 tons tin ore.

The preparatory work at the Scotia Tin Mine deep lead, situate near Gladstone, and owned by Mr. Galloway, is now completed, and mining operations will in future be carried on extensively. The prospects of this mine appear very satisfactory, and its proprietor is deserving of every success in his enterprising and costly undertaking in the opening up of this mine. In future large yields may be looked for.

There are several small claims being mined at Boobyalla River and vicinity, with but poor results.

Prospecting operations by means of boring-rods are being carried on at Bradshaw's Creek and its vicinity, testing the ground for a continuation of the Pioneer Company's deep lead. In other parts of the district a large amount of prospecting work is being done, which will probably lead to a considerable area of land being applied for to lease for mining purposes. During the autumn and early winter months there has been an unusually heavy rainfall, which has afforded an abundant supply of water for mining purposes, and has enabled a considerable extent of land to be mined that in previous years remained unworked through deficient water supply.

There is an increase in the quantity of tin ore won during the year ending 30th June, 1903, as compared with a similar period ending 30th June, 1902, of 443 tons 10 cwts., the quantity raised during the former period being 1379 tons 16 cwts., and the latter being 963 tons 16 cwts. As compared with the quantity raised during the year ending 30th June, 1901, being 683 tons 4 cwts., there is an increase of 696 tons 12 cwts.

With a continuation of a plentiful supply of water during the coming year, I look forward to a large increase in the output for that period.

It is gratifying to observe that the tin-mining industry in this district appears to be in a healthy and progressive state. A considerable amount of capital has been judiciously expended in *bonâ-fide* mining operations and works, in the development of deep leads of alluvial tin ore, and profitable returns may reasonably be looked for. On the whole, the prospects of the tin-mining industry appear brighter and more enduring than they have done for many years previously.

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

I have the honour to submit my Report for the year ending 30th June, 1903, upon the mining industry in the Eastern Mining District.

#### GOLD.

*Mathinna and vicinity.*—The mining industry in this portion of the district appears to be in a thoroughly healthy condition.

*The New Golden Gate.*—The mine has been working for the past 15½ years, and during that period gold to the value of over £700,000 has been won. This has been obtained from reefs varying from 3 to 30 feet wide and up to about 300 feet in length, from the surface down to the 1500-foot level. At present very little is being done at this level. These reefs have been cut off at a point south by a slide. Up to a few months ago the company had only been working on stone north of this slide, but lately, in prospecting south of the slide, at the 500-foot level, the continuation of

the reef has been discovered. A distance of from 60 to 70 feet has been driven on the reef. It has proved to be from 17 to 20 feet in width, at present, in face, being 20 feet wide, the assay of the stone being  $1\frac{1}{4}$  oz. The mine manager is now cross-cutting for the reef at the 316-feet, 600-feet, and 700-feet levels, and hopes within a few months to open up the reef at these levels. The value of this discovery cannot be estimated, but in all probability it means a big renewal of life to the mine.

*The Volunteer Consolidated.*—On this mine, at a depth of 450 feet, some good stone has been obtained. When I visited it, on the 17th of July last, 50 tons of stone had just been delivered to the Volunteer battery. There are three or four gold-bearing reefs on this property. All have been proved to be so, but not to a sufficient depth—I can only conclude, for want of capital. The prospects seem certainly to warrant a thorough trial, which the present company seem prepared to give. At 450 feet good stone has been found, and at that level the manager is driving to strike the intersection of two other reefs, which are known to carry gold. Should the stone at that depth prove payable, a long life to the mine is more than probable.

*The Volunteer.*—This company is also going down on its lode, with encouraging results. It has added to its battery, and has a good supply of stone to treat by it.

*The Tasmanian Consols*, late North Golden Gate, has opened up at 1200 feet, and driven 46 feet west, where it struck a continuation of the New Golden Gate ore-body with an average width of payable stone 4 feet. About 90 tons of stone have been raised, and will shortly be crushed at the New Golden Gate battery.

*The Yellow Boy Company.*—This claim is situated close to the Volunteer Consolidated. A tunnel has been driven between and 300 feet, and a trial crushing of 90 tons gave satisfactory results.

*The Golden Stairs.*—A company is being formed to develop this claim; the prospects are good, and work would have commenced now if the scare in Launceston had not occurred.

*The New Golden King* is opening up fairly well, and the company will soon be able to reap the advantage of crushing at its own battery.

*Mangana and vicinity.*—For some months nothing has been done at the mines in this neighbourhood. I am informed that at the *Mangana Reefs* work will shortly be resumed. The great drawback to progress in this portion of the district is the fact of so much of the land being private property.

*Abbotsford Creek.*—This property is situated near Tullochgorum. Work is being pushed along vigorously. A battery of 30 head of stampers is being erected, also a water-race constructed, and at the same time development of the ore-body is proceeding.

#### TIN.

*Avoca and vicinity.*—Mount Rex Mine.—This mine was first worked by a New Zealand company, for silver-bearing galena. After a few years the silver and lead gave place to tin, in the form of cassiterite, some copper, iron pyrites, zinc-blende, and a little galena. The company took out 3000 tons of stone or ore, from which they obtained 170 tons of tin oxide (metallic tin at that time being only £60 per ton). They then practically abandoned working the property, and leased it to tributors,

who in turn took out 1180 tons of ore, obtaining 81 tons of tin oxide. After this the property was floated as a public company, for 100,000 shares, but only 5000 were put into working capital, and this materially crippled the advantageous working of the mine. After disposing of a certain quantity of tin ore (concentrates), obtained from the 20-head battery installed by the new company, the purchasers in the Australian market refused to take any further lots, on account of its complex composition. The company then sent 50 tons to England, which netted them £54 per ton. This was in 1902, and since then there has been no difficulty in selling all the ore produced. During the past year, ending 30th June, 1903, the mine has been steadily developed. The necessary dead work that should have been taken in hand previously has been commenced. When the present manager took charge, in August, 1902, the development consisted of an adit level, driven in from the surface 40 feet below the outcrop, and a shaft sunk to a depth of 140 feet, from which a crosscut was driven to cut the ore-body. This met the ore 52 feet from the shaft, and, the level being opened up, has since proved the body of tin-bearing stone to be 78 feet wide and 100 feet long, still extending in a north-westerly direction. It is from these two levels that all the stone sent to the battery by the present company has been obtained. Since August last 4700 tons of stone have been supplied to the battery, the shaft has been further sunk 100 feet, and a crosscut 150 feet in length has been driven, proving the ore-body at this level (No. 2) 240 feet in depth to be 72 feet wide, and still extending. From this crosscut a drive has been put northwards, which is now in 25 feet, all in stone of payable quality, varying from 1 per cent. to 3.5 per cent. metallic tin. This drive, as well as the main crosscut, will be continued through the ore-body, and the level thoroughly proved. Arrangements are being made to sink the shaft still deeper. A battery, consisting of 20 head of stamps, double sets of plunger-jigs, Wilfley tables, and buddles, receive the stone from a Jacques crusher, which is connected to the surface plat by a tramway. The battery is run by water-power, situated at a higher elevation, and conveyed by means of a race  $3\frac{1}{2}$  miles in length, giving at the Pelton wheel a pressure of 120 lbs. to the square inch. A new dam is now in course of construction, which, when completed, will, with the old one, contain about 400,000,000 gallons of water—more than sufficient to keep the machinery running all through the year. The recent developments in No. 2 level, 240 feet, have been exceedingly encouraging, the drive put in toward the north still being in excellent stone, the assay being 1.87 metallic tin, equal to tin oxide 2.5 at 70 per cent. Considering the fact that experience in No. 1 level proved the northern end of the ore-body to be much richer than the southern end, there is every reason to expect richer stone when this level is opened up. From the above, it is clearly evident that, under the present systematic management, this property is being proved to be of value, increasing as depth is obtained.

*South Esk.*—This claim is situate about  $3\frac{1}{2}$  miles from Avoca. It is alluvial, and by careful management is made to pay.

*St. Helens and vicinity.*—In this portion of the district it is all alluvial working, but I hope in the near future a payable lode will be discovered. The principal leaseholder is the *Royal Ruby Company*, which is steadily working with payable results. Its race, which is twelve miles in length, gives it quite sufficient water, and, to all appearance, it has better prospects ahead.

*Thureau's Deep Lead.*—This company has, during the past year, had difficulties to contend with in repairs to its race. Now things are more satisfactory, and its ground has shown improvement. The other lessees working are *Patterson, P.*, and *Stevens and Fowell*. There are 22 miners' claims, and all the men are making fair wages.

*Lottah and the Blue Tier.*—At the *Anchor Mine* work is steadily proceeding. The season has been favourable, and the race has supplied a fair amount of water. It is much to be regretted that it has been found necessary to close down the *Liberator Mine*, as it promised well, but required more capital. The *Australian* ceased work for a time, but has now resumed. A tram is being put in, which will very materially be of benefit, causing far less handling the ore in conveying it to the battery. At the *Blue Tier* a strong Melbourne syndicate has taken up 13 previously-forfeited sections, in all containing 372 acres. The property will no doubt now be prospected thoroughly, and those who know the country are very sanguine as to results.

*Weldborough and vicinity.*—The *Weldborough Company* has at present 15 men employed, the work carried on being a dam at the intake of water-race at the *Cascade River*, continuing the low-level tunnel, the length of which will be about 1000 feet, and, as the driving lately is in much softer rock, a few weeks now should finish this very arduous undertaking. Sluicing the soft rock at a higher level is also being carried on with satisfactory results.

The *Weldborough Company* has seven men at work with hydraulic lift in the old bed of the *Weld*. Heavy floods have proved a great drawback lately. About 40 men, principally Chinese, are working in this neighbourhood on miners' claims. The late wet season has been of great benefit to them, and some have made from £4 to £5 a man per week.

#### COAL.

There are evident signs that the *Mount Nicholas* and the *Cornwall Coal Mines* are recovering from the effects of the late strikes, the output for the last quarter being 13,242 tons 2 cwts., against 9520 tons the previous one. One hundred and twenty-seven miners are employed.

Mr. Commissioner CHAMBERS (stationed at Zeehan) reports :—

I have the honour to submit my Report upon the mining industry in the Western Mining District for the year ending on 30th June last.

Owing to the more settled state of the English money market, the satisfactory advance, during the latter part of the year in the values of silver and copper, the successful completion of negotiations for the amalgamation of the two large copper companies operating in the *Lyell Division*, and several fresh and important discoveries of minerals in various *West Coast* localities, the depression reported as existing at the close of last year may be said to have given place to a greatly improved state of affairs, and the effectual development of many mining properties hitherto only partially prospected may be confidently expected. Mining rents have been paid up very fairly, and I have been pleased to observe a decrease in the number of applications for protection of sections upon which work has been resumed. Dealing first with the *Zeehan Division*, I may point out that the returns (courteously supplied by the manager, Mr. T. Kapp) of the *Tasmanian Smelting Company, Limited*, evidence operations upon an enormously larger scale than in the previous year. During

the twelve months this company—which has provided daily employment for 180 men—purchased 24,265 tons of ore, equalling a gross value of £212,054, and containing as follows:—Lead, 6924 tons; silver, 1,147,531 ozs.; gold, 2815 ozs.; and its export in bullion consisted of—lead, 6619 tons; silver, 1,131,226 ozs.; gold, 2474 ozs.; the gross value of the same being £204,402. The company smelted 23,981 tons of crude silver-lead ore, purchased 6593 tons of gossan flux, and quarried from its Balstrups section and sold to the North Mount Lyell Copper Company 4770 tons of iron-stone.

The out-put of one from the *British Zeehan Mines* aggregated 6646 tons, valued at £65,892, a marked advance upon the figures of the previous year—and mining operations during the year disclosed the existence of large reserves of highly-payable ore. This company's works are splendidly equipped, and the development of its various properties proceeds upon systematic and up-to-date lines. Apart from the ordinary mining expenditure the company spent during the twelve months in main-shafts and plats, cross-cuts, and unproductive drives, £4318; in machinery, £1382; and in rolling-stock, £200; totalling £5900 13s. 8d.

At the *Montana Mine* 2013 tons of first-class ore and 19,594 tons of second-class ore were raised. The latter, upon treatment by concentration, produced 1957 tons of marketable ore, making the total marketable ore shipped for the twelve months 3970 tons, of the net value of £44,674. The mine's work is represented by the following:—No. 1 shaft sunk 100 feet; No. 2 shaft enlarged and re-timbered 218 feet; winzes sunk 117 feet; rises put up 580 feet; crosscuts driven 352 feet; drives driven 2000 feet; stopes, 20,214 feet in length by 6 feet by 5 feet—606,420 cubic feet.

At the *Florence Mine* a large pumping and winding plant, capable of operating at 700 feet, has been erected, and a concentrating plant has been purchased for the mine. The main shaft is down 214 feet, and at 200 feet a level has been driven 300 feet. At 50 feet Astell's lode was cut, following the course of level to 140 feet, and varying in size from 2 inches to 24 inches. From this lode ore worth £1118 net has been won. At 140 feet and 150 feet carbonate of iron lodes have been met, and these doubtless will receive due attention.

The extensive properties of the renowned *Western Silver-mining Company* having been recently purchased by an influential British proprietary, are again to be placed in work, and the unwatering of the mine is now being carried out. Seeing that this mine up to 1901 provided employment for between 200 and 300 men, and returned handsome dividends to the former shareholders, it is expected that resumption of work, which is now assured, will, in a few months' time, largely contribute towards the future prosperity of this portion of the State.

Tributors continue working on the stannite lode at the *Oonah Mine* with satisfactory results.

At the *Silver King Mine* operations were suspended some time ago, and work has not yet been resumed.

My predecessor's forecast with regard to the *Hercules Gold and Silver Mine* at Mount Read has been amply fulfilled, the mine output having increased, and profitable operations being now in progress. The mine is making daily deliveries of fair-grade ore to the Zeehan smelting works, and the payment of a dividend to shareholders was recently announced.

Tullah (otherwise Mount Farrell) is now the scene of considerable activity, and at the *Mount Farrell* and *North Mount Farrell Mines* systematic development has taken place. The labour employed at the North Mount Farrell Mine has been increased to between 70 and 80 men, whilst 1100 tons of ore and 450 tons of concentrates from this mine have been sent out over the company's tramway—now completed to Rosebery—and sold, and 4000 tons of second-class ore are at grass awaiting concentration.

The *Comet Mine* at Dundas has been working throughout the year, maintaining an average monthly output of about 140 tons of silver-lead ore and 400 tons of ironstone flux, all of which has been sold to the Tasmanian Smelting Company. The Dundas field has recently claimed the attention of influential investors owing to the importance of its mineral deposits, and it is extremely likely that foreign capital will shortly be forthcoming to develop some of the more promising shows.

The revival of tin-mining in the vicinity of Heemskirk and Mount Agnew so far has been attended with satisfactory results. *Mayne's Tin Mine* having been bought by wealthy capitalists, a company has been formed to work the property, and the thorough development of the mine may be expected, and anticipations of rich results have been freely expressed by experts who have examined and tested portions of the property.

From *Connor's Tin Claim*, adjoining, a considerable quantity of good tin has been already won, and this property is being vigorously worked with satisfactory results.

Considerable activity has prevailed in the Comstock division, and very many sections have been pegged, either for lease or as prospecting areas. Discoveries of great promise have been lately made in this locality, and mineral sections in the vicinity are receiving marked attention.

Turning to the Lyell Division of the District, the most important event to be recorded for the year is the successful termination of the negotiations of the past few months for the amalgamation of the *Mount Lyell Mining and Railway Company, Limited*, and the *North Mount Lyell Copper Company, Limited*, and for the formation of a new and powerful company to take over the assets of the two companies mentioned, and to work the various valuable properties of the latter in conjunction. That such a course was eminently desirable in the interests as well of the shareholders of both the old companies as of the mining industry generally, has been long foreseen, and a long era of prosperity for the new combination can be safely predicted.

At the *Mount Lyell Mine* during the past year a regular daily output of 1000 tons of pyritic ore has been maintained, and with three to four furnaces in blast at the company's splendidly-equipped and capably-managed reduction works at Queenstown no less than 344,150 tons of ore have been submitted for treatment, the whole containing 6213 tons of blister copper, which produced, approximately, as follows:—

GOLD, FINE.				SILVER, FINE.				COPPER.			
Approximate value.				Approximate value.				Approximate value.			
ozs.	£	s.	d.	ozs.	£	s.	d.	tons	£	s.	d.
22.278	94,681	10	0	604,860	61,316	13	7	6141	357,353	1	1

or a total value of £513,351 4s. 8d.

The company has acquired several additional properties adjacent to the "big mine," and the installation of a new and up-to-date electric light plant in connection with its reduction works and its other industries should be mentioned in any record of the year's operations.

At the *North Mount Lyell Mine* the ore won totalled 41,512 tons, of the estimated value of £288,588, and the year's work has only confirmed previous experience as to the richness and magnitude of the deposits in this famous property.

In consequence of the amalgamation of the Mount Lyell and North Mount Lyell interests, smelting at the Crotty works of the North Mount Lyell Company has been discontinued, and it is understood that in future the ore from this mine will be treated in conjunction with the Mount Lyell ores at the Queenstown reduction works.

The *South Mount Lyell Mine* resumed work during the year, employing for a time about 70 men. Under an arrangement with the North Mount Lyell Proprietary, 13,507 tons of low-grade pyritic ore were raised from the mine, and conveyed to the Crotty reduction works for fluxing purposes. Operations at the mine have been again suspended.

A change of management has occurred at the *Mount Lyell Blocks Mine*, where Mr. J. H. Crittenden has been succeeded by Mr. Nicholas. Work has continued as usual. The main shaft has been extended to 572 feet, and at 550 feet plats have been opened. The copper-bearing clays found on the property are being operated upon, and the erection of additional plant for treating the same upon an extensive scale is in contemplation.

The *Tasman Lyell and Comstock Mines* were amalgamated during the year, and prospecting work has been carried out on the consolidated property.

At the *Tasman and Crown Lyell Extended Mine* the tunnel has been driven to 1453 feet, and prospecting has been industriously carried out.

On the *Crown Lyell Section* steady work has taken place, but the operations do not call for special reference.

The *Great Mount Lyell Mining Company* has resumed work after having discontinued operations for upwards of a year.

Several parties are prospecting on the *Jukes and Darwin Field*, and it is hoped that several properties in this locality will receive greater attention in the near future. There is some probability of the *Lake Jukes Mine* being again put in work, under the management of Mr. H. S. Muir, lately mine manager of the North Mount Lyell Mine. Some gold has been found at Mount Darwin.

Work is proceeding at the *Coronation Mine*, where a small steam plant is on the ground, and unwatering of the shaft has taken place preparatory to further testing the property.

Numerous prospectors are to be found seeking gold in the vicinity of Lynchford, Hall's Creek, the Queen River, and Conglomerate Creek, and during the year a considerable number of small parcels of nice-looking gold have been brought in and sold at Queenstown.

The *Woody Hill and Macquarie Gold Mines* at Howard's Plain, near Queenstown, are now let on tribute to the Mount Lyell Mining and Railway Company, and a tramway connecting the properties with the Queenstown reduction works is now in course of erection.

The handsome building erected for the Zeehan School of Mines and Metallurgy in Main-street, Zeehan, was opened during the year, and is now in occupation, and well equipped. The School has been affiliated to the University of Tasmania, and in the hands of Messrs. F. W. Reid, A.S.A., S.M. (Director and Registrar), W. S. Watt (Associate Otago S.M.), R. J. Allan (Ballarat S.M.), and a number of competent honorary lecturers, the students (numbering between 60 and 70) have all facilities afforded them of obtaining excellent tuition in the mining course.

It is pleasing to report that a School of Mines has also been started on satisfactory lines at Queenstown. At present the School is carried on entirely by voluntary contributions, and with a staff of highly-qualified honorary lecturers and teachers, but the success attending its opening, and the patronage accorded by students (who have enrolled to the number of about 60) justify the belief that the institution will become well established, and will ere long attain equal prominence with the well-known sister institutions in the various States.

Mr. Registrar DONOHUE (stationed at Waratah) reports:—

I have the honour to submit my Report on the mining industry in the Waratah Division for the year ending 30th June, 1903.

During the year a good deal of prospecting has been carried on at and about Waratah. At Badger Plains, about seven miles south of Waratah, Walsh and party have discovered payable tin ore. They disposed of a portion of their interest in two sections to a Mount Lyell syndicate, which has 12 men, under the management of Mr. Tom Jones, prospecting different parts of the sections, with very satisfactory results. Several sections have been taken up in the vicinity of the Badger, and a good number of men are now prospecting them.

About two miles north-west of Mount Bischoff, Mr. James Kelly has discovered what is said to be a very rich find of alluvial tin. A syndicate is being formed here to put the necessary machinery on the ground and work it.

The *Mount Bischoff Tin Mine* remains much about the same. A good deal of alluvial tin is being got from the northern slope of the mount. During the year 1276 tons of ore have been sent away, the average number of hands employed being 220.

The *Mount Bischoff West Tin Mine* continued operations until the 21st of May last, employing on an average 30 men, and exporting 24 tons of tin oxide. The work was then suspended pending additional crushing power, and the erection of the necessary plant is expected to be shortly taken in hand.

The *Waratah Alluvial Tin Claim* during the year sent away 24 tons of tin ore, valued at £1440, with an average of four men employed.

The *Stanhope Alluvial Tin Claim* sent away 8 tons of tin ore during the year, with an average of three men employed.

*Magnet Silver Mine.*—Work for the year has been principally devoted to the exploitation of the ore-body. A steady output of from 240 to 300 tons weekly has been maintained throughout most of the ore being shipped to New South Wales, with about 70 tons weekly to Zeehan. A winze has been sunk from the lowest level (No. 4 adit) for 47 feet, proving the lode to be of undiminished value at that depth. This will shortly be sent down to the 100 feet below No. 4. At the southern end of the lode a

very fine body of high-grade galena has been proved, and is being worked in the No. 1 south level. Another adit (No. 2 south) is now being driven 60 feet lower under this shoot. 100 men employed.

*Long Tunnel Syndicate* (formerly Mount Stewart).—This syndicate have about 40 tons of high-grade galena at grass, and is trying to raise the means to construct a tramway from Heazlewood-road to its mine. Two men employed.

*Washington Silver Mine*, Whyte River.—This mine has been idle some time, but is likely to start work again shortly.

*The Confidence Silver Mine*, Whyte River.—At this mine a small syndicate has been steadily working for the past 12 months, advancing the north drive of the lowest adit a distance of 580 feet from crosscut, or a total distance of 740 feet from entrance of adit. A strong and good body of concentrating ore is here disclosed, more or less richly impregnated with galena for approximately 300 feet, with small seams of ore on both hanging and foot walls.

*Godkin Silver Mine*, Whyte River.—Operations during the past year have been confined to driving a low level for the purpose of draining the old workings. Bad air and bad ground have been severe drawbacks, but have been successfully surmounted, and the water is now drained.

*Godkin Extended*, Whyte River.—Smith and Bell are now proceeding to drive a tunnel a distance of 700 or 800 feet for the purpose of intersecting a shoot of ore going under foot at the higher and older workings.

*Wealth of Tasmania Copper*, Heazlewood.—A shaft has been sunk about 60 feet, and a crosscut put in to intersect the rich body of ore disclosed on the surface. It is anticipated that the lode may be cut now any day.

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THE NEW BROTHERS' HOME NO. 1 TIN  
MINING COMPANY, DERBY.

By JAMES B. LEWIS, Esq., Manager.

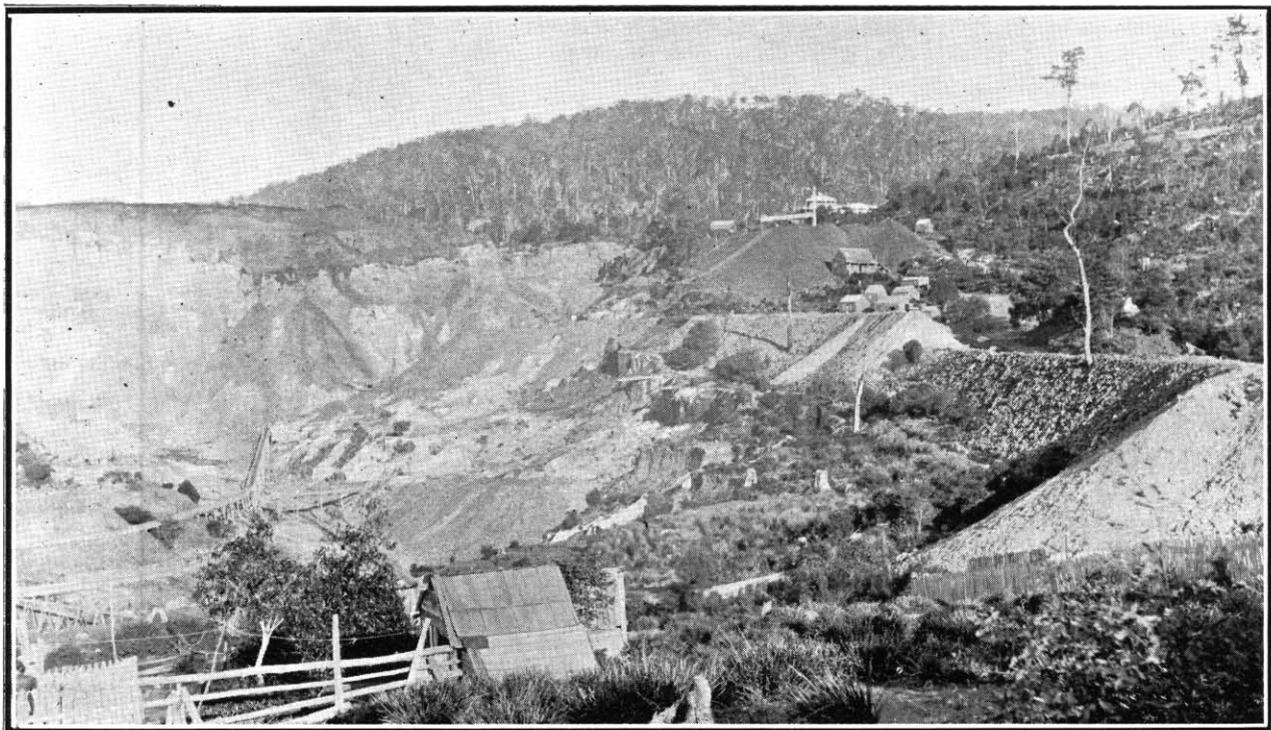
REMOVAL OF OVERBURDEN.

THE overburden, averaging about 100 feet thick, consists of varying material, mostly of volcanic origin, the bottom layer being from 50 feet to 60 feet thick, and described by the Government Geologist:—"Microscopical examinations of specimens from the lower basalt mass at the Brothers' Home show the rock to be an olivine basalt, in which the felspar is mostly porphyritic, and the groundmass largely consists of small brownish crystals of augite," but locally known as "decomposed basalt," a scapy material containing hard boulders. These vary in quantity in different parts—from 25% to 50% of the whole—and also in size from that of road metal up to two or three tons weight. Over this is a layer of recent drift, poor in tin, and from 10 feet to 12 feet thick. Over this again is a layer of columnar basalt from 20 feet to 40 feet thick, containing blocks many tons in weight. Above this is a volcanic breccia of stone about 6 inches diameter, and containing boulders up to two or three hundred tons. This is of varying depth up to about 30 feet. The greatest depth of overburden over all was about 130 feet, and contained the largest and hardest rock. This was the first part attacked.

As the two top layers—columnar basalt and breccia—contained little material that could be removed by water, and especially as our water supply was limited and get-away restricted, we decided to remove this, as far as it was economical, by dry stripping. A large heading, 8 feet by 8 feet, was started in the layer of poor drift mentioned above, which it was considered, judging by the exposed faces, would allow of its being carried through entirely in this easy material with suitable grades. Unfortunately there was a sudden dishing of the underground surfaces, and the heading rapidly ran out of the drift into the columnar basalt, and had to be continued, together with its branches, in this material. The method of excavation adopted was that frequently used in railway cuttings. The top, or back, of the heading for a third of its width on each side was covered with laths in the usual way, or where possible with longitudinal round stringers running over two or three sets. The centre of heading was covered with transverse timbers, called by the workmen "Chinamen" or "Chows." These being easily removed, a pass could be made at any time at any part of the heading. The rails used in the roads were mostly 20-lb. rails—these were light, 30-lb. rails being more suitable, but were not at the time available—spiked down to the sleepers with large dogs, and coupled with fishplates. The roads were carefully laid and ballasted, and rails on curves curved to the true radius. Mine roads frequently suffer from inferior platelaying; good work in this soon pays for itself. The dogs are usually too small, fishplates are neglected, curves carelessly laid, and ballasting neglected, while points and

crossings seem to exist rather to derail waggons than for any other purpose. The waggons were built to carry about four yards by measurement, or  $2\frac{1}{4}$  to  $2\frac{1}{2}$  yards of material in the solid. They were fiddlestick self-tipping waggons, made on the mine—first with cast-iron wheels, which were unsatisfactory, then with steel wheels, and finally with main-line wheels and axles (cast-iron bosses, wrought-iron arms, and steel tyres). The material was picked down on to the heading when possible, or shot down, powder being generally used for shifting softer material gelignite for breaking-up hard rock. A truck would be pushed or breasted into the heading by the horse to the most convenient spot indicated by the fillers, who would withdraw two or three "Chinamen," and direct the material into the waggon, a trimmer in the heading arranging the loading with a rake. The waggon then ran down a flat grade to a turnout outside the heading, where the empty truck stood. The latter was then breasted in by the horse, which was then attached to the full waggon by a spring-bar. The waggon was drawn about a quarter of a mile to the tip; the driver then disconnected the horse by releasing the spring-bar; the horse got clear of the track; the waggon, with the momentum gained by the horse galloping a few yards before being released, ran against a bumper on the end of the tip, tipped itself, and then fell back on to the rear axle again. A fiddlestick waggon has the front wheels a little in front of the centre of gravity, and attached to the body, while the rear pedestals are not connected, thus allowing the body to tip free of them, the correct distance between the axles being kept by a frame known as a "fiddlestick." The horse was then attached to the rear of the waggon by the string-bar to draw it back to the heading. In this case only one waggon was run out at a time, the grades and curves making this a full load for one horse; but under more favourable circumstances two waggons could have been used, if branch roads were provided at the tip. This work cost a little less than  $9\frac{1}{2}d.$  per cubic yard, including horses, explosives, roads, electric light, headings, waggons, labour, &c. When the circumstances were favourable two shifts were worked; the afternoon shift, however, never worked quite as cheaply as the day shift. This disposed of nearly all the top layers, except the material on one wing, which was left to come down on the heading at the lower face, about 100 feet below this level.

The lower faces were worked with the assistance of the hydraulic nozzle, and water with 320-feet pressure. For wherever water under pressure can be applied, with even moderate success, material can be removed much more cheaply than by any other method, some Californian results being claimed at less than a halfpenny per yard. Consequently this method has fatal attractions, for the first cost is frequently extremely heavy, the securing of water rights, construction of races, and means of distribution adding frequently  $3d.$  or  $4d.$  per yard on to the cost of removing material. Again, where it does not complete the removal thoroughly, and subsidiary means are required, the latter are usually inadequate or quite neglected. Then the disposal of tailings—where the natural outlet is restricted—becomes a serious matter. Time also becomes of importance, and although we are told that water will wear the hardest stone, it is frequently somewhat tedious waiting for it to do so. Efforts have been made to remove this heavy overburden by hydraulic alone. With a large body of water, a large quantity of soft material to act as



NEW BROTHERS' HOME No. 1, TIN MINE, DERBY.

General View.—In the face the darker shade shows overburden, lighter shade shows drift.

slurry-rounded boulders, and a steep tail-race, suitably lined, it can be done, but the achievement is neither speedy nor economical. Consequently some other method of handling the rock becomes necessary. Too often it is simply thrown back out of the way of the immediate work, to be handled again and again; sometimes wheelbarrows and planks are used; sometimes the stone is stacked carefully on the top of valuable drift; sometimes tram-roads are laid and hand-trucks used, the cost of removal in the latter case varying, according to circumstances, from 1s. 6d. to 2s. 6d. per cubic yard. Better results are claimed than achieved, as the stone is measured in the loose, as if it were solid, and trucks containing half a yard or three-quarters of a yard are reckoned as yard trucks, and, of course, tallies are not always reliable. In many cases it is a question whether automatic plant—some form or adaptation of a travelling-crane or steam navvy—might not be advantageously used in shifting this rock, and the matter was carefully considered in this case. But the first cost of such, the frequently scattered state of the rock, which would make the working of such unprofitable, and the difficulty of working it in conjunction with the water, would make its success problematical. Headings were, however, driven in the drift under the overburden, similar to those described in the first part of the paper, but with heavier timbering, and extended out in front in the form of a stage, and falls of overburden were brought down on these with the nozzle by undercutting in the drift. The small stuff was washed out where possible down temporary sluices, and the larger stone dropped down through the "Chinamen" into large waggons in the ordinary way, and as described before. When stone was plentiful and easily got, this cost, including all charges, about 8½d. per yard. When the face worked back from the heading and the slopes were flat, requiring the stone to be handled, the cost went up to 11d. Where there was not enough stone in the face to justify the use of headings, numbers of branch roads and sluices were brought up to the faces, and followed them up closely. When a fall came down here, as much stuff as possible was washed out of it with the nozzle and down the sluices, and the large stone left was then loaded into small fiddlestick waggons, containing about 1½ cubic yard each, or about 3 tons. Two of these were run out together, switched on to different lines at the tip, and tipped separately. These were made very low for convenience of loading, the backs were hinged and let down for the purpose of rolling large boulders in without lifting them; they were light, easily handled, and cheap of construction. Sometimes a small temporary stage was constructed level with the back of the truck, and the stones rolled down on to this were readily rolled into the waggons. These took but two or three minutes to erect consisting of a spar supported at the ends and decked with laths. The cheapest cost of trucking here was 9½d. per yard, and the highest 11½d. As time went on this cost would probably have been lessened as means of improvement were discovered. The cost of hydraulicing the remainder of the overburden was not cheap, on account of the disabilities under which we laboured. The regulations did not permit us to send anything into the river over 2½ inches diameter, we had no dumping ground, the river was always in a bad state on account of the materials sent in by the different mines, and on account of the dry seasons. For the latter reason, also, our water supply was very unsatisfactory,

being frequently short, for months failing altogether, and usually only available at night. The cost was first 4·64*d.* per cubic yard, including all charges, but this afterwards increased to 5·17*d.* per cubic yard as the difficulties increased. With a supply varying from nothing to 8 sluice-heads, and about 40 men, the maximum amount removed was 15,225 cubic yards in a month, of which 8913 were trucked and 6312 sluiced; or for two years about 213,165 cubic yards, at an average cost, including all charges, of 81*d.* per cubic yard. In removing the overburden a quantity of drift had also to be sluiced, but being the highest and poorest, it contained a minimum amount of tin. This was saved by placing ripples in the tail-races, and shaking them up whenever any great amount of drift was sent down. These were cleaned out about twice a year, and the results indicated that with this rough method practically all the tin was saved, and without hampering or delaying the removal of overburden, which was considered the most urgent and important work.

The quantity of water required per cubic yard of material sluiced was at first 6039 gallons, but later, as disabilities increased, 8137 gallons. The Californian experience varies from 2455 gallons up to 9000 gallons—usually about 3860 gallons to the cubic yard of material removed. The higher figure has been frequently exceeded in this neighbourhood.

As the working arrangement with the Briseis Company removes two of the disabilities under which we have been working—shortness of water and lack of dumping ground—and as the worst of the hill is probably now removed, the future cost of removal of overburden should be reduced and the speed increased.

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NEW BROTHERS' HOME No. 1, TIN MINE, DERBY.  
Lower Face.—Showing Stage, &c., and Hand Trucks.

## THE PROFITABLE TREATMENT OF SILICEOUS LOW-GRADE COPPER ORES.

By J. J. MUIR, M.Inst. M.E.

THE question of the economic treatment of these ores is of the highest importance, and will require to be seriously undertaken at some future time. The writer, in discussing this question, does not propose to touch on the fire concentration or smelting methods. The majority of these deposits are situated in positions that would not admit of the importation of fluxes and fuels to effect a smelting operation at a commercial profit.

No doubt in many typical cases of self-fluxing ores, or with such fluxes and fuels adjacent to the copper ore deposits, the method of matte smelting and converting the product to copper could not be surpassed, either as regards continuous action in operation or the cost of same.

Unfortunately, the notable successes in that line do not account for the ultimate metallurgical destiny of the isolated deposits of the above classes of ores.

If we take chalcopyrite ore, distributed in small particles through a siliceous matrix, it will be sufficiently representative of the isolated deposits scattered through Australia and Tasmania. It will be clearly seen that there is a wide field for discussion regarding their profitable treatment. For some years past the writer has occupied a considerable portion of his time in an investigation and study of this class of ore from the other States and the West Coast of Tasmania. In consequence, the fact has been fully borne home to him that, in regarding these occurrences individually, and as a possible source of profit to their owners, the lines of investigation must be carried out in some other direction than fire concentration. The writer therefore commenced his lengthy series of investigations with the experimental concentration of low-grade copper sulphide ores by water.

### *Experimental Concentration by Water.*

The aim in this test was to obtain a degree of concentration, both in bulk, by weight of material, and increase in copper contents of the concentrates, that would about return the costs of the operation, leaving any profit that might be possible to be recovered from the tailings. It appeared that if operation costs could be thus returned, a deferred profit might be acceptable. The test which most closely resembles this result will now be described. The ore-sample used was 100 lbs. of a typical low-grade ore, as described hereunder. It was carefully weighed after grinding and crushing on a castiron board, and passed through a sieve of 40 holes to the linear inch. The ore was then carefully concentrated in small lots in a riffle dish by an expert manipulator. The three products, investigated in rotation, are as follows:—First, the crude ore; second, the concentrates; third, the tailings.

The following is the writer's analysis of the crude ore :—

Copper. Per cent.	Iron. Per cent.	Silica. Per cent.	Alumina. Per cent.	Sulphur, alkali, &c., undetermined. Per cent.
3·9	9·55	50·15	16·85	19·51

The concentrates, after being dried at 100° C., were found to contain by weight 7·277 per cent. of the original ore-sample tested of 100 lbs., and a separation into the tailings of 92·723 per cent.

The writer's analysis of these concentrates was as follows :—

Copper. Per cent.	Iron. Per cent.	Silica. Per cent.	Alumina. Per cent.	Undetermined Per cent.
11·12	28·40	14·40	4·60	41·48

The tailings, after being dried at 100° C., were then assayed for copper, and found to contain 3·37 per cent., as the tailings contained by weight 92·723 per cent. of the original ore-sample this calculated out to a separation into the tailings of 3·13 per cent. of the copper contents of the crude ore, and a recovery in the concentrates of 0·81 per cent. of the copper contents of the crude ore.

The concentrates should then contain by calculation  $0·81 \div 7·277 \times 100 = 11·13$  per cent. of copper, proving the assay to be concordant to 0·01 per cent.

The small percentage of copper recovery in the concentrates is accounted for by the sliming of the ore.

The results of the writer's tests clearly show that, in the case of low-grade chalcopyrite ore, the grinding of the material to the necessary degree of fineness, to prepare it for lixiviation, pulverises the chalcopyrite contained in the rock to so minutely divided powder that each microscopic particle has a gravity unequal to settling in the bulk of water in contact with it; and, in consequence, it floats away on the surface of the water. The tailings from this experiment were then subjected to a lixiviation test, as follows :—A 5 per cent. solution of sulphuric acid by volume was adopted on the basis of one ton of solution to one ton of tailings, and as temperature plays an important part in the time of extraction, the vat was kept as nearly as possible at a temperature of 70° F., to agree with a climate that would be favourable to a method of this description.

The following table shows the time of extraction of the copper from the tailings under these conditions :—

No. of Assay.	Tailings.	Copper Per cent.	Extraction Per cent.
1	At start	3·37	Nil.
2	After 12 weeks	0·50	2·87

The conclusions at which the writer arrives is that the wet concentration of the sulphide ores of copper should not be attempted unless it is intended to make a profitable recovery from the prepared and residual tailings.

It might be possible by a lengthy lock-up of capital to obtain a slow profit in the way described in the foregoing test, but it does not recommend itself as having any particular merit.

In the large pyritic deposits in Spain, a country whose climate is eminently suited to it, large profits are made by natural lixiviation, when the persistent formation of sulphates can be relied on.

The writer regards the concentration tests by water as merely a useful basis from which to start in following up the inquiry.

PART II.—*Chemical Methods.*

The next stage in the investigation was a careful examination of the various chemical methods that have been employed or proposed in various countries for the treatment of this class of ore. The writer started with the old and well-known method of the chloridising roast. The principle involved in this process is the conversion of the copper sulphides to cupric chlorides by roasting the crushed ores with an admixture of salt. Very nicely drawn conditions require to be observed in order to obtain a high extraction of the copper. The roasting operation requires to be carried out in a muffle furnace provided with water-condensers, to recover the cupric chloride that is largely volatilised. The cost of this operation is therefore much higher than a roast carried out in an open hearth reverberatory calciner, where the heat generated by the fuel used is applied directly to the ore.

The other conditions necessary to successful operation were, according to the writer's tests, as follows:—First, the sulphur should not exceed  $1\frac{1}{2}$  times the quantity of copper present; second, from 5 to 6 per cent. of copper is the outside limit that the ore should contain; third, the temperature of the furnace should not exceed dull redness. Over a number of trials on ores containing various copper contents, it was found that a proportion of anything less than four units of salt to one unit of copper gave most unsatisfactory extractions.

With all the conditions carefully observed and attended to, an extraction of 70 per cent. of the copper present could be relied upon. The writer's conclusions, however, are that the high charges of a muffle roast, coupled with the cost and importation of the necessary quantities of salt, would not admit of profitable treatment.

*The Hunt-Douglas Method.*

The principles laid down in this method were the next in order of the investigation programme. The crushed and roasted ores are treated by a solvent solution, whereby the copper is taken into solution as its chloride; and it is precipitated from the solution by the injection of sulphurous acid gas. The solution is regenerated by addition of salt. This process gives excellent results where the conditions are favourable to its operation. The necessary adjunct of a cheaply-mined pyritic body would strictly limit the economic value of its application. It can therefore be passed over in the present consideration of the various methods. Various other methods of minor importance were then tried, and, with one exception, they did not offer sufficient encouragement to follow up. The exception referred to is the method of roasting the crushed ores with ferrous sulphate. It is carried out very cheaply in some countries, in the following manner:—The crushed ores are made into stiff paste bricks with cementation liquors, and then burnt in kilns, thus converting the low-grade sulphides into sulphates, which are soluble in water. After arriving at this stage, it appeared essential that a satisfactory financial solution was of equal importance with a successful hydro-metallurgical one, and, in addition, a continuous and sustained action that would compare with that obtained by a smelting operation. If these opposing factors could be reconciled, it appeared evident that a satisfactory solution of this problem could be arrived at. The field of investigation was now narrowed down to definite lines of inquiry, and the final outcome was that the writer has demonstrated that the following method will fulfil all of the above con-

ditions. All ore was selected for treatment typical of the low-grade siliceous ores surrounding the Mount Lyell field, and from the Mount Lyell Comstock Mine.

The following is a complete analysis of it by the writer :—

	Per cent.
Silica ... ..	48·0
Copper ... ..	4·56
Iron ... ..	13·29
Sulphur ... ..	12·60
Alumina ... ..	12·90
Zinc ... ..	1·17
Manganese ... ..	1·26
Lead ... ..	1·40
Magnesia ... ..	3·40
Oxygen, and loss ... ..	1·42
	<hr/>
	100·00

It will be seen from the conditions that these ores contain considerable sulphur contents, and, moreover, that by a judicious selection of a small proportion of the ores as they leave the mine, the sulphur contents of that small portion can be considerably increased. This is the main factor on which the writer proceeded to work out this method for their profitable treatment, and he now proposes to follow the ores in their progress from the mine to their final conversion to a marketable product. The following is a detailed description of the method :—

#### *Operations at the Mine.*

When the ore is extracted from its place *in situ* by any of the usual systems, the aim should be to roughly and cheaply throw out the richer sulphides, to the extent of from 1-8th to 1-10th of the bulk of the ore treated. In the generality of cases an enriched sulphide zone has been deposited on the footwalls of these ore-bodies. If they are not greatly enriched in copper, owing to the increased amount of iron sulphide present, these narrow zones are notably increased in sulphur contents. When this is the case, the taking out of this portion separately would save the small additional cost of the rough selection. This smaller proportion is reserved for separate treatment, and the main bulk of the ore then goes forward to the regular plant.

#### *Preparation of the Ore (main bulk).*

The ore is first reduced to such a degree of fineness as the operator may find necessary, in order to expose the small sulphide particles to the oxidising flame of the calciner. The machinery employed for this purpose can be adopted by any particular operator to suit himself.

#### *Calcination of the Ore.*

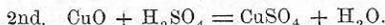
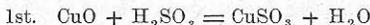
This operation is of great importance, and a consideration of the chemistry of calcination is essential. When the ore is subjected to an oxidising roast in its pulverised state, it undergoes two important changes, viz., a chemical and a physical one. The chemical change is, firstly, the oxidising of the first atom of sulphur, which is feebly combined, with the generation of sulphurous acid gas; and, secondly, the combustion of the second

atom with the generation of both sulphurous and sulphuric acid gases; and, finally, as the temperature is raised, the formation of oxides and sulphates of copper.

Although these reactions are well-known, it is not generally known that the physical change imparted to the finely-ground ore is of equal importance where a leaching operation is contemplated. The fine rock particles are granulated, and are made amenable to free percolation, and perfect leaching. This fact has now become so well recognised in America that the slimes from a previous operation, and which require a further wet treatment, now undergo a preliminary roast, when they are found in good physical condition for percolation and leaching. The stage to which the calcination of the ore is carried is the first important consideration, and, provided that the last of the sulphides as such are converted, it is a matter of no moment what proportion the residual oxides and sulphates bear to one another, and the charges can be drawn at that stage. It can be noted that the over-roasting of the charge has no prejudicial effect on subsequent operations, except slightly adding to the cost. Automatic reverberatory calciners, when used on a large proposition, are the most economical; but the hand-rabbed type on small and isolated mines are less costly.

#### *Forced Leaching of the Ore.*

The calcined ore is then transferred to the wooden leaching-vats (fitted with filter bottoms), and discharged gradually and not from the calciner into the sulphurous and sulphuric acid solution in the leaching vats, derived from the ore that has been separately treated. The best mixing proportion is 200 gallons of solution to one ton of ore. The ore is well covered, and the temperature raised considerably by the hot ore. The discharge-pipe from the muffle furnace (described under the separate treatment) is then started, and the temperature is further raised by that means. The copper sulphates in the charge being easily soluble, the writer has provided for the attack on the oxides only. These are then attacked very rapidly by the sulphurous and sulphuric acid solution, and the reaction completed in a very short time.



The hot oxygen of the blast also tends to oxidise the surplus,  $\text{H}_2\text{SO}_3$  to  $\text{H}_2\text{SO}_4$ , which is an advantage.

#### *Precipitation of the Copper.*

The strong copper solution is then run through the filter-taps into the precipitating vats on to bars of pigiron, and the precipitation effected hot. About 1-12th of the copper contents will be retained by the dampness of the charge in soluble form. This can be recovered with one wash water.

#### *Separate Treatment of the Selected Portion of the Ore.*

This portion, being higher in sulphur contents than the main portion of the ore-body, is used for making the sulphurous and sulphuric acid waters necessary for leaching the whole of the ore. By a convenient muffle arrangement of a small type, the furnace gases are injected into the ore-extraction vats, thus generating the sulphurous and sulphuric acids in the solution. This is further increased by arranging a hot-air coil in the fire-chamber

and passing the hot-air also through the muffle. As pyrites does not give up the whole of its sulphur in a closed muffle, this obviates that difficulty, and reduces cost.

*Treatment Cost per ton of Crude Ore.*

These costs have been carefully considered, and are on the conservative side :—

	Cost per ton.
	s. d.
Crushing schistose ores ... ..	5 0
Reverberatory roast ... ..	3 6
Labour on leaching-vats ... ..	0 6
Hot air ... ..	0 6
Sulphurous and sulphuric acid waters ...	2 6
Pigiron ... ..	1 0
	<hr/>
Total ... ..	13 0

Against this a reduction of 4s. can be safely made on the copper values from the muffle roast, making the treatment charges against the ore 9s. per ton.

With the mining charges added, it will leave a range of profit on a fairly low grade ore. The precipitated copper would be the final product, and it would range in assay value from 70 to 80 per cent. of copper. There is a ready Australian market for this high-grade product, which only requires a common melting operation to convert it to copper.

CONCLUSION.

After a long investigation of this subject, the writer has arrived at the conclusion that this process will fulfil the conditions necessary for the successful treatment of these ores. The action is rapid, continuous, and complete. Various further economies in the costs of running can be made, notably in the regeneration of the solutions, &c.

A plant in full running order, capable of treating 100 tons of ore per diem, could be installed for about £2500; and for every 100 tons additional, an increase of 25 per cent. on that amount.

An advantage of this process is that it is not based on finely-drawn chemical equations, as most chemical processes are; and a few days' experience on an ore would show the best working conditions to each individual operator.

## TRACHYDOLERITE IN TASMANIA.

By W. H. TWELVETREES, F.G.S., Government Geologist.

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IN 1889 evidence was laid before this Society by Mr. W. F. Petterd and myself, demonstrating the existence in Tasmania of two centres or districts characterised by eruptive rocks derived from elæolitic and theralitic magmas.

I now submit further localities for rocks belonging to the same great felspathoid series. One of these is the Table Cape Bluff, near Wynyard, on the North-West Coast, and another is the Nut at Circular Head. A third is One Tree Point, Sandy Bay, near Hobart, where melilite basalt has been identified, but only the first two will be dealt with in these notes.

The tertiary basaltic rock which forms the headland near Wynyard came many years ago under the notice of the late Professor Ulrich, who thought at the time that he could recognise the small water-clear hexagons which are abundantly visible in prepared slides as sections of the felspathoid mineral nepheline. Both my colleague and I were, on the other hand, disposed to diagnose the mineral as apatite, and we learned from the lamented Professor shortly before his death that he had arrived at the same opinion. Mr. Thos. Stephens often communicated to me his idea that this coarsely crystalline rock was a distinct flow from our common olivine basalt. The mere difference in texture did not appear to me a valid reason for assuming any further difference between the two rocks. However, in drawing up a classification scheme, the occurrence of a dyke of limburgite on the Emu Bay Railway Line, nine miles from Burnie, led me to hesitate, in view of the fact that Rosenbusch classes limburgite as belonging to the theralitic magmas. Renewed examination of the doleritic rock at Table Cape and Circular Head showed the presence of a felspathoid. The optical tests were confirmed by staining, and a specimen was sent Home to Professor Rosenbusch. It was referred by him to trachydolerite, the effusive form of essexite. I wish here to acknowledge the readiness with which the professor has always aided in solving difficulties in Tasmanian petrology. His letter reads as follows:—"The compact basaltic rock of the Table Cape Bluff and Circular Head is best referred to the trachydolerite group. Besides labradorite, augite, olivine iron ore, and abundant apatite, it contains a colourless mineral with

a very low refractive index and abnormal double refraction, which gelatinises in weak acid and allows much  $\text{Na}_2\text{O}$  to go into solution. I regard it as analcime. It is always allotriomorphic, and it is highly probable that this mineral is derived from nepheline. In a special slice which I prepared I saw distinctly in an isotropic spot the interference figure of a negative uniaxial mineral (nepheline)."

The hornblende, h a yne, and sphene, which are common in typical trachydolerite, are absent, so the rock is not a normal member of the family.

In the Table Cape rock, olivine is abundant as phenocrysts; augite as prisms, also in grains of the second generation; labradorite in slender twinned prisms; apatite in vertical and hexagonal sections, iron ores in numerous grains and cubes. There is a great deal of the feebly refractive analcime in plates of extreme tenuity. In some slides thin rectangular sections of the mineral determined by Professor Rosenbusch as nepheline are present.

In the Circular Head rock, the augite is in larger crystals and plates, and exceeds the olivine in quantity. It is the violet-tinted variety of diopside so common in nepheline-bearing rock. Apatite is abundant in the slides in the form of short columns, spindle-shaped, or hexagonal sections. Titaniferous iron or magnetite has separated out. The interstitial groundmass abounds with microlites and with isotropic or feebly refractive material. It is apparently saturated with analcime, and in one instance natrolite could be detected.

The macroscopic aspect of these rocks is doleritic. The Circular Head variety is somewhat coarser in grain than that of Table Cape.

Briefly, the abundance of apatite and analcime warn us that we are not dealing with an ordinary basalt, and the presence of nepheline, in however small quantity, confirms this belief.

It is difficult to suggest what relation the rock of these Bluff bears to the ordinary Tertiary olivine basalt of the coast. Both are of Tertiary age, but each is the product of a different magma, and such rocks hitherto have not been found associated. The two families would be represented as under—

Normal olivine basalt

Trachydolerite

Diabase (Dolerite)

Gabbro

Essexite (not yet discovered)

The term trachydolerite here has not the original sense in which it was used in 1841 by Abich, who understood by it a basic trachyte or a rock intermediate between trachyte and basalt. Its alkali percentage is high, viz.—6 to 11%, against the usual 3% or 4% in ordinary basalt. The variety of constitution points strongly to essexite parentage, and as essexite occurs physically connected with elæolite syenite, so trachydolerite is associated with alkali trachytes, phonolites, tephrites, &c. Its sp. gr. is 2·86.

Professor F. Loewinson-Lessing differs from this Rosenbuschian view, and ranges trachydolerite among monzonitic magmas, and not among essexitic ones.\* He treats it as equivalent to ciminite (Washington), a passage rock between basalt and trachyte, and would suppress ciminite in its favor or in favor of "trachyte basalt." It is, then, considered the effusive equivalent of gabbro syenite or monzonite. But, as there is reason to regard the basic syenite known as monzonite as being not so much a passage rock between syenite and gabbro, as between normal syenite and alkali syenite, so trachydolerite must be looked upon as intermediate, not between normal basalt and trachyte, but between tephrite and alkali trachyte. The occasional presence in it of haüyne, sodalite, barkevikitic hornblende, anorthoclase, leucite, and ægirine points to the alkali magma.

It is possible that some of our other Tertiary basalts may, on closer examination, prove to be trachydoleritic; and the eventual discovery of the parent plutonic rock, essexite, is probable.

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\* Kritische Beiträge zur Systematik der Eruptivgesteine : Tschermak's min. n. petrogr. Mittheilungen xix. 1900. iv. p. 303.

## ON CERTAIN CALCAREOUS NODULES.

By Professor E. G. Hogg, M.A.

[Two photos.]

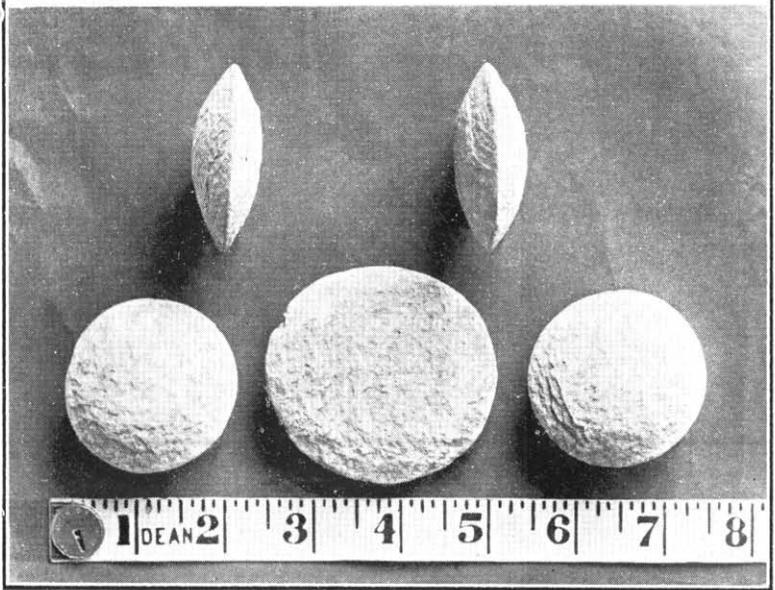
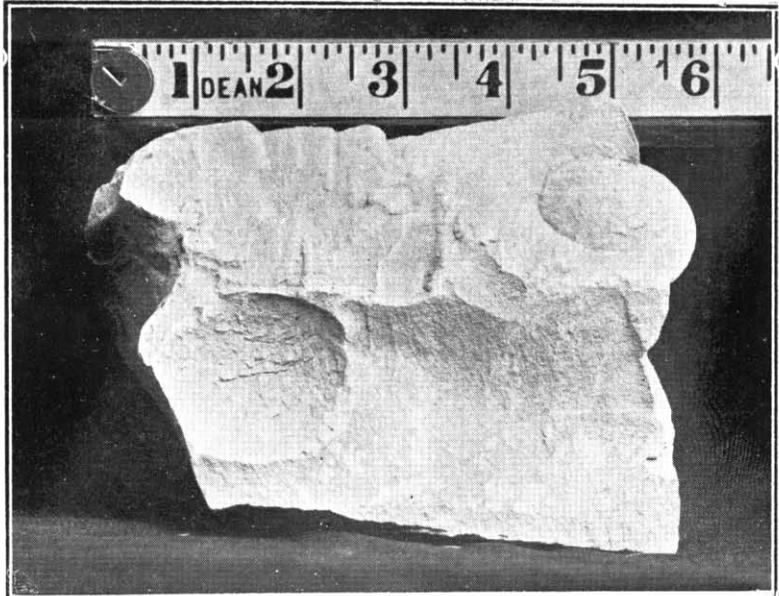
THE nodules described in the following paper occur in certain bands in the upper members of the strata disclosed at Duff's quarry, in Forster-street, New Town. The nodule-bearing bands appear to be unfossiliferous, but both above and below them are other bands carrying numerous fossil impressions, including *Alethopteris australis*, *Thinnfeldia obtusifolia*, *Phyllothea*, &c. The whole series of bands is just below the horizon of the New Town Coal Measures. The beds in which the nodules are found are grey and blue-grey in colour, traversed by thin layers of darker hue, thus giving rise to a banded structure; they may be described as a calcareous sandstone of fine texture, fairly tough, and showing little or no tendency to split along the planes of banding.

In general the nodules have the shape of double-convex lenses, giving in the most perfect forms a circle in plan and two intersecting circular arcs of different curvatures in elevation. The equatorial planes of the nodules were almost invariably parallel to the bedding planes; in the case of those nodules having bounding surfaces of different curvature the surface of greatest curvature was generally found to be the one lying uppermost. The larger nodules have an equatorial diameter about four inches long, and the lens at its thickest part is about half an inch through; on fracturing, the interior shows a crystalline structure, the surfaces exposed having a steel-blue sub-metallic lustre.

An analysis of the crystalline part of one of these nodules, kindly made for me by Mr. Ward, A.R.S.M., Government Analyst, gave the following result:—

Carbonate of Lime .....	44·0	per cent.
Silica, &c., insoluble in acid .....	50·6	„
Total Iron, taken as Peroxide...	4·7	„
Carbonate of Magnesia and loss.	0·7	„
	<hr/>	
	100·0	
	<hr/>	

The specific gravity is 2·5.



5 cm

Mr. Ward writes—"The nodule appears to consist of a fine sand cemented by crystalline carbonate of lime."

Slides of the nodules were prepared parallel to and cutting transversely the equatorial plane. In natural light the slide shows a confused micro-granular structure, the component grains being transparent, opaque, and grey; on rotating the slide, a slight change of tint, due to variation of absorption, is noticed. With crossed nicols, large areas of the slide extinguish simultaneously, and it is seen that adjacent crystalline aggregates appear to grow into each other, there being no trace whatever of anything like a definite crystal boundary, or of the twinning characteristic of tabular calcite crystals. Minute angular grains of quartz and opaque matter are irregularly dispersed through the calcite aggregate.

The nodules in which the most perfect geometrical form is developed show little or no crystalline structure on fracture; bands running parallel to the equatorial plane of the nodule are seen to traverse the broken face, and occasionally the area between two consecutive bands, presents a crystalline appearance very similar to that shown in the larger nodules. The nodules of perfect form are rather less than two inches in diameter, and they pass by stages into smaller ones of roughly spherical shape. These smaller ones show a banded structure, but exhibit when broken no traces of crystallisation.

When the containing rock is broken the nodules are separated from the cavities in which they repose without the slightest difficulty. After the rock has been blasted, the nodules may be found lying in all directions, with scarcely a trace of the bed-rock adhering to them. The cavities and the exterior of the nodules, especially those of larger size, are frequently stained red. The nodules appear to occur most numerous along the bedding planes; in one slab, the largest dimension of which was about fourteen inches, seven cavities were counted.

The bed-rock is in places traversed by narrow irregular fissures containing calcite.

CONTRIBUTION TO THE PHYSIOGRAPHY OF  
TASMANIA.

By COL. W. V. LEGGE, R.A.

[Plate.]

No. 1.—PINE ISLAND, GREAT LAKE.

PINE ISLAND is one of the five or six islets which, at wide intervals, dot the surface of the magnificent sheet of water known as the Great Lake.

Considering the shallowness of its waters and its extremely irregular outline, it is singular that there are so few islands in this lake. Those that do exist are all of small area.

Pine Island is situated in the north-eastern corner of the great bend of the lake, the eastern shore of which skirts the foot of the so-called "Sand-bank Tier," a rugged talus-strewn range, about 4 miles in length. The local name has its origin in the sandy shore which bounds this part, and along which the water is remarkably shallow, running out for about half a mile, with a depth of not more than a couple of feet.

During a recent visit, I was much struck with the singular character of the shore of this island; and the desirability suggested itself of writing a short descriptive account of the spot for the information of our Fellows, and in the hope that a satisfactory explanation of the causes which have led to the formation which I noticed, may be arrived at from a discussion on it.

The distance from the head of the lake, where the boat belonging to the "Improvement Association" of Deloraine is kept, is about four miles, and on the afternoon of my trip, in March last, we sailed down (my son and myself), accompanied by Police Trooper Archer, in about half an hour.

The long, low outline of the island is visible from the starting-place, and as we neared it the basaltic "tors," which rise from its centre, became conspicuous. It is said to have been formerly covered with timber, the King William Pine having been chiefly in evidence, but the only signs of this that now exist are the gaunt and bleached trunks of one or two "Cider" gums and one pine. At the "Cove," on the eastern shore, there are several large

fallen trunks of pines lying partly in the water: further evidence of the ravages of fire! The stupid practice of setting fire to the country by shepherds and others, which obtains in the western wilds of this country, is probably answerable for the desolate state of this islet at present. On nearing it, however, scattered green bushes are seen, chiefly near the margin, and these are the only prominent signs of botanical life until one lands, when the surface is found to be fairly covered with the usual coarse vegetation and low bushes found in all open tracts of this upland region.

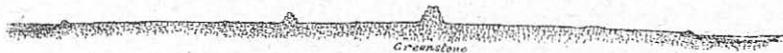
At about half a mile distant the singular character of the shore becomes apparent, the entire coast-line consisting of a raised terrace, rising about 7 feet from the water, and looking as regular and uniform in structure as if it had been built artificially. In looking for a landing-place we were able to examine the structure of this curious terrace, and found the rocks composing it to vary from somewhere about one ton in weight to stones of nearly one cwt. The face forms a regular slope of  $35^{\circ}$  or steeper in some places with an almost concave profile, and stands on a formation of small rocks below the surface, projecting outwards about four or five feet as a rule, and skirted by a flat bottom of shingle, the water being not more than three feet deep. The water is shallow all round the island, as indeed it is throughout the better part of the great bay at the north of the lake.

The contour of the west side is circular, the terrace sweeping round in regular curves to the northern and southern sides, which run almost due east to the eastern end, where the terrace is broken by a little cove of shingle, which my son visited, but which I did not, myself, see. The island is about 600 yards long, 250 broad at the widest part, and contains about 30 acres. The shape is roughly given in the accompanying sketch, enlarged from the 1-inch to the mile map of the lake. On landing, we found the group of "tors" we observed in the distance to consist of six or seven mounds of basalt, rising more or less perpendicularly from the surrounding and, in some directions, almost level land, the whole describing a crescent across the centre from west to east. The highest of these eminences was in the centre of the island, and rose to a height of 45 feet above the water, and 30 feet from the ground at its base. The others, at a distance of about 30 to 50 yards from each other, were smaller, the groups at the west end of the crescent being sub-divided into detached rocks. The class of rock, both in the "tors" and the boul-

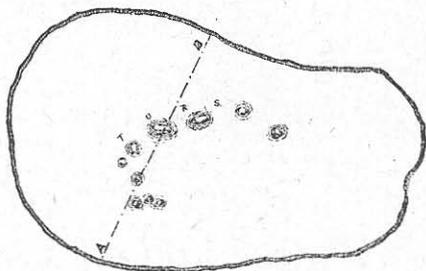
ders which form the terraced show, is greenstone, of which the entire structure of the island also consists, as here and there the same formation projects through the shallow soil. In view of this fact some clue is obtained as to the cause of the terraced formation of the shore.

The island lies almost in the middle of the strait—about  $1\frac{1}{2}$  mile wide—which connects the two great water tracts at the north of the lake, namely, the large “North-West Bay” and equally wide “East Bend”; and from all points of the compass, save two—north-east and south-west—it is exposed to the full force of the waves, with several miles of water behind them. The prevailing gales on the lake are from the north-west, south-south-west and south-west, and an extremely violent sea rises with them. After a hard winter, when the ice is from three to five inches thick, it generally breaks up during these gales, and drives in huge floes, with great violence, on the shore of the island. It seems, therefore, reasonable to suppose that, during the course of the centuries, the effect of wave and ice pressure has been sufficient to cast up what was formerly a foreshore of scattered stones and boulders into rampart, or terrace, now existing. Once this began to assume the elevated character of a roughly-formed terrace, there is no doubt that the ice movement and force of the waves would gradually mould it, little by little, into its present form. The formation of the rampart is equally regular on the south-west and north-west sides, the latter part being somewhat less exposed to heavy weather. Round the whole island, with the exception of the cove or break on the east side, the rock bank is almost of uniform height.

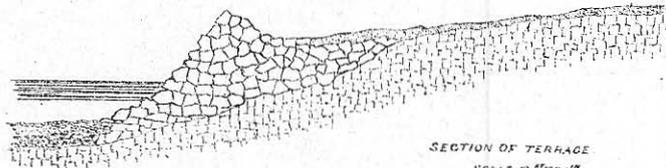
As the botany of these high regions is interesting, it may be proper to remark on the vegetation which we found clothing the islet. The surface is practically level, there being a gentle rise from the shore towards the “tors” in the centre. The soil is, for the most part, covered with a dwarf form of the ordinary cattle or “thatch” grass (*Poa caespitosa*), thickly interspersed and patched with the Epacris-like bushes *Pultenaea rubumbellata*, *Bechia gunniana*, and *Comesperma retusum*. The second of these was in flower at the time of my visit, and gave colour to the sward. We noticed that the dead tussocks of “thatch” grass (*Poa*) were partly covered with a curious earthy-looking deposit lying on them in thick patches, and on closely examining them found, to our surprise, that the covering was a lichen. The grass is killed in the usual way, by cold and age, as in the lowlands on our cattle-runs, and is



IDEAL SECTION ON AB. ; SCALE 30" TO 1" = 10'

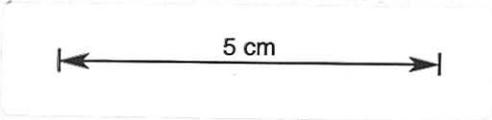


PLAN, ENLARGED 12 TIMES  
FROM 1" TO MILE MAP.



SECTION OF TERRACE  
SCALE, 12" TO 1" = 10'

PINE ISLAND.



W. V. L.  
del.

JOHN VAIL, GOVERNMENT PRINTER, TASMANIA.

apparently then fastened on by this curious lichen. Of flowering grasses, we gathered the tall Alpine Holy grass (*Hierochloë redolens*), the *Craspedia richiei*, whose tall stalk and downy, button-shaped flower towered above the dwarf *Poa* grass; we also gathered two other species (*Hypochaeris radicata* and *Prasophyllum fuscum*). On the northern shore, near the bank of stones, and here and there elsewhere, isolated bushes of the "Mountain Pittosporum" were found, and these were the tallest shrubs on the island. The Pepper tree (*Drimys aromatica*), with its red stems and berries, was more plentiful than the last, and grew in company with the pretty little bush *Bellendena montana*, which has green leaves, with a red obverse surface. The "Yellow Bush," so well known on the mountain plateaus of Tasmania, with its intensely hard wood, is found on the island, as well as round the shores of the lake; but I have not seen it anywhere so plentiful as on Ben Lomond. Other small shrubs make up the vegetation we observed, and are included in the list at the end of this note, and for the identification of all of which I am indebted to Mr. Rodway.

As regards the zoology of this lonely little tract, one would naturally expect to find it devoid of life; but Mr. Archer assures me he once saw on it the largest specimen of a Porcupine (*Echidna*) he ever came upon; the inference of which discovery is, that this animal must be a permanent inhabitant of Pine Island, or crossed over on the ice previous to a thaw. Whip-snakes are also said to be denizens of it.

The only bird seen was the ubiquitous Pipit, or Ground Lark (*Anthus australis*). The little Gull breeds, at times, plentifully on Garden Island, near the Police Station, and no doubt affects this one, but we had not time to look for evidence in the shape of old nests, many of which we came upon in the former islet.

The list of grasses and shrubs observed on Pine Island is as follows—

SHRUBS.

<i>Drimys aromatica</i> .....	Pepper Tree.
<i>Pittosporum bicolor</i> .....	Pittosporum.
<i>Orites revoluta</i> .....	Yellow-bush.
<i>Pultenæa rubumbellata</i> .....	Native Wallflower.
<i>Bellendena montana</i> .....	Mountain Roebel.
<i>Coprosma nitida</i> .....	Mountain Currant.
<i>Comesperma retusum</i> .....	Purple Broom.
<i>Olearia myrsinoides</i> . .....	Rough-leaved Daisy-tree.
<i>Ozothamus Hookeri</i> .....	Hooker's Scent-bush.
<i>Bæchia gunniana</i> .....	Gunn's Bæckia.
<i>Hakea microcarpa</i> .....	Small-fruited Hakea.

## GRASSES.

<i>Hierochloë redolens</i> .....	Tall Holy Grass.
<i>Poa cæspidosa</i> .....	Thatch Grass, Dwarf.
<i>Craspedia richel</i> .....	Soldiers' Buttons.
<i>Hypochoeris radicata</i> .....	Deep-rooted Dandelion.
<i>Prasophyllum fuscum</i> .....	Brown Fly-Orchis.
<i>Prasophyllum patens</i> .....	Fly Orchis.
<i>Brachycome</i> sp. ....	Mauve Daisy.
<i>Helichrysum bracteatum</i> ...	Coarse-flowered Everlasting.
<i>Celnusia longifolia</i> .....	Mountain Aster.
<i>Eriochilus autumnalis</i> .....	Autumn Orchis.

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## THE TOURMALINE-BEARING ROCKS OF THE HEEMSKIRK DISTRICT.

By G. A. WALLER and E. G. HOGG, M.A.

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THE Heemskirk district was visited some weeks ago by one of the authors in the course of his official duties as Assistant Government Geologist. Most of the field observations then made have already been published in the report on the district recently issued by the Mines Department\*, but the necessity of writing these reports as soon as possible after the examination of the district in question is completed precludes the possibility of a minute examination into the microscopical character of the rocks prior to publication. In the case of the Heemskirk district, not only are the field observations of more than ordinary interest, but the additional evidence afforded by micro-examination of the rocks is important. The authors, therefore, think that a short description of the rocks, both as regards their microscopical characters and their field relations, may not be out of place among the proceedings of this Society. It may also be mentioned that, since the publication of the Mines Department report, other portions of the district have been examined, so that some of the field observations here recorded are published for the first time.

Mt. Heemskirk is situated on the West Coast of Tasmania, about 24 miles north of the entrance to Macquarie Harbour. The district may be regarded as extending along the coast from Trial Harbour on the south to Granville Harbour on the north. The major axis of the mountain range runs approximately parallel to, and about 4 miles distant from, the coast. Mt. Agnew is the most southerly and the highest peak of the range, and rises about 2800 feet above sea-level. The mountain range is composed almost entirely of granite, which extends along the coast from a little north of Trial Harbour to beyond Granville. To the south and east of the granite the Silurian slates and sandstones outcrop, and these have suffered metamorphism near their contact with the granite.

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\* Report on the tin ore deposits of Mt. Heemskirk, by G. A. Waller, Assistant Government Geologist.

*The Normal Granite.*

The rock which we have termed the normal granite consists of a medium to coarse-grained biotite granite. It is much more widely distributed than the other types, and appears to be of more uniform composition. The rock shows, on microscopic examination, the following minerals:—Orthoclase, plagioclase feldspar, biotite, quartz, tourmaline, iron pyrites, and apatite. The feldspars have suffered much decomposition; the clouded appearance of the plagioclase feldspar makes the determination of its character very difficult, but the low angle of extinction points strongly to its being oligoclase. It has preceded the orthoclase in the order of crystallisation. The biotite is very pleochroic, and contains on the whole very few inclusions; it appears to have undergone very slight alteration, but it is occasionally somewhat bleached, and a small amount of resorption with separation out of opaque material has taken place. Apatite in small grains is rare, and small masses of iron pyrites, destitute of crystal boundaries, are present. The main interest of the slides centres round the remaining minerals, quartz and tourmaline. The tourmaline occurs as short slender opaque rods, traversing the quartz grains in all directions. The rods, as a rule, are quite straight, but in some few instances they are curved; a radiant structure is very characteristic, the centre of radiation being sometimes a minute speck of opaque matter; in other cases the rods appear to radiate from the line of separation of two quartz grains, and the rods then show a tendency to lie parallel to this line of separation; no case was observed of a rod crossing the line of separation and penetrating both of two adjacent quartz grains.

The distribution of the rods in the quartz is very capricious; they crowd some grains and are comparatively rare in others, while sometimes the same grain may be rich in them in one part while the remainder of the grain is absolutely destitute of them. In one marked case a quartz grain is crowded with needles, and carries a moderate amount of minute opaque specks, while the remainder of the grain, though in optical continuity, is devoid of rods, and almost devoid of opaque specks. The phenomenon would appear to point to the presence here of quartz of two generations, the younger quartz having been deposited from a solution free from tourmaline, and having crystallised round an eroded grain of the older quartz in optical continuity with it. The presence of veins containing iron pyrites in the vicinity seems to support the hypothesis that

this normal granite has undergone a small amount of metamorphic change.

*Tourmaline Granites and Aplites.*

These rocks occur in considerable quantities in many parts of the district, especially in the vicinity of known tin-bearing deposits. Tourmaline granites occur in the form of dykes and masses in the normal granite, and in the latter condition often extend over areas of some hundreds of acres. The tourmaline aplites, or fine-grained tourmaline granites, occur as irregular masses and nodules in the tourmaline granites, and also as dykes, both in the tourmaline granites and in the normal granites. Dykes, nodules, and masses of non-tourmaline-bearing aplite are also found in the normal granites, and dykes of the same rock traverse the tourmaline granite.

The tourmaline granites exhibit a large amount of variation, both in the proportions of the several minerals contained and also in the size of the constituent grains. We have only two somewhat imperfect slides of these rocks at our disposal, so that our description must be principally confined to macroscopical characters. The minerals which may be seen with the naked eye comprise the following:—Felspar, quartz, tourmaline, muscovite, and a dull green mica (probably biotite which has been partly altered to chlorite).

The most striking characteristic of the rock is in connection with the distribution of the tourmaline. This occurs in patches or bundles of radiating needles or prisms, from 1 up to 3 inches in diameter, usually associated with quartz. As the granite becomes finer grained, and approaches to the aplites in structure, the tourmaline loses its radiating character, and, together with quartz and a little felspar, forms more or less well-defined balls or nodules (quartz tourmaline nodules), which occur sometimes distributed at regular intervals through the granites, and sometimes collected together in masses. The groundmass of the rock consists of a medium to fine-grained crystalline granular mixture of quartz, felspar, and two micas. Small miarolitic cavities may be often observed, into which the crystal faces of quartz and felspar protrude. Under the microscope the felspar is seen to consist both of orthoclase and plagioclase, both much decomposed. The quartz differs from that of the normal granite, in that it contains no microscopic rods of tourmaline, the whole of the latter mineral appearing to be concentrated in the quartz tourmaline nodules.

With the exception of a little muscovite, there is no mica present in our sections. It may be said that the mica is generally present in much smaller quantities than in the normal granites, and in some cases it appears to be entirely absent.

From the above description it will be seen that the tourmaline granites differ from the normal granites in the following particulars:—

- (1.) The greater amount of variation exhibited by the tourmaline granites, both in the mineralogical composition and in the size of the constituent grains.
- (2.) The frequent presence of miarolitic cavities.
- (3.) The presence of macroscopic bundles of radiating tourmaline or of quartz tourmaline nodules.
- (4.) The absence of microscopic rods of tourmaline in the quartz.
- (5.) The presence of small quantities of muscovite, which appears to be absent from the normal type.
- (6.) The lesser abundance of biotite.

The tourmaline aplites, as has already been stated, occur in irregular masses in tourmaline granites, and as dykes in both the tourmaline granites and the normal granites. In neither case is there any sign of parting at the contact between the aplite and the granite. In the case of the dykes the walls are well defined, but there is no distinct plane of division, the one rock appearing to "grow into" the other. This phenomenon is ascribed by Rosenbusch\* to the fact that the aplite was introduced into the fissures while the granite was still in a highly heated condition. In the case of the masses the contact is even less sharp, and it is sometimes impossible to say within two or three inches where the aplite begins and the granite ends. Occasionally the masses of aplite throw out irregular apophyses into the surrounding granite. The whole appearance of the masses gives the impression that they were formed while both magmas were still liquid, and one may ascribe the irregular shape of some of them to movements in the still molten magma. The aplites are usually much richer in tourmaline than the tourmaline granites. The mineral is, however, confined to the quartz tourmaline nodules, which are often very abundant, and generally are almost perfect spheres. The quartz tourmaline nodules withstand the decomposing action of the atmosphere for a longer time than the sur-

\* H. Rosenbusch. *Elemente der Gesteinslehre*, p. 215.

rounding rock, and this causes them to stand out on the weathered surface, giving the rock a very remarkable appearance. From the same cause the subsoil in some localities is largely composed of these nodules.

Under the microscope the groundmass of the tourmaline aplites consists essentially of orthoclase, plagioclase, and quartz, with small quantities of both biotite and muscovite. The plagioclase is oligoclase-andesine, or albite. Measurements of extinction angles on sections cut approximately perpendicular to the twining lamellæ give results ranging from  $9^{\circ}$  to  $16^{\circ}$ . Some of the quartz appears to have preceded the felspar in order of crystallisation. Some of the grains have defined crystal edges, and they often protrude into, or are included in, the felspar crystals. Like the tourmaline granites, the quartz contains no microscopic rods of tourmaline. One section was prepared, showing the junction between a quartz tourmaline nodule and the surrounding rock. As the centre of the slide is approached, grains and hypidiomorphic crystals of tourmaline make their appearance; they are, for the most part, yellow-brown in colour, and show faint pleochroism. As the centre of the nodule is approached, the felspar—which is almost entirely plagioclase—dwindles, and the rock appears to be entirely constituted of quartz and tourmaline. The quartz occurs sometimes in the form of hypidiomorphic crystals surrounded by tourmaline, which is almost entirely without crystal boundaries; the tourmaline is blue in colour, and moderately pleochroic.

Other slides of nodules show an intensely pleochroic tourmaline of blue colour; the crystals are sometimes of tabular habit, and enclose grains of quartz in such a manner as to give rise to a pœcilitic structure. A small amount of much-altered plagioclase felspar is also present; it has preceded the tourmaline in the order of crystallisation. Rods of tourmaline are absent from the quartz of these nodules. Although not observed in the slides, a small quantity of tin oxide appears to be always present in the quartz tourmaline nodules. A small prospect was always obtained by crushing and vanning the stone, while a bulk assay taken from the nodules occurring at the Federation Mine yielded 0.2 per cent of metallic tin.

The tourmaline aplites may be said to differ from the tourmaline granites in the following particulars:—

- (1.) They are finer grained.
- (2.) They contain quartz tourmaline nodules in greater abundance, and in larger and more perfectly developed spheres.

- (3.) Some of the quartz has preceded the felspar in order of crystallisation. The structure may be described as partly panidiomorphic.

*Normal Aplites.*

Many of the aplites do not contain quartz tourmaline nodules. They occur in the form of dykes in the normal granite and in the tourmaline granite, and as masses and nodules in the normal granite. One case was observed in which a small dyke of aplite contained a central seam of large crystals of quartz and felspar (pegmatite) with small cavities or druses, into which the crystal faces project. In many other cases miarolitic cavities were observed irregularly distributed through the dykes. Microscopically, the normal aplites closely resemble the groundmass of the tourmaline aplites. They are somewhat even-grained rocks, composed essentially of orthoclase, plagioclase felspar, with a little biotite and accessory tourmaline and apatite. The felspars are much decomposed; the plagioclase felspar, which is relatively less abundant than in the normal granite, appears to be oligoclase-andesine, or albite, and has preceded orthoclase in order of crystallisation. The quartz is more abundant than in the normal granites, and in some cases the grains carry rods of tourmaline quite similar in appearance to those described in connection with the normal granite. Their disposition is very capricious, as they are numerous in some grains and quite absent from others. The biotite shows bleaching and resorption phenomena; apatite occurs as an inclusion in biotite. Some of the quartz has defined crystal edges; it also appears as eyes in the orthoclase. When present in the latter form, tourmaline rods are absent.

*Quartz Tourmaline Reefs.*

The rocks which have now been described form in part the wall rocks of numerous quartz tourmaline reefs which occur throughout the district. We propose to use the term "reef" in the sense in which it is used locally, and by most mining men in Australia, viz., to denote any non-clastic tabular deposit composed largely of silicious material irrespective of its supposed mode of formation. Until comparatively recent years the filling-matter of fissures was regarded as being divisible into two well-defined classes—one formed by cooling from a molten condition, the other formed by precipitation from aqueous solution; and these classes are still known as dykes and veins respectively. It

is, however, now generally conceded that it is impossible to draw any sharp line of division between these two types, and our investigation of the quartz tourmaline rocks of the Heemskirk district affords evidence of this fact. We find that there are both quartz tourmaline dykes and quartz tourmaline veins, and also types which occupy an intermediate position. As it is often difficult to decide at once to which class any given deposit belongs, it is evident that a general term is desirable, and the term "reef" appears to us to be quite suitable.

#### *Quartz Tourmaline Veins.*

It is a well-recognised fact that fissure veins are often not merely "fissures filled with mineral matter;" the material forming the vein may have been either deposited in an open cavity formed by the fissure, or it may have been deposited as a replacement of the wall-rock, or of some of the constituents of the latter. In the quartz tourmaline reefs of the Heemskirk district the greater part of the material has been deposited as a replacement of the wall rock, and only a very small portion as the actual filling of the fissure. These two portions of the vein we propose to distinguish by the terms "vein rock" and "vein stone," the former denoting that portion of the vein which has been formed as a replacement of the wall rock, and the latter that portion which has been deposited along the plane of the fissure, and generally in an open cavity.

The quartz tourmaline veins consist of tabular deposits composed essentially of quartz and tourmaline, traversing both the granite and the surrounding Silurian strata. There is a central seam or fissure filled usually with tourmaline, or quartz and tourmaline (the vein stone), and on either side of this is a granular rock composed of quartz, quartz and tourmaline, or quartz and white mica (muscovite or lithia mica) and tourmaline (the vein rock). Both the vein stone and the vein rock may carry tin oxide. The former is sometimes very rich in tin, the ore being often beautifully crystallised; in the latter the tin oxide occurs in crystalline grains, and is often finely disseminated. Pyrites appears to be an invariable constituent wherever the veins have been explored below water-level. It occurs in bunches in the vein stone, and also disseminated through the vein rock. In some cases the vein rock consists almost entirely of granular quartz and pyrite, the latter having the appearance of replacing the felspar of the granite. Besides those already mentioned, most of the other minerals

which are of common occurrence in tin veins are present in small quantities, viz., bismuthinite, molybdenite (rare), arsenopyrite, chalcopyrite, galena, and zinc-blende (both of these rare, and in very small quantities), fluorite (in small quantities), and smoky quartz.

The vein rock differs very greatly in the amount of tourmaline present. Often it is composed almost wholly of quartz, but at other times the only quartz present appears to be that which formed the original quartz of the granite, the whole of the felspar being replaced by tourmaline. In other cases the felspar has been replaced by white mica, with or without the addition of quartz and tourmaline. The vein rock then forms a typical greissen. The tourmaline is of two varieties, the black or iron tourmaline and the green or alkali tourmaline. Although tin ore is associated with both varieties, the green tourmaline appears to be much the more favourable indication for tin.

The veins vary in width from a few inches up to 20 or 30 feet; in the latter case there are usually a number of parallel fissures filled with tourmaline running through the vein rock, and the mineralisation has evidently spread outwards from these fissures until the adjacent zones of replacement met in the centre. Often bands or lenticular bodies of unaltered granite exist within the reefs between two such zones. The veins generally run in parallel groups, but often there are several main directions of strike in the same locality. When the veins cross one another there is usually no faulting, pointing to the fact that the fissures were produced by contraction of the granite on cooling. The proof of the metasomatic nature of the vein rock is very conclusive, and may be deduced both from the field evidence and from the examination of thin sections under the microscope. When the veins occur in granite, the vein rock is granular, and the size of the grains is the same as that of the adjacent granite or aplite; there is no parting between the granite and the vein rock, the one seeming to pass over into the other. When the veins traverse sedimentary rocks, the vein rock, or metamorphosed wall rock, retains the original laminated structure. Original differences in porosity or composition have led to deposition of quartz along certain layers, and tourmaline along others, with the result that a black-and-white striped rock is produced, of very striking appearance. Perhaps the most striking field evidence of replacement is to be seen when a vein passes through a granite or aplite which is rich in quartz tourmaline nodules. The nodules are seen in the same abundance and of the same size in the vein rock as in

the adjoining wall rock. When the nodules are absent from the wall rock, they are also absent from the vein rock. It is quite evident that the quartz tourmaline nodules, which consist of the same material as was contained in the solutions, were not attacked by them, but remained unaltered while the surrounding feldspar of the granite or aplite was replaced.

Microscopic examination of the vein rock entirely confirms these conclusions. Two slides were prepared from a vein-stone poor in tourmaline, replacing granite, which contains quartz tourmaline nodules. The vein stone also contains nodules, but these were not sliced. Both slices are almost entirely made up of quartz, which is present in two forms. It occurs either as large grains, having the usual aspect of the quartz of the tourmaline granites (containing no microscopic rods of tourmaline), and as very small grains confusedly arranged, so as to produce a mosaic structure. A small amount of pleochroic hypidiomorphic tourmaline, enclosing small grains of quartz also occurs either entirely within or nearly surrounded by the mosaic quartz. The tourmaline and mosaic quartz are evidently replacements of the feldspar of the granite. There is a tendency of the mosaic quartz to extinguish simultaneously over fairly well-defined areas. The junction of two such areas may be a straight line or an irregular line, suggesting strongly that the orientation of the quartz grains was conditioned by the position of the original feldspar grains of the granite, the straight lines representing the contact planes of two adjacent members of a polysynthetically-twinned feldspar.

Three sections were cut of quartz tourmaline rock replacing normal granite in which quartz tourmaline nodules were absent. These slides are composed of quartz, tourmaline, and a small amount of opaque matter, disseminated through the former mineral. The two types of quartz which have already been described as occurring in the quartz rock are also present in these slides. The large grains contain a little opaque matter and fluid pores arranged somewhat in linear fashion, and opaque rods of tourmaline showing radiant structure of exactly the same nature as those described as occurring in the quartz of the normal granite. There can be no doubt that these grains represent the original quartz of the granite. The mosaic or secondary quartz is of the same nature as that described in the quartz rock, but is less abundant, and in one of the slides is absent. The tourmaline occurs as idiomorphic crystals of prismatic habit in the secondary quartz, and as confused, ragged

masses, sometimes fibrous in structure, and then showing tendency to radiant arrangement. We believe that this tourmaline is a replacement mineral after felspar and biotite, no trace of either of which minerals can be seen in the slides. Contrary to what was observed in the case of the replacing quartz, however, the felspar crystals have not determined any special orientation in the case of the tourmaline. In the slide in which replacing quartz is absent the original quartz grains do not seem to have entirely escaped change. They appear to be corroded around the edges, and to some extent replaced by tourmaline; this appearance is nearly absent from the slides, which contain secondary quartz.

One slide was prepared of greissen, occurring as a replacement of a granite or aplite, containing quartz tourmaline nodules. The rock consists of quartz, tourmaline, and a fibrous mica; the quartz appears for the most part in the form typical of the quartz of tourmaline granite, but there is in addition a small number of minute grains of quartz surrounded by a confused mesh of mica; the mica is in fibrous crystals, sometimes arranged with radial structure; it shows no pleochrism, but there is a considerable amount of absorption of light as the slide is rotated. It polarises in very high colours, and appears to have the optical properties of muscovite. Tourmaline occurs in small quantities as hypidiomorphic pleochroic crystals, but it is not present in the form of rods in the quartz grains. The mica would appear to be for the most part a replacement after felspar, but the occurrence of small nests and meshes of mica in the larger grains of quartz shows that the latter mineral has also suffered replacement. In the slide are a few very minute crystals of a highly refractory substance, which may be zircon; the material of the slide surrounding these specks is frequently coloured brown. One slide was prepared of quartz tourmaline rock, replacing slate which appears originally to have possessed a finely laminated structure. The laminae have been for the most part replaced by grains of pleochroic tourmaline arranged linearly, and are separated from each other by minute grains of clear quartz.

The vein stone was not examined microscopically. It often consists almost wholly of tourmaline, but is sometimes very rich in tin oxide. The tourmaline often occurs in large bunches of radiating prisms or needles going up to 6 or 8 inches in length. Occasionally, however, a good deal of quartz is present, and this is especially the

case where the veins traverse the sedimentary rocks. The tourmaline appears to gradually decrease as the distance from the granite increases, until finally only quartz veins are to be seen. With the disappearance of the tourmaline, disappears also the metamorphism of the wall rock, which is so characteristic of the veins, both in the granite and in its immediate vicinity.

#### *Quartz-tourmaline Dykes.*

These interesting dykes were, we believe, first observed by Mr. F. J. Ernst. They are found traversing both the granite and the sedimentary rocks, and are distinguished from the veins by the fact that their structure is not dependent upon the character of the wall rock, since they traverse granites, aplites, and sedimentary rocks without undergoing change. They have no central fissure, and the walls are generally sharp and clear-cut, even more so than the aplite dykes. They are usually of uniform composition throughout, consisting of a somewhat finely granular mixture of quartz and tourmaline, with sometimes a little feldspar. When they traverse sedimentary rocks, they often contain included angular fragments of the country-rock. In the slides of this rock which were prepared the only minerals observed were quartz and tourmaline. The former mineral occurs as irregular grains, containing a very small amount of minute opaque specks. Tourmaline is present in well-formed crystals of prismatic habit, as grains, and as clusters of grains and crystals. The larger crystals of prismatic habit have a marked pleochroism, but as the crystals dwindle in size the pleochroism gradually diminishes, and cannot be detected in the smallest crystals. The tourmaline has preceded the quartz in order of crystallisation; radiating prisms of small size frequently penetrate the quartz grains, the centre of radiation being often one of the larger tourmaline crystals. The tourmaline rods previously alluded to are quite absent from the quartz of this rock.

In many cases the wall rock of the dykes has suffered metamorphism in a similar manner to that of the tourmaline veins, but to a lesser extent. In several instances, where the dykes occurred in granite, it was observed that the latter had been converted into quartz-rock or quartz-tourmaline rock, for a short distance (generally not more than a few inches) on either side of the dyke. In other cases, even along the same dyke, the wall rock had remained apparently unaltered. It is conceivable that this

metamorphism may have been produced by vapours which traversed the fissure, prior to the introduction of the quartz-tourmaline magma, but it seems more probable that it was caused by emanations from the dyke-rock itself.

Two interesting instances of variation in composition were noted in the dykes traversing the Silurian strata at the Gentle Annie Rise, to the east of Mount Heemskirk. In one case of a dyke  $2\frac{1}{2}$  inches in width, a portion of the tourmaline had segregated towards the centre of the dyke and formed a central seam about  $\frac{3}{4}$  inch in width, the remainder of the dyke being composed of the normal quartz-tourmaline mixture. In another case of a somewhat larger dyke, the quartz had segregated, and for a foot or fifteen inches the dyke channel was filled with white quartz almost free from tourmaline. The latter instance seems to point to the fact that the quartz-tourmaline dykes may change to quartz veins as well as the quartz tourmaline veins.

Several observations were made at the Gentle Annie Rise of small quartz and quartz-tourmaline veins being cut through or faulted by quartz-tourmaline dykes. These observations are perhaps not yet sufficiently numerous to establish the relative ages of the two kinds of reefs definitely, but it may be said, that in some cases at least, the dykes are younger than the veins. This conclusion is of great importance, for it proves that the quartz and quartz-tourmaline veins were formed before the close of the period of eruptive action of the granite.

#### *Conclusions.*

We may now state briefly the conclusions which we think are justified by the facts which were observed in this district with regard to the origin of these tourmaline rocks and the associated tin-bearing veins.

It appears perfectly evident that the tourmaline is an original constituent of the granite magma, since in one form or another it is contained in all the rocks which have been examined. There appears, however, to have been a continued tendency for the tourmaline to segregate together and separate itself from the rest of the magma. In the normal granite, it occurs only in microscopic rods in some of the quartz, and must represent an extremely small percentage of the total composition of the rock. But even here there is a tendency for the tourmaline to come together and form minute bundles of interlacing or radiating rods. In the tourmaline granites, the tourmaline is much

more abundant, and forms macroscopic bundles of radiating needles, and even granular nodules of quartz and tourmaline. This great increase in the amount of tourmaline present is, we believe, to be accounted for by some process of differentiation or segregation in the original granite magma, while the presence of tourmaline in separate bundles and nodules may be accounted for by a further process of magmatic segregation from the already differentiated tourmaline-bearing magma. The tourmaline-aplite magma may have separated from the tourmaline-granite magma in the same way as the tourmaline-granite magma separated from the normal granite magma. The presence of irregular masses of tourmaline-granite in the normal granite, and of tourmaline-aplite in tourmaline-granite, is we think, convincing evidence that the three types of rock have originated from one and the same magma, and that the differentiation has taken place before, and not after, the consolidation of the magma. A definite order of consolidation of the three rocks may be observed. Dykes of tourmaline-granite occur in the normal granite, but not in the tourmaline-aplite, while dykes of tourmaline-aplite occur both in the tourmaline-granite and in the normal granite. It is evident therefore that the order of consolidation was (1) normal granite, (2) tourmaline-granite, (3) tourmaline-aplite.

The composition of the quartz-tourmaline nodules at once suggests that the quartz-tourmaline reefs are in some way connected with these. In many places the nodules appear to have a tendency to come together and unite to form larger masses of quartz-tourmaline rock. At greater depths, where the cooling of the magma would proceed more slowly, this might well take place, and the quartz-tourmaline magma thus formed might be the origin of the quartz-tourmaline dykes. The presence of the veins, however, suggests that a further separation first takes place within the quartz-tourmaline magma, namely, a separation into a highly aqueous and a less aqueous magma. The former would be virtually a saturated solution, and in this would be concentrated the heavy metals originally contained in the magma, since, from the common occurrence of these metals in mineral veins, we know them to be specially soluble in heated waters. Assuming, now, that such masses of quartz-tourmaline magma were intersected by fissures formed by the contraction of the granite in cooling, the more highly aqueous portion, being the more fluid, would be first erupted, and owing to its highly-heated condition and the presence of such powerful mineralising agents as

boron, fluorine (both of these are present in tourmaline), hydrogen sulphide and water would have a very powerful chemical action on the wall of the fissures, producing the complete metamorphism of the wall rock, which has already been described. The more viscous quartz-tourmaline magma might be erupted later and form quartz-tourmaline dykes.

It will be remembered that the quartz-tourmaline veins traverse both the normal granite and the tourmaline granite and aplites, while in several instances the quartz-tourmaline dykes were observed to fault the quartz-tourmaline veins. The relative ages of all of the tourmaline-bearing rocks, described in this paper appear therefore to be as follows,—(1) normal granite, (2) tourmaline-granite, (3) tourmaline-aplite, (4) quartz-tourmaline veins, (5) quartz-tourmaline dykes.

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A GEOLOGICAL EXCURSION TO PORT CYGNET  
IN CONNECTION WITH THE AUSTRALASIAN  
ASSOCIATION FOR THE ADVANCEMENT OF  
SCIENCE, 1902.

By W. H. TWELVETREES.

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THE interest attaching to the plexus of felspathoid rocks, now known to occur at Port Cygnet, led to a flying visit being paid to the locality by members of Section C. (Geology) of the Australasian Association for the Advancement of Science, in January, 1902. The occurrence of this division of eruptive rocks in Tasmania is so restricted, and their development is exposed so instructively, that a brief account of the excursion will be interesting to others besides the actual visitors.

Seventeen members took advantage of the opportunity, and travelled to Port Cygnet by one of the Channel steamers, making the trip in a few hours. A call was made at Kettering, in the D'Entrecasteaux Channel, where Professor E. C. Hogg led the party to an exposure of Permo-Carboniferous till, with glaciated pebbles. Oyster Cove, where the belt of alkali rocks comes through from Port Cygnet, was not visited, the entire energies of the expedition being reserved for the better known area at Lovett. Elæolite syenite, essexite and alkali rocks with trachytoidal ground-mass, occur at Oyster Cove.

The assistance rendered to the cause of Science by the Hon. Edward Mulcahy, the then Minister of Lands, Works, and Mines, in lending the services of the two State geologists, was appreciated by the members and duly acknowledged at the time. Despite the short time at the disposal of some of the professors, who had to return to Hobart to attend a meeting of Council, the area examined was considerable, the only regret being that members could not linger a few days longer at a spot which it was recognised must eventually become one of classic interest to petrographers.

As the steamer drew near to the jetty at the head of the arm of the Huon, known as Port Cygnet, about a mile south of the township of Lovett, the scene was owned to be highly

picturesque. Wooded heights ascend from the water's edge on each side, and large fruit orchards diversify the aspect of the slopes. The view eastwards is shut in by the high range in the background, a ridge of Mesozoic diabase (dolerite), the holocrystalline plagioclase-augite rock, which R. M. Johnston shows, is prolonged southwards from Mt. Wellington and apparently forms the axis of the peninsula which divides the waters of Port Cygnet from the Channel. This high ridge is flanked by Permo-Carboniferous sandstone and mudstone on either side, and, according to F. J. Ernst, crosses the zone of alkali rocks in their N.E.-S.W. course. Westwards the same Permo-Carboniferous beds are found, also broken through by the elæolite syenites, tinguaites and allied rocks, which the members of the Section now hastened to examine *in situ*.

At the extreme head of the arm the water is shallow, and old residents say that it has receded considerably in recent years. The shores are flat, and no good exposures of rock are visible. The first outcrop of the alkali rocks is seen on the shore, between the two jetties, but a more striking development occurs at, and immediately south of, the Regatta ground. This point, the termination of a projecting headland a few hundred feet wide, consists of elæolite-syenite with varieties of alkali and alkali-quartz, syenite passing at each margin into darker varieties, which have been determined by Professor H. Rosenbusch, to whom samples were submitted by the Mines Department, as jacupirangite, essexite, and nephelinite (or monchiquite). Generally speaking, there are no sharp divisions between the central mass of light-coloured syenite and the dark marginal rocks, though well-defined bands and veins of the lighter rock traverse the other, sometimes in such profusion as to form a meshwork. At other times the most gradual variation is seen from one to the other, the lighter variety growing darker by imperceptible stages. The darker rocks also vary considerably, both in texture and colour. It is impossible to resist the conclusion that we are here in the presence of an example of magmatic differentiation. The leucocratic centre is elæolite-syenite, and the dark marginal rocks are differentiated products. Of the latter, the mica nephelinite (containing large crystals of biotite) has only been found as scattered stones, but a little excavation work would probably reveal the bed-rock. The locality is between the Regatta Box and the Point. Professor Rosenbusch says this rock is nephelinite with the habit of a monchiquite, to some extent actually a monchiquite with a groundmass of nepheline, instead of analcime or glass. Monchiquite is usually considered to be

a rock composed of the dark silicates in a groundmass of analcime. Some authors affirm the analcime to be Primary, others believe it may be the hydration product of original glass.

The essexite of the Regatta ground is a dark dioritic-looking rock found at the water's edge below the Regatta Box. I have also seen it at Oyster Cove. It consists of labradorite and andesine feldspars + augite + amphibole with quartz and iron oxide. Although it possesses the characteristics of its family, it differs, according to Professor Rosenbusch, in type from other essexites known to him, and requires further study.

The jacupirangite (nepheline + augite) is not always so intensely pyroxenic as typical specimens from Jacupiranga. Professor Rosenbusch has, with his usual kindness, furnished me with the following note upon it.

"It is a highly pyroxenic differentiation of the elaeolite and alkali syenites at the Regatta ground, Port Cygnet, and possesses the characters of the so-called jacupirangite of San Paulo, in Brazil, and of Alnö, in Sweden. It would be rather interesting to examine the sand of any adjacent creeks which may flow over the syenites with this jacupirangite facies. The interesting mineral, Baddeleyite ( $ZrO_2$ ) may be expected to occur."

Further south from this promontory a few dykes were visited on the shore of the Arm, traversing mudstones of Permo-Carboniferous age. One is a green sölvbergite porphyry, its colour due to aegirine. It contains parallel layers of porphyritic tabular crystals of sanidine. Another dyke, a little further south, contains the new variety of garnet, Johnstonotite. It is a mica sölvbergite. Professor Rosenbusch calls attention to an undetermined mineral which he has observed in it. He says.—

"This rock contains in small quantities, but widely distributed, a strongly refractive, red, transparent, isotropic mineral, which I have noticed in many other rocks of the alkali series, but which I have not been able to determine yet. I suspect that it belongs to the pyrochlore group."

The next day the party visited Mount Livingstone, one mile N.E. of Lovett, where large collections were made of the beautiful elaeolite syenite porphyry, which seems to form the axis of the hill, and can be gathered in loose blocks on the crest. These rocks had been previously designated phonolitic trachyte and nosean or haayne trachyte by the writer, but Professor Rosenbusch has identified them as elaeolite syenite porphyries with trachytoid groundmass. He has taken the trouble to accompany his identification with the

following remarks. Speaking of the porphyry with the large biscuit-like felspar crystals ("magpie" locally), he says:—

"Large crystals of orthoclase with splendid cleavage parallel to P (001), M (010), and (101), a little triclinic felspar, a few pseudomorphs of natrolite after nepheline, pseudomorphs of iron ores after nosean and biotite (?) and some garnets lie in a very fine fluidal trachytic groundmass of felspars. The pseudomorphs after nepheline are the most charming aggregates of natrolite that I have ever seen, except in the tinguaite from Alnö. At the same time it is also possible that the original mineral was sodalite. These pseudomorphs are also enclosed in the felspars. The rock is strongly impregnated with pyrite. I hesitate only whether to call it an alkali syenite porphyry or on elæolite syenite porphyry."

The pseudomorphs of iron ore after nosean have been a puzzling question for some time, and I sent a slide to Professor Rosenbusch containing a section of one of them plainly replacing garnet, and suggested that garnet may have been the original mineral in all instances. The Professor's reply shows an openness of mind which is refreshing to meet with now-a-days. It is as follows:—

"I agree with you in referring the iron ore pseudomorphs in the slide which you sent me to garnet (melanite). At the same time, I am not sure whether this holds good for the pseudomorphs in my slides. It may possibly do so. The difference in habit may be due to varying thickness of the slices. In my slices the forms remind me of nosean in leucitophyres and allied rocks. Had I seen your slide first, perhaps my interpretation would not have occurred to me."

It may, therefore, well be that some of these iron ore pseudomorphs are really after nosean, while others replace garnet. From the fact that we have undoubted nepheline in this group of rocks, it is likely that the matrolitic pseudomorphs are after nepheline.

Closely allied with the above is a fresh-looking garnetiferous porphyry of trachytic aspect, with glistening phenocrysts of sanidine, and spotted in places rather abundantly with small soft grey or white crystals of haiyne or nosean. Nosean trachyte or phonolite appeared a convenient name, but Professor Rosenbusch calls it a melanite-bearing elæolite syenite porphyry. He writes:—

"The felspar is fresh and like sanidine. A few small elæolites are converted for the most part into aggregates of natrolite. The dark constituent is an amphibole with  $\epsilon : c = 20^\circ \gamma$ —a weak,  $\epsilon = b$  blue green,  $a$  greenish yellow.

The garnet is fresh, zonally marked, highly idiomorphic, and occurs not only as phenocrysts, but also as a constituent of the trachytoid groundmass."

The nosean mineral, though plentiful in many specimens of the rock, is rare in others, and is sometimes quite absent. A suggestion was made to me in Victoria that the identification of the nosean might be incorrect. I felt satisfied that no mistake had been made, and Professor David, to whom I showed a slide, confirmed the reference. Professor Rosenbusch also recognised nosean, or hauyne, in a slide which was sent to him. He says:—

"Whether hauyne (rich in Ca) or nosean (rich in Na) is present cannot be determined without chemical investigation, but one of these two minerals is undoubtedly here."

I do not know that nosean or hauyne has been recorded elsewhere in Australasia.

Mount Mary is situate to the west of Lovett, and a trip made to it disclosed the occurrence of other members of the alkali series. The elaeolite, or alkali syenite porphyry, with the biscuit-like felspar phenocrysts, was seen at the Mount Mary mine, and a little above it the hillside was strewn with stones of green tinguaitite, or fluidal tinguaitite porphyry. The summit is occupied by a grey tinguaitite porphyry, with large glassy sanidine feldspars, and rich in fresh-looking melanite, but poor in nepheline. It occurs in contact with Permo-Carboniferous sediments, impregnated with pyrites. Near the summit are outcrops of the alkali syenite intrusion, which apparently forms the mass of the mountains.

On the Back Road the plutonic rock is well exposed. With respect to this Professor Rosenbusch writes:—

"It consists of dull orthoclase, fresh and beautifully zoned albitic felspar, with basic margins; augite ( $\alpha : c = 48^\circ$ ) green in colour, with occasional narrow margins of deeper tint passing over into aegirine augite. The rock belongs to the alkali augite syenites, though it does not agree with either Pulaskite, Nordmarkite, Umptekite, or Laurvikite, &c.; in fact, it does not correspond exactly with any of the numerous rocks of that series. According to its dominant structure, I would call it either an alkali syenite with porphyritic facies, or an alkali syenite porphyry with granular facies."

The visit of the members of Section C. to Port Cygnet has proved of double value to the cause of geological science, inasmuch as it has led to the above remarks from this great German master of petrology.

These intrusive rocks carry pyrites, and along the lines of their contact with the Permo-Carboniferous sedimentary strata some silicification has taken place, accompanied by a concentration of pyrite. Some of the contact stone assays 5 to 6 ozs. silver and from  $\frac{1}{2}$  dwt. to 2 or 3 dwts. gold per ton. The district has yielded about 3000 ozs. alluvial gold, most of which was derived from the small flats near Lymington.

The variations which distinguish the Port Cygnet rocks from alkali rocks elsewhere may be appealed to in illustration of the theory of petrological provinces. They cannot be exactly correlated with the known members of the series elsewhere, and possibly new names may be required for some of them.

The study of the group is not complete, and as it progresses readjustment of the nomenclature are inevitable, but at present the series would be arranged as follows:—

#### ALKALI ROCKS.

##### *Family 1.*—ALKALI GRANITE.

Not represented.

##### *Family 2.*—ALKALI SYENITE.

(a) Plutonic representatives:—

1. Quartz augite syenite: a medium-grained, yellowish rock at Regatta Point (alkali felspar + augite + quartz).
2. Alkali syenite at Regatta Point and on Back Road (orthoclase and albitic felspar + augite + amphibole with accessory biotite, quartz, sphene, and apatite). Has frequently a porphyritic facies.

##### *Family 3.* ELAEOLITE SYENITE.

(a) Plutonic representatives:—

1. Elaeolite syenite: coarse syenite rock at Regatta Point, and near top of Mount Mary (alkali felspar + elaeolite + alkaline pyroxene + amphibole). Contains melanite and biotite, also hydronephelite after elaeolite [or sodalite], and accessory sphene and apatite.

(b) Complementary and dyke representatives:—

1. Elaeolite Syenite porphyry, viz —

- (i.) The biscuit felspar rock on Mount Livingstone and Mount Mary ("Magpie") [orthoclase and a little triclinic felspar + alkaline pyroxene and amphibole + melanite and iron ore pseudomorphs after nosean and garnet with natrolitic pseudomorphs after nepheline (or sodalite)]. Has a fluidal felspathic groundmass.

- (ii.) The nosean rock on Mount Livingstone, closely related to the preceding. (Sanidine + amphibole + alkaline pyroxene + melanite + nosean or haüyne. Aggregates of natrolite after small crystals of nepheline.
2. Mica sölvbergite. Dyke on beach one mile south of Regatta Point: (orthoclase and albite feldspars + brownish yellow mica + garnet + a pyrochlore mineral?).
  3. Sölvbergite porphyry. a little north of the preceding. (Phenocrysts = sanidine + aegirine and natrolite after aegirine. Groundmass = acicular aegirine + sanidine + analcime and a little nepheline.
  4. Tinguaitite porphyry: On Mount Mary (Phenocrysts = aegirine augite + melanite + sanidine + sphene + nepheline. Groundmass = sanidine + acicular aegirine + analcime
  5. Jacupirangite: at Regatta Point (nepheline + augite.)

*Family 4.—ESSEXITE.*

(a.) Plutonic representatives.

1. Essexite, dark, dioritic-looking rock below the Regatta Box (Labradorite and andesine feldspar + augite + amphibole + quartz).

*Family 5.—THERALITE.*

(a.) Plutonic representatives absent.

(b.) Complementary and dyke representatives:—

1. Mica nephelinite. At Regatta Point (Nepheline + augite + biotite + amphibole and accessory apatite. Has the habit of a monchiquite.

*Family 6.—IJOLITE.*

This is not represented, unless with H. Stanley Jevons\* we detach jacupirangite from the elaeolite syenite family and place it among the feldsparless ijolites. Its tendency to variation in mineral constitution and its usual intimate association with elaeolite syenite incline me to retain it as a differentiation of that magma.

The alkali rocks are also found in other parts of Tasmania, and to make their enumerations complete I cite the additional localities, viz:—

*Family 4.—ESSEXITE.*

(c) Effusive representatives:—

1. Trachydolerite: the bluffs at Table Cape and Circular Head (labradorite + augite + olivine, with analcime and apatite (and nepheline?).
2. Melilite basalt: on the Shannon Tier, at Sandy Bay, and near Rokeby (melilite + olivine (sometimes as fayalite) + augite + perovskite.

\* A systematic nomenclature for igneous rocks. H. S. Jevons, M.A., Geol. Mag. 1901, p. 304.

*Family 5.—THERALITE.*

## (c) Effusive representatives :—

1. Nephelinite : on the Shannon Tier (nepheline + augite).
2. Limburgite : a dyke on the Emu Bay railway, near Burnie (olivine + augite).

The alkali rocks form one of the two primary divisions of the eruptives. One division is that comprising granites, syenites, diorites, gabbro, and the ultra basics : the other comprises the alkali eruptives. The latter, though not so universally abundant as the former, illustrate a remarkable aptitude for differentiation in the alkaline magma : hence numerous variations from typical forms and increasing additions to the nomenclature. The occurrences of Tasmanian rocks belonging to this division are consequently of distinct interest to both the petrographer and the geologist.

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